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All bidders are responsible to review all drawings and include all necessary work related to their trade on any and all drawings.

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SECTION 001100 – ADVERTISEMENT FOR BIDS

(as published in THE NEWS JOURNAL: 9/26/13 and 10/3/13)

Bid #2-14-26, William F. Cooke, Jr. Elementary School. There will be a MANDATORY pre-bid meeting on October 4, 2013 at 10:00am at **William F. Cooke, Jr. Elementary School Jobsite Trailers located at 2025 Graves Road, Hockessin, DE 19707.** Bid specifications will be available (free on CD) at the pre-bid meeting from the Whiting-Turner Contracting Company. The following are the bid offerings:

Roofing: Bid # 2-14-26-07A – REBID

Metal Panels: Bid # 2-14-26-07C – REBID

Glass & Glazing: Bid # 2-14-26-08A – REBID

All bids will be publicly opened at **William F. Cooke, Jr. Elementary School Jobsite Trailers on October 24, 2013 at 2:00 P.M.**

Time and place for opening of bids may be extended from that described above on not less than two calendar days notice by certified delivery, facsimile machine, or other verifiable electronic means to those bidders who obtained copies of the plans and specifications.

EOE

END OF SECTION 001100

SECTION 001110 – INVITATION TO BID

Sealed bids for RCCSD Contract No. 2-14-26 – William F. Cooke Elementary School will be received by the Red Clay Consolidated School District at **William F. Cooke, Jr. Elementary School Jobsite Trailers located at 2025 Graves Road, Hockessin, DE 19707** until 2:00 p.m. local time on Thursday, October 24, 2013, at which time they will be publicly opened and read aloud. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

Roofing: Bid # 2-14-26-07A – REBID

Metal Panels: Bid # 2-14-26-07C – REBID

Glass & Glazing: Bid # 2-14-26-08A – REBID

Project involves the construction of a new 70,000 SF elementary school facility with associated site development and improvements. The project site is located at 2025 Graves Road, Hockessin, Delaware.

A **MANDATORY** Pre-Bid Meeting will be held on October 4, 2013 at 10:00am at **William F. Cooke, Jr. Elementary School Jobsite Trailers located at 2025 Graves Road, Hockessin, DE 19707** 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 AT THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to the Red Clay Consolidated School District, 1502 Spruce Avenue, Wilmington, DE 19805. The outer envelope should clearly indicate: **“RCCSD CONTRACT NO. 2-14-05-INCLUDING THE BID PACKAGE # – WILLIAM F. COOKE ELEMENTARY SCHOOL – SEALED BID – DO NOT OPEN.”**

Contract documents may be obtained beginning October 4, 2013, they will also be available (free on CD) at the pre-bid meeting from the Whiting-Turner Contracting Company.

All bids will be publicly opened at **William F. Cooke, Jr. Elementary School Jobsite Trailers located at 2025 Graves Road, Hockessin, DE 19707** on October 24, 2013 at 2:00 P.M. Time and place for opening of bids may be extended from that described above on not less than two calendar days notice by certified delivery, facsimile machine, or other verifiable electronic means to those bidders who obtained copies of the plans and specifications.

Construction documents will be available for review beginning October 4, 2013, at the following locations: The Whiting-Turner Contracting Co. and Red Clay Consolidated School District Offices.

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 SECTION 001110

SECTION 002113 – INSTRUCTIONS TO BIDDERS

TABLE OF ARTICLES

1. DEFINITIONS
2. BIDDER'S REPRESENTATION
3. BIDDING DOCUMENTS
4. BIDDING PROCEDURES
5. CONSIDERATION OF BIDS
6. POST-BID INFORMATION
7. PERFORMANCE BOND AND PAYMENT BOND
8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

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 ALTERNATE BID (or ALTERNATE): 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 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) or a Delaware business license number, and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification or Delaware business license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. Prior to execution of the resulting contract, the successful Bidder shall be required to produce proof of its Delaware business license if not provided in its bid.
- 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 A132-2009 Standard Form of Agreement between Owner and Contractor, Construction Manager as Adviser Edition.

END OF SECTION 002113

503 Maryland Avenue
Unit 106
Delmar, MD 21875
Local 410-749-0940
Fax 410-896-3478
www.hcea.com

March 12, 2013

Mr. Michael Riemann

Red Clay School District
C/o Becker-Morgan Group
312 West Main Street
Salisbury, MD 21801

Reference: Report of Subsurface Exploration and Geotechnical Evaluation for:
Graves Road Elementary School
Wilmington, Delaware
HCEA Project No. D12162

Dear Mr. Michalski:

Hillis-Carnes Engineering Associates, Inc. (HCEA) is pleased to submit our findings regarding our geotechnical investigation for the referenced project. This work was performed in accordance with our proposal dated November 26, 2012.

We wish to advise you that the boring samples will be stored at our Dover, Delaware office for a period of 30 days from the date of this letter. Should you wish the samples to be stored for a longer period of time or to be delivered to you or another party, please advise us in writing prior to the end of the 30-day period. Otherwise, the samples will be discarded at the end of the 30-day storage period.

HCEA appreciates having had the opportunity to provide the geotechnical exploration services for this project. Should you have any questions concerning the contents of this report, or require additional consultation, design, inspection, or testing services, please contact our office.

Respectfully submitted,
HILLIS-CARNES ENGINEERING ASSOCIATES, INC.

William T. Schick, P.G.
Branch Manager

Jeremy M. Boehm, P.E.
Project Engineer

**Graves Road Elementary School
Wilmington, Delaware
HCEA Project No. D12162**

Prepared For:

Red Clay School District
C/o Becker-Morgan Group
312 West Main Street
Salisbury, MD 21801

Attn: Mr. Michael Riemann

Prepared By:

Hillis-Carnes Engineering Associates, Inc.
1277 McD Drive
Dover, Delaware 19901

March 12, 2013

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1.0 PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the existing site and to provide guidance pertaining to soil conditions for the future construction of buildings, pavements, storm water management best management practices (SWM BMP's), and underground utilities.

The evaluations and recommendations presented in this report were developed from an analysis of known project characteristics. A general interpretation of the subsurface conditions was based on the borings information shown on the Records of Soil Exploration boring logs included in the Appendix of this report. The soil layers indicated on the boring logs represent the approximate boundaries between soil types; however, the in-situ transitions may be gradual.

An evaluation of the site with respect to potential construction problems and recommendations dealing with the earthwork and inspection during construction are also included. The inspection is considered necessary to verify the subsurface conditions and to verify that the soils-related construction phases are performed properly.

2.0 PROJECT CHARACTERISTICS

The parcel being investigated is currently a vacant field located in the southwest quadrant of the intersection of Graves Road and Newport Gap Pike in New Castle County, Wilmington, Delaware. See Figure 1 in the Appendix.

The proposed project consists of a new elementary school of approximately 70,000 square feet with classrooms, administration, gymnasium, media center, and a cafeteria. The classrooms are two stories with the remaining sections typically one story. There will be no basements. The foundation loads are expected to be up to 4,000 pounds per foot for continuous foundations and 150 kips for column footings.

3.0 FIELD EXPLORATION AND LABORATORY PROGRAM

In order to determine the general subsurface conditions beneath the project site and to characterize the behavior of the existing soils and ground water conditions on site, Standard Penetration Test (SPT) borings were performed between January 29 and February 6, 2013 utilizing a Mobile B-31 truck-mounted drill rig. HCEA performed ten (10) structural borings designated as B-101 through B-110, extending to depths between 11 and 30 feet below existing grade (b.e.g.). HCEA performed 11 pavement area borings designated as P-1 through P-11, extending to depths of 6 feet b.e.g. HCEA performed four (4) stormwater management area borings designated as SWM-1 through SWM-4, extending to depths of 16 feet b.e.g. Two test pits, designated as the berm and SWM-5 locations, were excavated on January 15 and February 28 to a depth of 8 feet and 10 feet

b.e.g. HCEA performed five (5) in-situ single ring falling head infiltration tests at locations designated as SWM-1 through SWM-5.

The structural SPT borings were advanced with hollow-stem augers and the subsurface soils were sampled at 2.5 foot intervals in the upper 10 feet and at 5.0 foot intervals thereafter. The pavement and stormwater management borings were sampled continuously. Samples were taken by driving a 1-3/8 inch I.D. (2-inch O.D.) split-spoon sampler in accordance with ASTM D-1586 specifications. The sampler was first seated 6 inches to penetrate any loose cuttings and then was driven an additional foot with blows of a 140 pound hammer falling 30 inches, imparting 350 foot-pounds of kinetic energy to the soil. The number of hammer blows required to drive the sampler from 6 inches to 18 inches is designated as the "Penetration Resistance" or "N" value. The penetration resistance, when properly evaluated, is an index of the soil strength and compressive characteristics.

Representative portions of each soil sample were placed in glass jars and transported to HCEA's laboratory. In the lab, the samples were visually classified by the Geotechnical Engineer in accordance with the Unified Soil Classification System (USCS). The USCS symbols appear on the boring logs and the system nomenclature is briefly described in the Appendix.

Laboratory testing was performed on selected samples to assist with the evaluation of the subsurface materials. We performed 24 natural moisture content determinations and 24 grain size analyses on samples recovered from proposed building, pavement, and stormwater management areas. We also performed two Standard Proctor tests and two California Bearing Ratio (CBR) tests on composite samples from proposed pavement areas. Laboratory test results are noted on the Particle Size Distribution Reports and the Records of Soil Exploration in the Appendix.

HCEA also reviewed our July 27, 2011 *Report of Subsurface Exploration and Geotechnical Evaluation* for the project site. We have incorporated the nine SPT borings performed for that evaluation into the current report and we include them in the appendix.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions encountered at the site are shown on the Records of Soil Exploration boring logs. A brief description of the subsurface conditions and pertinent engineering characteristics of the soils are given below.

Strata divisions shown on the boring logs have been estimated based on visual examinations of the recovered samples. In the field, strata changes could occur gradually and/or at slightly different levels than indicated. Also, groundwater conditions indicated on

the log sheets are those observed during the period of the subsurface exploration. Fluctuations in groundwater levels could occur seasonally and might also be influenced by changes in grading, recent precipitation and other influencing factors.

4.1 Site Geology

According to the Geologic Map of New Castle County Delaware, Geologic Map Series, No. 13, prepared by the Delaware Geological Survey (DGS) and dated 2005, the area is situated in the Piedmont Province which is composed of structurally complex bodies of metamorphic and igneous rocks. The site is underlain by the Wissahickon Formation (Cambrian to Ordovician) described as interlayered psammitic and pelitic gneiss with amphibolite. Psammatic gneiss is a medium to fine grained biotite-plagioclase-quartz gneiss with or without small garnets. Pelitic gneiss is medium to coarse grained garnet-sillimanite-biotite-plagioclase-quartz gneiss.

4.2 Surficial Materials

Organic bearing soil, ranging in thickness from 4 to 12 inches, was encountered at the boring and test pit locations. Based on the previous agricultural use of the project organic bearing soil thicknesses should be expected to vary across the site and may exceed the encountered thicknesses in local areas.

4.3 Subsoils

Soils encountered are predominantly multicolored, loose to very dense, SAND with varying percentages of silt and clay (SC, SM, SP-SM). A medium stiff to stiff SILT (ML) was encountered from the surface to depths ranging from 1.5 feet to 4 feet in the building and pavement areas, and 4 to 8 feet in the stormwater management areas. Mica was present at most boring locations as was the presence of mottling (which indicates a previous high water elevation), and decomposed rock. The lower SAND stratum is residual soil (saprolite) and exhibits relic structures from the parent gneiss.

Based on the recovered split spoon samples, a medium stiff to stiff SILT (ML) overlies predominantly medium dense to very dense silty SAND or decomposed rock. As seen in the Records of Soil Exploration, the SPT "N" values commonly show a value of 50/X" (50 hammer drops required to penetrate X inches). We terminated eleven of the structural borings prematurely due to auger refusal (the augers could not be advanced any further due to the presence of rock). The following table provides the auger refusal depths of the building area borings.

Boring	Auger Refusal (ft b.e.g.)*	Elevation at Refusal
B-1	26.5	289.5
B-2	---	---
B-3	---	---

B-4	---	---
B-5	16.5	304
B-6	27	286
B-7	14	302.5
B-8	12	295.5
B-101	14.5	307.5
B-102	---	---
B-103	---	---
B-104	---	---
B-105	19	300
B-106	---	---
B-107	17.5	296.5
B-108	12.5	300.5
B-109	24	289
B-110	11	298

*ft b.e.g. = feet below existing grade

Based on the proposed footing elevations provided by Baker, Ingram & Associates, the proposed footings are above the elevations where we encountered rock in the borings. Generally, auger refusals or penetration resistance greater than 25 blows per inch (50/2") suggest that the removal of rock cannot be expected to be achieved by traditional mechanical methods (e.g., power shovels) and, should any structural element or utility component be required in construction, hydraulic chisels or controlled blasting may be required to complete excavations. If utilities must be located below the depth of auger refusal, rock coring can be performed at those locations to better determine the recommended method of rock excavation.

4.4 Groundwater

Groundwater was encountered in boring B-102 at a depth of 18.5 feet at the time of boring completion. The boring walls caved in from 4 to 17.2 feet below existing grade.

If required, an accurate determination of the hydrostatic water table would require the installation of perforated pipes or piezometers which could be monitored over an extended period of time. The actual level of the hydrostatic water table should be anticipated to fluctuate throughout the year, depending on variations in precipitation, surface runoff, infiltration, site topography, and drainage.

5.0 RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, subsurface conditions, and soil properties. If there are any changes to the project characteristics or if different subsurface conditions are

encountered during construction, HCEA should be consulted so that the recommendations of this report can be reviewed and revised, if necessary.

5.1 General Site Preparation

The initial step in the development of this site should be the controlled removal of topsoil, frozen, wet, soft or loose soils and any other deleterious materials. These operations should be performed in a manner consistent with good erosion and sediment control practices.

After the initial stripping process is completed, areas of the site to receive fill, or areas of the site at-grade where structures will be located, should be proofrolled. The proofrolling operations should be performed using a 20-ton, fully-loaded dump truck or another pneumatic-tire vehicle of similar size and weight. The purpose of the proofrolling will be to locate any near-surface pockets of soft or loose soils requiring undercutting. An HCEA Geotechnical Engineer or experienced Soils Inspector should witness the proofrolling operations and should determine which areas need further undercutting and/or stabilization.

The upper layer of subsoil consists of silt across a majority of the building and pavement areas. These soils are moisture sensitive and, when wet, will deteriorate under construction traffic. Care should be taken during stripping and all phases of construction to avoid destabilizing silt subgrades.

5.2 Groundwater and Drainage

It is previously noted that groundwater was encountered at only one boring location, at an approximate elevation of 301.4 feet. Mottling was observed in recovered soil samples corresponding to an elevation of $300.0 \pm$ which implies a previous high ground water level. Based on the subsurface conditions encountered in the soil borings, HCEA believes that the high groundwater level at the site represents a seasonal perched condition.

Should construction be initiated, adequate drainage should be provided at the site to minimize any increases in the moisture contents of roadway or structural subgrade soils. Any water infiltration resulting from precipitation or surface run-off should be able to be controlled by means of sump pits and pumps, or by gravity ditching procedures if it is only necessary to lower the water by a minimal amount (on the order of $1 \pm$ foot to $2 \pm$ feet, or less). If any conditions are encountered which cannot be handled in such a manner, the Geotechnical Engineer should be consulted.

5.3 Fill Selection, Placement and Compaction

All material to be used as fill or backfill should be inspected, tested and approved by the Geotechnical Engineer. In general, the on-site soils which are free from organic and other deleterious components can be re-used as general site fill. Materials suitable for various construction purposes can be identified by an experienced HCEA Soils Inspector during grading operations. We recommend that any required fill material(s), on-site or imported, be tested in our laboratory before placement to determine its maximum dry density and optimum moisture content as determined by Standard Proctor Analyses. Granular soils with less than 35% passing the #200 sieve with USCS classifications of SP-SM, SP, SW and SC are recommended for structural and sub-base fill materials. Moisture conditioning (that is, wetting or drying) of the soils should be anticipated to achieve proper compaction. The moisture contents of the soils should be controlled properly to avoid extensive construction delays. The upper clayey silts are moisture sensitive and will be difficult to moisture condition.

All fill beneath structures and pavement areas should be placed in relatively horizontal 8-inch (maximum) loose lifts and should be compacted to a minimum of 95 percent of the Standard Proctor (ASTM D-698) maximum dry density. Fill materials in landscape and other non-structural areas should be compacted to at least 90 percent of the Standard Proctor maximum dry density if significant subsidence of the fill under its own weight is to be avoided. Field moisture contents should be maintained within 2 percentage points of the optimum moisture content in order to provide adequate compaction.

5.4 Foundation Recommendations

HCEA recommends that continuous strip footings be dimensioned for net allowable bearing capacities of 3,500 lb/ft². Column footings located at Elevation 313 feet or lower can be dimensioned for net allowable bearing capacities of 5,000 lb/ft². Column footings located above Elevation 313 feet can be dimensioned for net allowable bearing capacities of 4,000 lb/ft². These bearing pressures are applicable for footings founded on the native silty sands at a relatively shallow (approximately 2 feet) depth below existing grade.

Settlement of structures under static conditions is dependent on the loads applied by the structure, and the dimensions and depths of individual foundation elements constructed to support the structure. If the recommendations outlined in this report are followed, we estimate post-construction settlements on the order of 1 inch or less. Differential settlements of approximately ½ inch should be expected.

5.5 Pavements

All pavement subgrade areas should be prepared in accordance with the recommendations provided in Sections 5.1 and 5.3 of this report. In particular, pavement sub-grades should be proofrolled to locate any isolated areas of soft or loose soils requiring undercutting and/or stabilization.

The pavement subgrade should be properly prepared and compacted to county and state specifications prior to the placement of paving materials. The existing subgrade should be proofrolled in the presence of an experienced soils inspector under the direction of a Geotechnical Engineer. Any soft or loose areas at the time of proofrolling should be undercut and/or stabilized prior to the placement of the paving sections.

HCEA performed CBR testing on two composite samples from proposed pavement areas. The laboratory determined CBR values were 2.5% and 3.4%. Our pavement recommendations are based on a design CBR of 3%.

For areas receiving bus traffic, HCEA recommends a heavy-duty pavement section consisting of 8 inches of graded aggregate base course (GABC), 3 inches of Type B hot-mix, and 2 inches of Type C hot-mix (Structural Number = 3.12). For areas receiving only automobile traffic, HCEA recommends a standard-duty pavement section consisting of 8 inches of graded aggregate base course (GABC), 2.75 inches of Type B hot-mix, and 1.25 inches of Type C hot-mix (Structural Number = 2.32).

5.6 Infiltration Testing

Prior to conducting the single ring infiltration tests the proposed invert elevation of the basin was excavated and exposed for observation. The subgrade soils consisted of brown, clayey SILT with varying percentages of sand and gravel. Following completion of the three initial infiltration tests (SWM-1, SWM-2, and SWM-3), HCEA conducted two additional tests (SWM-4 and SWM-5) at greater depths below grade. The measured hydraulic conductivities were 0.93 in per hour and 1.26 inches per hour respectively. Based on these results, we recommend a hydraulic conductivity of 1.02 inches per hour for design.

5.7 Additional Utility Recommendations

Prior to the placement of utilities, any organic materials, non-soil components, frozen, wet, soft, or other deleterious materials should be removed and wasted. After the footing excavation operations have been completed to utility trench bottom elevations, the exposed subgrade soils should be inspected by an experienced HCEA soils technician. Any required undercutting can be identified during this time.

6.0 RECOMMENDED ADDITIONAL SERVICES

Additional soil engineering, testing, and consulting services recommended for this project are summarized below:

Site Preparation: An HCEA Geotechnical Engineer or experienced Soils Inspector should inspect the site prior to fill placement to confirm that organics and other deleterious matter have been removed. The inspector should determine if any undercutting or in-place densification is necessary to prepare a subgrade for fill placement.

Fill Placement and Compaction: An HCEA Geotechnical Engineer or experienced Soils Inspector should witness any required filling operations and should take sufficient in-place density tests to verify that the specified degree of fill compaction is achieved. Proposed borrow materials should be observed, sampled, and tested prior to acceptance to determine the sampled soils index properties and suitability for any proposed application.

Bearing Capacity: A Geotechnical Engineer or experienced Soils Inspector should inspect the foundation bearing soils. The inspector should determine if bearing soils are firm or if any undercutting or in-place densification is necessary to prepare a subgrade for concrete placement.

7.0 QUALIFICATIONS

This report has been prepared to aid in the evaluation of the site for the proposed construction. It is considered that adequate recommendations have been provided to serve as a basis for design and preparation of plans and specifications. Additional recommendations can be provided as needed.

These analyses and recommendations are, of necessity, based on the information made available to us at the time of the actual writing of the report and the on-site conditions, surface and subsurface, which existed at the time the exploratory borings were drilled. Further assumption has been made that the limited exploratory borings, in relation both to the areal extent of the site and to depth, are representative of conditions across the site.

If subsurface conditions are encountered which differ from those reported herein, this Office should be notified immediately so that the analyses and recommendations can be reviewed and/or revised as necessary. It is also recommended that:

1. We be given the opportunity to review any plans and specifications in order to comment on the interaction of the soil conditions as described herein and the design requirements.
2. A Geotechnical Engineer or experienced Soils Inspector be present at the site during the construction phase to verify installation according to the approved plans and specifications. This is particularly important during excavation, placement, and compaction of fill materials.

Please note that successful completion of the project is dependent on your compliance with all of the recommendations provided in this report. While represented separately, the recommendations represent work that is intertwined. The successful completion of the project is specifically conditioned on your complying with all recommendations.

APPENDIX

Figure 1: Project Location Map

Figure 2: Boring Location Plan

Figure 3: CPT and DMT Location Plan

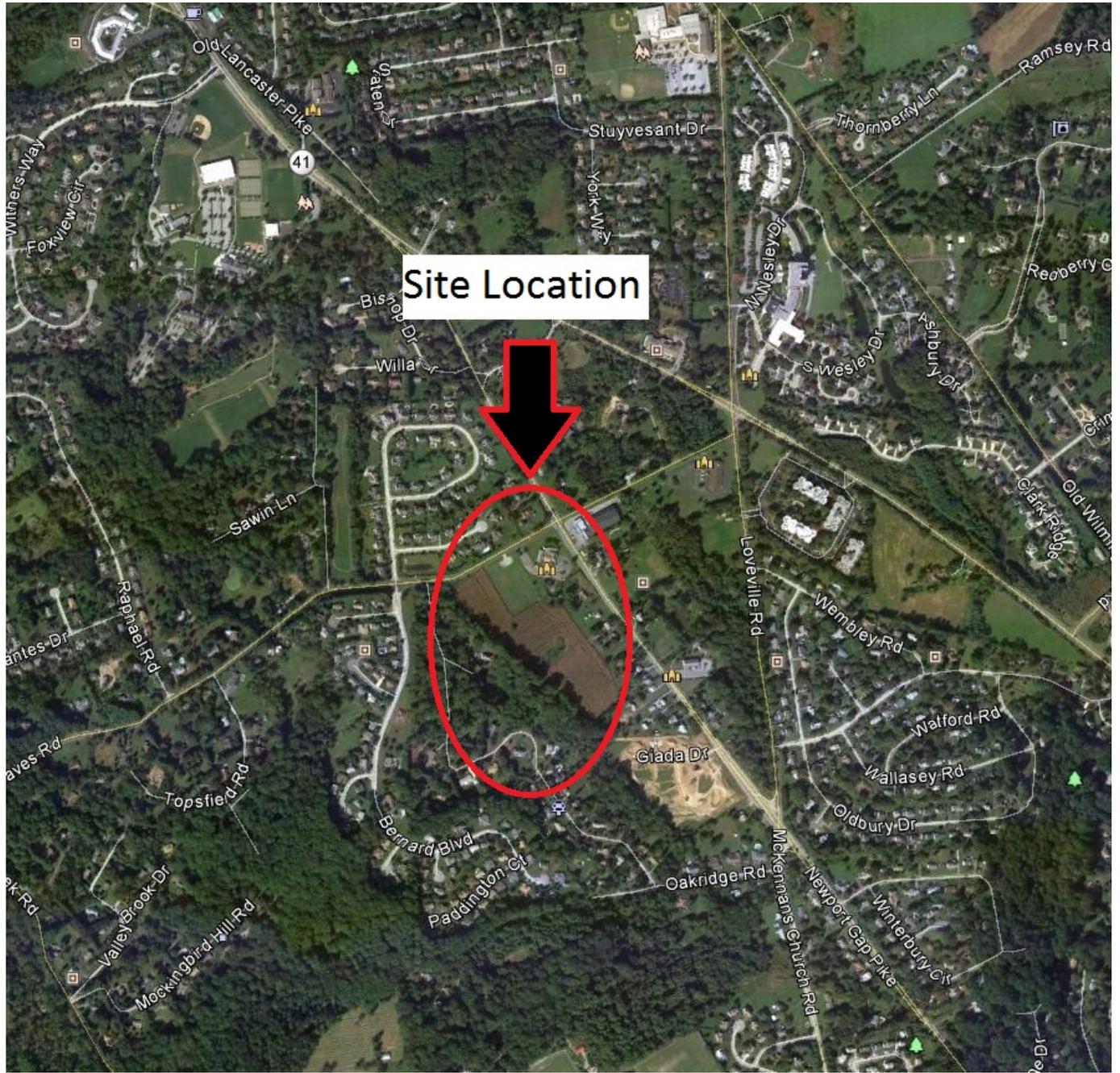
Exploratory Soil Borings

- 1) Records of Subsurface Investigation
- 2) Particle Size Distribution Reports

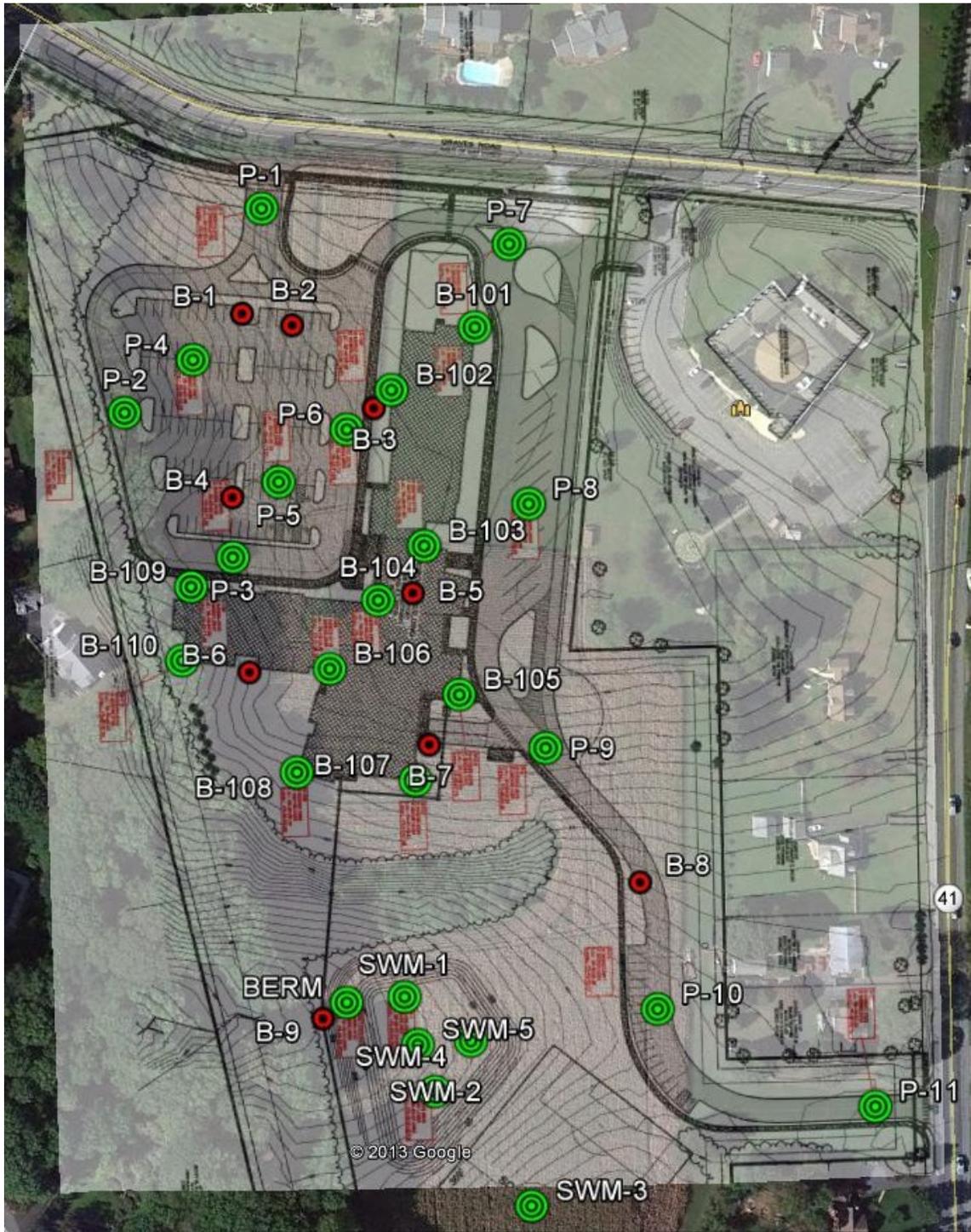
Standard Proctor and CBR Reports

Infiltration Test Results

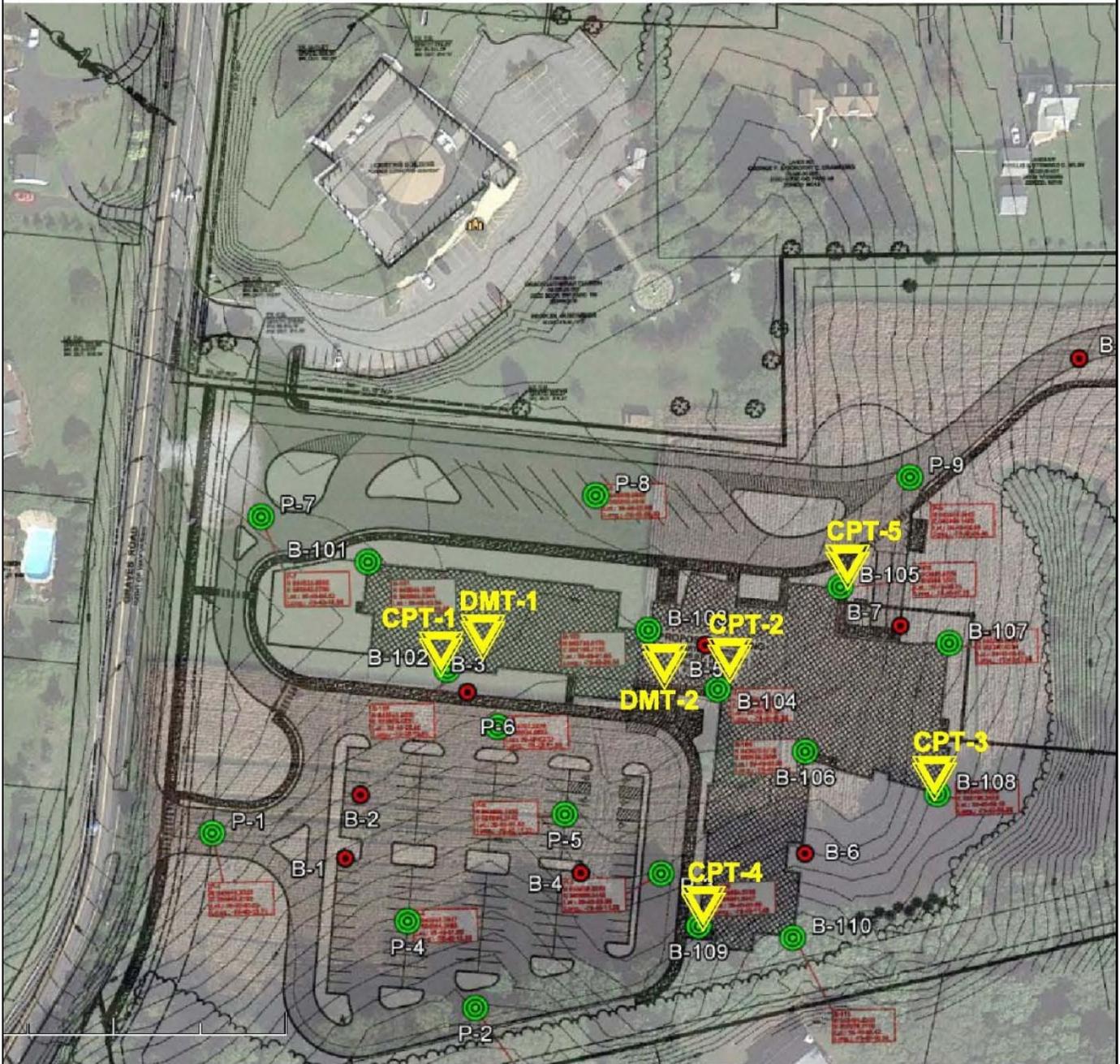
Field Classification Sheet



HILLIS - CARNES ENGINEERING ASSOCIATES, INC.	PROJECT LOCATION MAP FIGURE 1 Graves Road Elementary School Wilmington, Delaware	JOB No.:	D12162	DESIGN BY:	Google
		DATE:	3/11/13	DRAWN BY:	JMB
1277 McD Drive Dover, Delaware 19901		SCALE:	As shown		
PHONE: (302) 744-9855 FAX: (302) 744-9160		PAGE:	1	CHECKED BY:	WTS



HILLIS - CARNES	ENGINEERING ASSOCIATES, INC.	BORING LOCATION PLAN	JOB No.:	D12162	DESIGN BY:	Google
			DATE:	3/11/13	DRAWN BY:	JMB
1277 McD Drive Dover, Delaware 19901		FIGURE 2 Graves Road Elementary School Wilmington, Delaware	SCALE:	As shown		
PHONE: (302) 744-9855 FAX: (302) 744-9160			PAGE:	1	CHECKED BY:	WTS



H I L L I S - C A R N E S

ENGINEERING ASSOCIATES, INC.

1277 McD Drive Dover, Delaware 19901
 PHONE: (302) 744-9855 FAX: (302) 744-9160

CPT AND DMT LOCATION PLAN

FIGURE 3

Graves Road Elementary School
 Wilmington, Delaware

JOB No.:	D12162	DESIGN BY:	Google
DATE:	3/11/13	DRAWN BY:	AM
SCALE:	As shown		
PAGE:	1	CHECKED BY:	WTS

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-101

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 322 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/4/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/4/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, medium stiff, clayey SILT	0		ML	▲	D	3	3	5	1	14	Approximately 8 inches of organic bearing soil (topsoil) at surface.
318	Gray/dark brown, moist, medium dense to very dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments			SM	▲	D	4	5	8	2	17	
		6			▲	D	3	5	7	3	12	
312					▲	D	20	23	24	4	16	
		12			▲	D	50/1			5	1	
306	Auger refusal at 14.5 feet b.e.g.											
		18										
300												
		24										
294												
		30										
288												

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-102

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 320 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/4/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/4/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
318	Brown, moist, soft, clayey SILT	0		ML	▲	I	2	2	3	1	12	Approximately 8 inches of organic bearing soil (topsoil) at surface.
	Gray/brown, dry, loose to very dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments			SM	▲	D	3	4	5	2	16	
312		6			▲	D	3	6	4	3	14	
					▲	D	5	7	11	4	17	
306		12			▲	D	4	8	20	5	14	
300		18			▲	D	19	19	50/3	6	15	Weathered rock
294		24			▲	D	6	17	50/2	7	14	
					▲	D	45	50/4		8	10	
288	Boring terminated approximately 30 feet b.e.g.	30										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion 18.6 ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
25.6 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-103

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 320 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 1/30/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 1/30/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES	
318	Brown, moist, soft, clayey SILT	0		ML	▲	D	3	2	3	1	18	Approximately 8 inches of organic bearing soil (topsoil) at surface.	
	Gray/brown, dry, medium dense to dense, silty, micaceous, fine to coarse SAND, trace rock fragments			SM	▲	D	4	7	5	2	12		
					▲	D	8	7	9	3	10		
312					▲	D	9	11	18	4	14		
			12			▲	D	12	20	27	5		15
306						▲	D	12	17	22	6		12
300						▲	D	5	6	6	7		10
294	Boring terminated at approximately 25 feet b.e.g.	24											
288		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-104

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 319 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 1/30/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 1/30/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES	
318	Brown, moist, medium stiff, clayey SILT, trace sand	0		ML	▲	D	3	4	6	1	12	Approximately 8 inches of organic bearing soil (topsoil) at surface. Groundwater at 23 feet 24 hours after boring completion. Caved in at 24 feet 24 hours after boring completion.	
	Brown, dry, loose to very dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments			SM	▲	D	3	2	3	2	9		
					▲	D	3	4	5	3	13		
312		6			▲	D	4	7	10	4	10		
					▲	D	14	10	30	5	10		
306		12			▲	D	20	50/2		6	8		Weathered rock
300		18			▲	D	50/5			7	5		
294	Boring terminated approximately 25 feet b.e.g.	24			▲	D							
288		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-105

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 319 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/5/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/5/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
318	Brown, moist, medium stiff, clayey SILT	0		ML	▲	D	2	3	4	1	7	Approximately 8 inches of organic bearing soil (topsoil) at surface.
	Brown, moist to dry, loose to very dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments			SM	▲	D	3	5	6	2	12	
312		6			▲	D	4	5	5	3	14	
						▲	D	6	8	14	4	
306		12				D	50/2			5	2	Weathered rock
300	Auger refusal at 19 feet b.e.g.	18				D	50/1			6	1	
294		24										
288		30										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-106

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 317 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 1/30/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 1/30/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, medium dense, clayey SILT, trace sand	0		ML	▲	D	3	4	6	1	8	Approximately 8 inches of organic bearing soil (topsoil) at surface. Caved in at 21 feet 24 hours after boring completion.
312	Brown, dry, loose to very dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments	6		SM	▲	D	3	4	4	2	12	
					▲	D	3	4	3	3	9	
306					▲	D	21	33	50/2	4	8	Weathered rock
					▲	D	50/5			5	4	
300					▲	D	9	20	29	6	13	
294					▲	D	50/1			7	1	
	Boring terminated at approximately 25 feet b.e.g.											
288												
		30										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-107

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 314 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 1/29/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 1/29/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES
312	Brown, moist, medium stiff, clayey SILT	0		ML	▲	D	5	3	3	1	8	Approximately 8 inches of organic bearing soil (topsoil) at surface. Caved in at 16.5 feet 24 hours after boring completion. Weathered rock
	Brown, dry, medium dense to very dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments			SM	▲	D	5	6	6	2	13	
		6			▲	D	5	6	15	3	11	
306					▲	D	21	47	50/4	4	14	
					▲	D	50/2			5	2	
300		12										
	Auger refusal at 17.5 feet b.e.g.	18										
294												
		24										
288												
		30										
282												

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 17.2 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-108

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 313 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/4/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/4/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLER TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES				
312	Brown, moist, loose to medium dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments	0	SM		D	D	3	5	4	1	8	Approximately 6 inches of organic bearing soil (topsoil) at surface.				
306		6			D	D	4	4	9	3	15					
					D	D	5	8	7	4	11					
300	Auger refusal at 12.5 feet b.e.g.	12														
294		18														
288		24														
282		30														

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 10.9 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number B-109

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 313 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/4/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/4/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"			No.	REC.	BORING & SAMPLING NOTES	
312	Brown, moist, medium stiff, clayey SILT	0		ML	▲	D	2	3	3	1	10	Approximately 8 inches of organic bearing soil (topsoil) at surface.	
	Brown, moist to dry, medium dense to dense, silty, micaceous, fine to coarse SAND, trace to some rock fragments			SM	▲	D	4	6	7	2	12		
306		6			▲	D	3	6	8	3	10		
						▲	D	12	16	13	4		16
300			12			▲	D	29	15	17	5		13
294			18			▲	D	22	15	13	6		18
288		Auger refusal at 24 feet b.e.g.	24			—	D	50/1			7		1
282		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number BERM

SAMPLER

Datum Topo Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman K Kelley
 Surf. Elev. 290 ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 1/15/2013 Sampler Diameter _____ in. O.D. Boring Method Test Date Completed 1/15/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
288	Brown, moist, clayey SILT, some sand	0		ML				1		Approximately 6 inches of organic bearing soil (topsoil) at surface.
	Light brown, moist, clayey SILT, some sand (mottled)			ML				2		
	Brown, moist, micaceous, clayey SILT, some sand			ML				3		
	Brown, moist, clayey SILT, some sand	6		CL				4		
282	Brown and gray, moist, micaceous, silty, fine to coarse SAND			SM				5		
	Test pit terminated at 8 feet b.e.g.	12								
276										
		18								
270										
		24								
264										
		30								
258										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

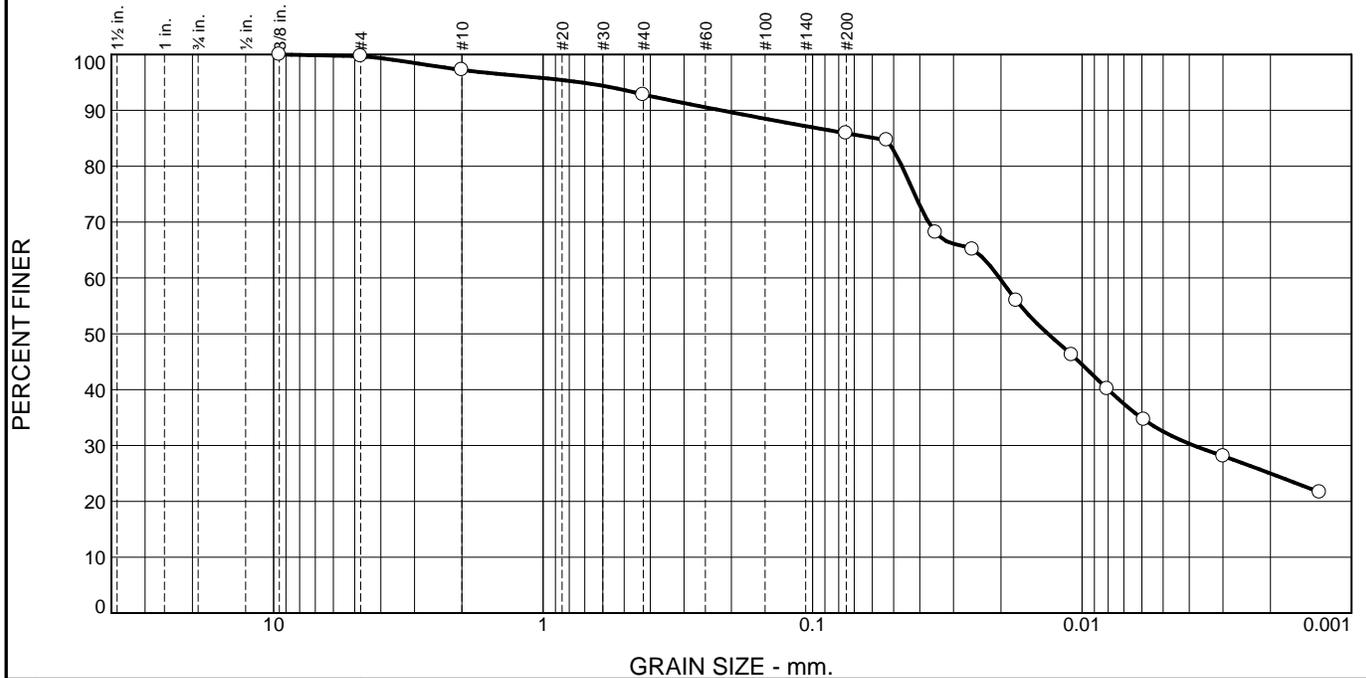
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	2.5	4.4	6.9	53.4	32.5

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	99.7		
#10	97.2		
#40	92.8		
#200	85.9		
#270	84.7		
0.0350 mm.	68.1		
0.0255 mm.	65.1		
0.0175 mm.	56.0		
0.0109 mm.	46.2		
0.0081 mm.	40.1		
0.0059 mm.	34.7		
0.0030 mm.	28.1		
0.0013 mm.	21.6		

* (no specification provided)

Material Description

Light brown, moist, micaceous, silty CLAY with little fine to medium sand (mottled)

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 0.2182 D₈₅= 0.0583 D₆₀= 0.0202
D₅₀= 0.0134 D₃₀= 0.0038 D₁₅=
D₁₀= C_u= C_c=

Remarks

Moisture Content: 22 percent
USDA CLASS: Sandy Clay Loam

Date Received: 1/5/18 Date Tested: 1/18/13
Tested By: K Kelley
Checked By: J Boehm
Title: Project Engineer

Source of Sample: BERM Depth: 1.5 Date Sampled: 1/15/13
Sample Number: 2

HILLIS-CARNES ENGINEERING ASSOCIATES	Client: Becker Morgan Group
DOVER, DE	Project: Graves Road Elementary School
	Project No: D12162 Figure

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-1

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 322 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/4/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/4/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
318	Brown to light brown, moist, loose to medium dense, micaceous, silty SAND, trace gravel	0		SM	▲	D	2	2	3	6	1	18	Approximately 8 inches of organic bearing soil (topsoil) at surface. Caved in at 4 feet 24 hours after boring completion.
				ML	▲	D	6	7	8	9	2	24	
				ML	▲	D	4	5	6	7	3	20	
	Boring terminated at 6 feet b.e.g.	6											
312													
306													
300													
294													
288													

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

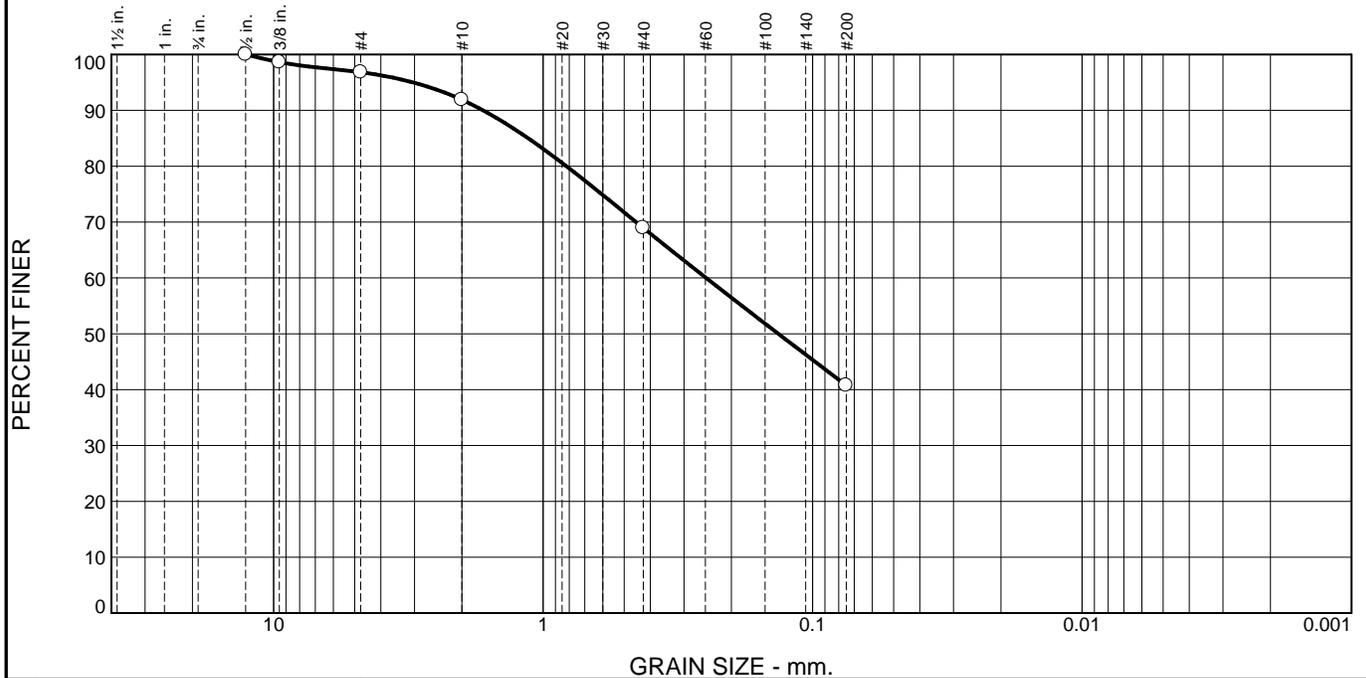
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.2	4.9	22.9	28.2	40.8	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.5	100.0		
.375	98.6		
#4	96.8		
#10	91.9		
#40	69.0		
#200	40.8		

Material Description

Brown, micaceous, silty, fine to medium SAND

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 1.6693 D₈₅= 1.1356 D₆₀= 0.2483
 D₅₀= 0.1339 D₃₀= D₁₅=
 D₁₀= C_u= C_c=

Remarks

Date Received: 2/5/13 Date Tested: 2/6/13

Tested By: M. Frick

Checked By: K. Kelley

Title: F.O. Supervisor

* (no specification provided)

Location: P-1
 Depth: 1-4 ft

Date Sampled: 2/4/13

HILLIS-CARNES ENGINEERING ASSOCIATES

Client: Becker Morgan Group
 Project: Graves Road Elementary School

DOVER, DE

Project No: D12162

Figure

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-2

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 309 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/4/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/4/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
306	Brown, moist, medium stiff, clayey SILT	0	[Vertical lines]	ML	▲	I	3	4	5	6	1	24	Approximately 8 inches of organic bearing soil (topsoil) at surface.
	Brown, moist, medium stiff, clayey SILT with some sand			ML	▲	I	3	4	6	5	2	24	
					▲	I	3	4	5	7	3	23	
	Boring terminated at 6 feet b.e.g.	6											
300													
		12											
294													
		18											
288													
		24											
282													
		30											
276													

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-3

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 316 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/1/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/1/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, medium stiff, clayey SILT	0		ML	▲	D	2	2	4	5	1	8	Approximately 8 inches of organic bearing soil (topsoil) at surface.
312	Brown, moist, loose, micaceous, fine to coarse SAND, some silt			SM	▲	D	3	3	4	6	2	10	
					▲	D	2	2	3	3	3	8	
	Boring terminated at 6 feet b.e.g.	6											
306													
		12											
300													
		18											
294													
		24											
288													
		30											
282													

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 4 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-4

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 313 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/4/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/4/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES			
312	Brown, moist, soft to stiff, clayey SILT	0		ML			2	2	3	4	1	22	Approximately 8 inches of organic bearing soil (topsoil) at surface.			
306	Boring terminated at 6 feet b.e.g.	6														
		12														
		18														
		24														
		30														

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 3.7 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-5

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 317 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/1/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/1/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES			
	Brown, moist to dry, very loose to dense, silty, fine to coarse SAND	0	[Pattern]	SM	[Symbol]	D	1	2	2	5	1	8	Approximately 8 inches of organic bearing soil (topsoil) at surface.			
312																
	Boring terminated at 6 feet b.e.g.	6														
		12														
		18														
		24														
		30														
288																

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

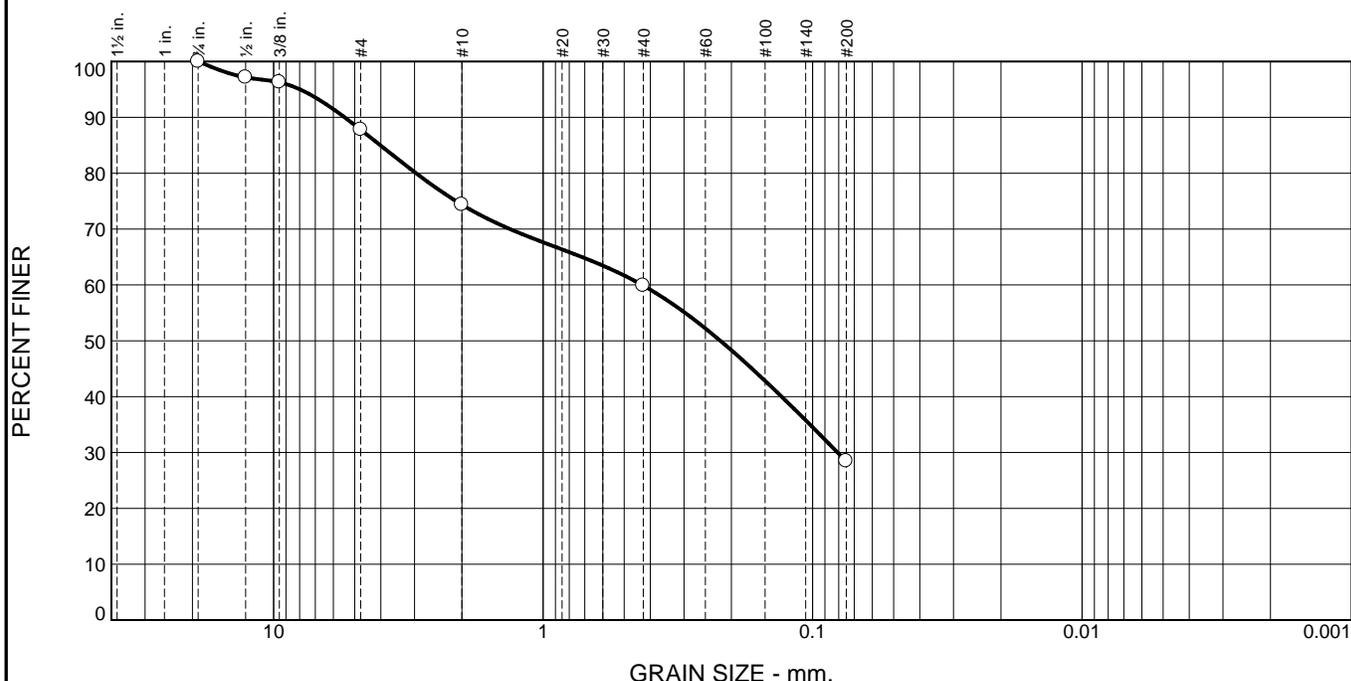
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 4 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.2	13.5	14.4	31.5	28.4	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.5	97.1		
.375	96.3		
#4	87.8		
#10	74.3		
#40	59.9		
#200	28.4		

Material Description

Brown, micaceous, fine to coarse SAND, some silt, trace gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 5.4478 D₈₅= 4.0148 D₆₀= 0.4288
D₅₀= 0.2197 D₃₀= 0.0807 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 2/4/13 Date Tested: 2/6/13
Tested By: M. Frick
Checked By: K. Kelley
Title: F.O. Supervisor

* (no specification provided)

Location: P-5
Depth: 1-4 ft

Date Sampled: 2/1/13

HILLIS-CARNES ENGINEERING ASSOCIATES DOVER, DE	Client: Becker Morgan Group Project: Graves Road Elementary School Project No: D12162
Figure	

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-6

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 319 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/1/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/1/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
318	Light brown, moist, soft, clayey SILT	0		ML	▲	I	2	2	2	6	1	18	Approximately 8 inches of organic bearing soil (topsoil) at surface.
	Brown to dark brown, dry, loose to medium dense, micaceous, silty, fine to medium SAND			SM	▲	D	3	3	6	10	2	18	
				SM	▲	D	6	7	8	7	3	18	
312	Boring terminated at 6 feet b.e.g.	6											
306		12											
300		18											
294		24											
288		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 4 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-7

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 323 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/5/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/5/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, medium stiff, clayey SILT	0		ML		I	5	4	3	5	1	18	Approximately 8 inches of organic bearing soil (topsoil) at surface.
	Brown, dry, medium dense, micaceous, silty, fine to coarse SAND			SM		D	4	5	7	8	2	24	
318		6				D	9	8	7	8	3	12	
	Boring terminated at 6 feet b.e.g.												
312		12											
306		18											
300		24											
294		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 4 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-8

SAMPLER

Datum Topo Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman K Kelley
 Surf. Elev. 321 ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/6/2013 Sampler Diameter _____ in. O.D. Boring Method Hand Date Completed 2/6/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
	Brown, moist, clayey SILT, trace sand	0		ML		D	4	3	5	5	1		Approximately 8 inches of organic bearing soil (topsoil) at surface.
				SM		D	3	3	3	4	2		
318	Brown, moist to dry, micaceous, silty, fine to coarse SAND, trace rock fragments					D	5	6	7	13	3		
						D	13	13	13	13	4		
						D	7	7	8	8	5		
						D	14	13	14	16	6		
	Boring terminated at 6 feet b.e.g.	6											
312													
		12											
306													
		18											
300													
		24											
294													
		30											
288													

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-9

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 317 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/1/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/1/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
	Light brown, moist, medium stiff to stiff, clayey SILT	0		ML	▲	D	2	2	4	5	1	18	Approximately 8 inches of organic bearing soil (topsoil) at surface.
					▲	D	4	5	6	7	2	18	
312	Brown, moist, medium dense, micaceous, silty fine to coarse SAND	6		SM	▲	D	3	4	7	8	3	18	
	Boring terminated at 6 feet b.e.g.												
306		12											
300		18											
294		24											
288		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

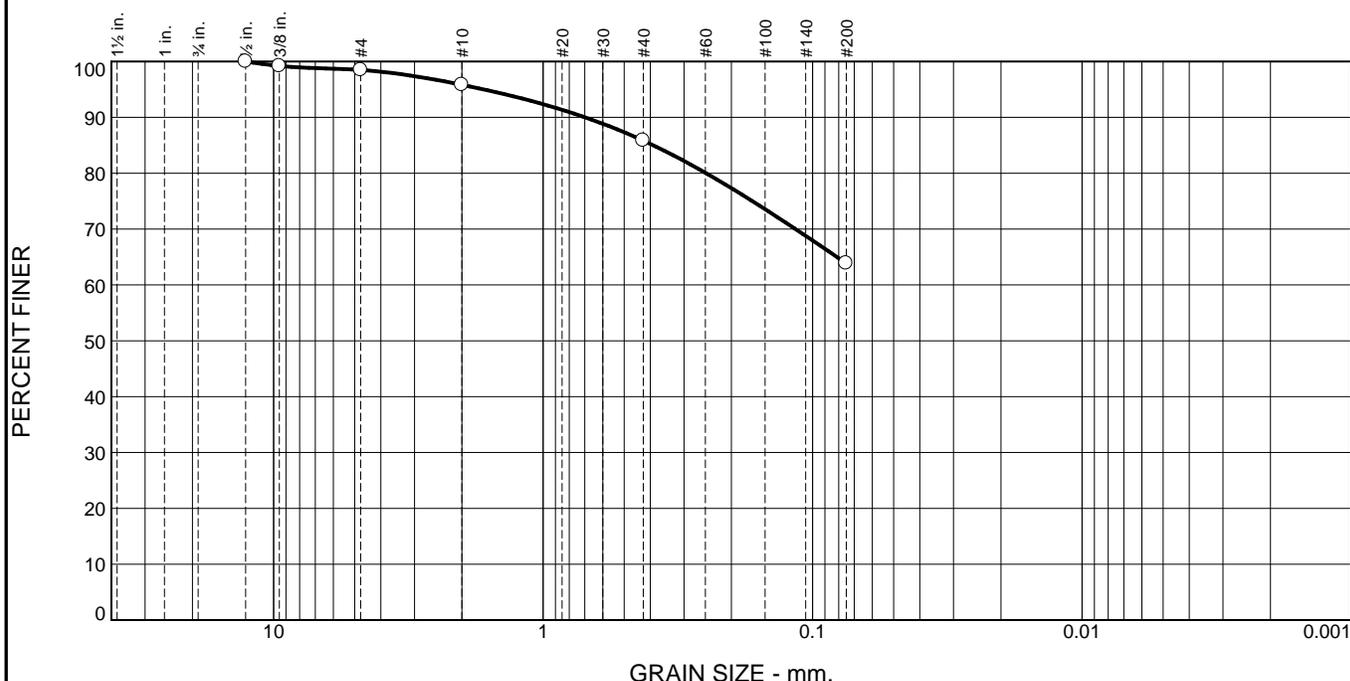
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 4 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.5	2.7	10.0	21.9	63.9	

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.5	100.0		
.375	99.2		
#4	98.5		
#10	95.8		
#40	85.8		
#200	63.9		

Material Description

Brown, micaceous, sandy SILT

Atterberg Limits (ASTM D 4318)

PL= _____ LL= _____ PI= _____

Classification

USCS (D 2487)= ML AASHTO (M 145)= _____

Coefficients

D₉₀= 0.6982 D₈₅= 0.3901 D₆₀= _____
 D₅₀= _____ C_u= _____ D₁₅= _____
 D₁₀= _____ C_c= _____

Remarks

Date Received: 2/4/13 Date Tested: 2/6/13
 Tested By: M. Frick
 Checked By: K. Kelley
 Title: F.O. Supervisor

* (no specification provided)

Location: P-9
 Depth: 1-4 ft

Date Sampled: 2/1/13

HILLIS-CARNES ENGINEERING ASSOCIATES

Client: Becker Morgan Group
 Project: Graves Road Elementary School

DOVER, DE

Project No: D12162

Figure

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-10

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 303 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 1/29/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 1/29/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
300	Brown, moist, medium stiff to stiff, clayey SILT	0		ML		I	2	4	3	3	1	13	Approximately 8 inches of organic bearing soil (topsoil) at surface.
						I	5	5	7	7	2	18	
	Brown, dry, medium dense, micaceous, silty, fine to coarse SAND	6		SM		D	4	6	7	9	3	16	
294	Boring terminated at 6 feet b.e.g.												
		12											
288		18											
282		24											
276		30											
270													

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
4 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number P-11

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 302 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/5/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/5/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
300	Brown, moist, soft, clayey SILT	0		ML	▲	D	2	2	2	2	1	13	Approximately 8 inches of organic bearing soil (topsoil) at surface.
	Brown, dry, loose to medium dense, micaceous, silty, fine to coarse SAND			SM	▲	D	4	4	5	6	2	24	
					▲	D	4	5	6	7	3	24	
294	Boring terminated at 6 feet b.e.g.	6											
		12											
288		18											
282		24											
276		30											
270													

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 4 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number SWM-1

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 292 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/1/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/1/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES	
288	Brown, moist, soft to stiff, clayey SILT	0		ML	I		1	2	2	4	1	20	Approximatley 8 inches of organic bearing soil (topsoil) at surface.	
							4	5	7	9	2	18		
							2	4	4	6	3	18		
							3	4	5	7	4	12		
282	Brown/gray, dry, loose to dense, micaceous, silty, fine to coarse SAND, trace to some rock fragments	6		SM	D		2	2	5	7	5	10		Weathered rock
							2	5	9	13	6	10		
							3	9	12	14	7	20		
							4	18	29	48	8	20		
276	Boring terminated at 16 feet b.e.g.	18												
270		24												
264		30												
258														

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

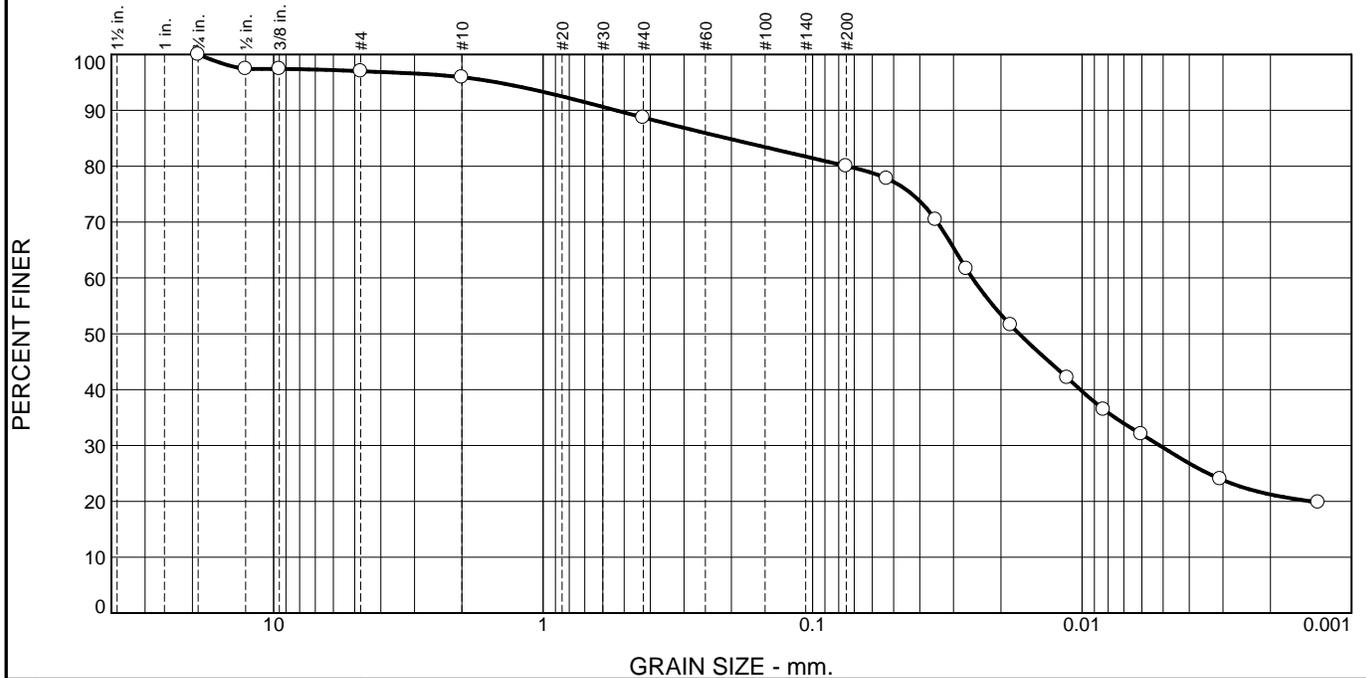
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.0	1.1	7.2	8.7	50.4	29.6

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.50	97.4		
.375	97.4		
#4	97.0		
#10	95.9		
#40	88.7		
#200	80.0		
#270	77.8		
0.0350 mm.	70.4		
0.0269 mm.	61.6		
0.0184 mm.	51.6		
0.0113 mm.	42.1		
0.0083 mm.	36.5		
0.0060 mm.	32.1		
0.0031 mm.	24.0		
0.0013 mm.	19.8		

* (no specification provided)

Material Description

Brown, micaceous, clayey SILT, some fine to medium sand, trace rock fragments

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 0.5362 D₈₅= 0.2069 D₆₀= 0.0255
D₅₀= 0.0171 D₃₀= 0.0052 D₁₅=
D₁₀= C_u= C_c=

Remarks

Moisture Content: 25.6 percent
USDA CLASS: Silt Loam

Date Received: 1/15/13 Date Tested: 1/18/13
Tested By: K Kelley
Checked By: J Boehm
Title: Project Engineer

Location: SWM-1
Depth: 3 feet

Date Sampled: 1/15/13

HILLIS-CARNES ENGINEERING ASSOCIATES

Client: Becker Morgan Group
Project: Graves Road Elementary School

DOVER, DE

Project No: D12162

Figure

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number SWM-2

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 293 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/1/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/1/2013

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
288	Light brown/brown, moist, medium stiff to stiff, micaceous, clayey SILT	0	ML		D		2	3	4	5	1	18	Approximatley 12 inches of organic bearing soil (topsoil) at surface.
							3	4	5	6	2	10	
							4	6	7	8	3	18	
282	Brown/gray, dry, medium dense, micaceous, silty, fine to coarse SAND, trace rock fragments	6	SM		D		4	6	8	8	4	10	
							2	5	6	8	5	10	
							4	7	8	10	6	18	
							6	7	10	12	7	12	
							5	7	8	11	8	12	
276	Boring terminated at 16 feet b.e.g.	18											
270		24											
264		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

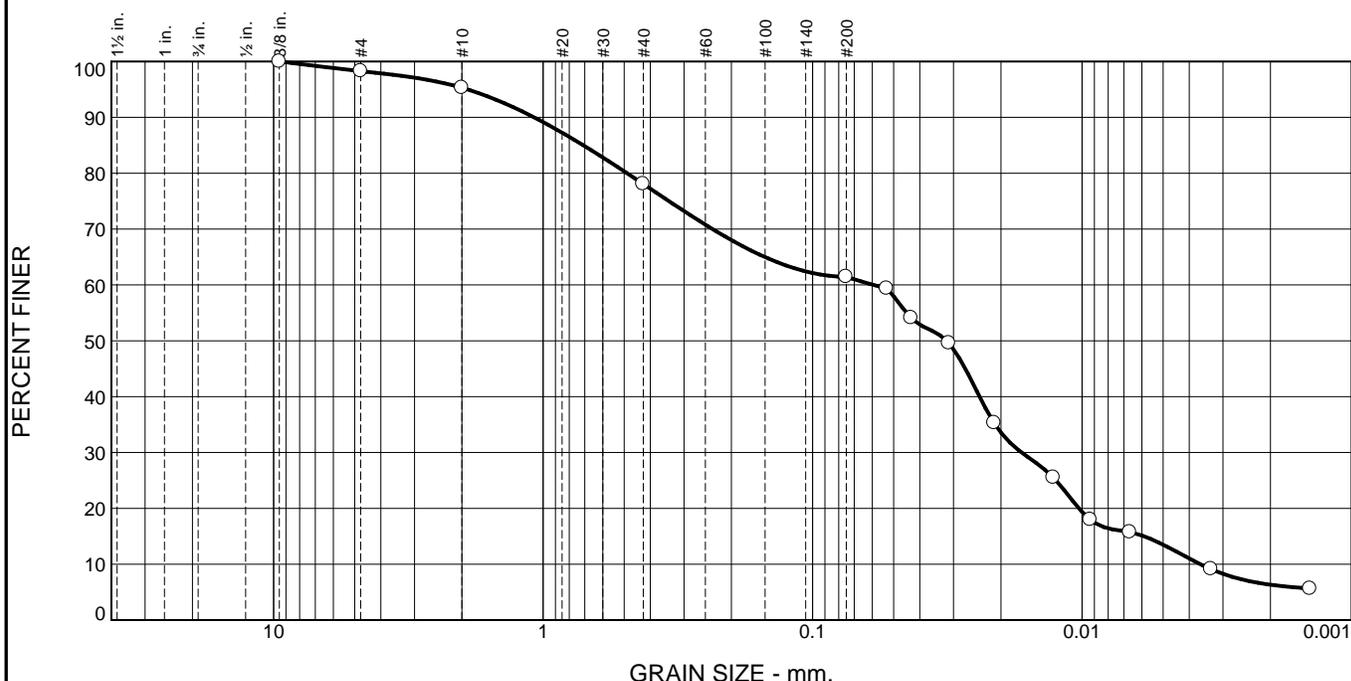
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 12 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	3.0	17.2	16.6	48.0	13.5

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	98.3		
#10	95.3		
#40	78.1		
#200	61.5		
#270	59.4		
0.0431 mm.	54.1		
0.0312 mm.	49.6		
0.0212 mm.	35.3		
0.0128 mm.	25.5		
0.0093 mm.	18.0		
0.0067 mm.	15.7		
0.0033 mm.	9.1		
0.0014 mm.	5.6		

* (no specification provided)

Material Description

Brown, micaceous, clayey SILT, some fine to medium sand

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 1.0800 D₈₅= 0.7091 D₆₀= 0.0593
D₅₀= 0.0318 D₃₀= 0.0168 D₁₅= 0.0059
D₁₀= 0.0036 C_u= 16.30 C_c= 1.30

Remarks

Moisture Content: 24.3 percent
USDA CLASS: Silt Loam

Date Received: 1/15/13 Date Tested: 1/18/13
Tested By: K Kelley
Checked By: J Boehm
Title: Project Engineer

Location: SWM-2
Depth: 4 feet

Date Sampled: 1/15/13

HILLIS-CARNES ENGINEERING ASSOCIATES	Client: Becker Morgan Group
DOVER, DE	Project: Graves Road Elementary School
Project No: D12162	Figure

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number SWM-3

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 306 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 1/29/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 1/29/13

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES
306	Brown, moist, medium stiff, micaceous, clayey SILT, some sand, some rock fragments, trace clay	0	ML		I	I	9	5	5	6	1	10	Approximately 6 inches of organic bearing soil (topsoil) at surface. Weathered rock
							3	2	6	14	2	8	
300	Brown, moist, medium dense to very dense, micaceous, fine to coarse, silty SAND, some rock fragments	6	SM		I	D	8	11	14	13	3	12	
							8	10	13	15	4	13	
							8	14	14	18	5	11	
							16	25	42	50/5	6	14	
							32	50/5		7	11		
294	Boring terminated at 16 feet b.e.g.	12			D	D	47	50/4			8	10	
288		18											
282		24											
276		30											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location Hockessin, Delaware
 Job Number D12162
 Boring Number SWM-4

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6 in. Foreman J Shippee
 Surf. Elev. 295 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by J Boehm
 Date Started 2/5/2013 Sampler Diameter 2 in. O.D. Boring Method HSA Date Completed 2/5/13

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"				No.	REC.	BORING & SAMPLING NOTES				
294	Light brown, moist, medium stiff to stiff, clayey SILT	0		ML	D		3	4	5	6	1	19	Approximately 8 inches of organic bearing soil (topsoil) at surface.				
		6															
288	Brown/gray, dry, medium dense, micaceous, silty, fine to coarse SAND			SM	D		4	6	5	5	4	18					
							12										
282							8	12	14	16	6	22					
							6	10	15	16	7	24					
							10	13	12	17	8	24					
276	Boring terminated at 16 feet b.e.g.	18															
270		24															
264		30															

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

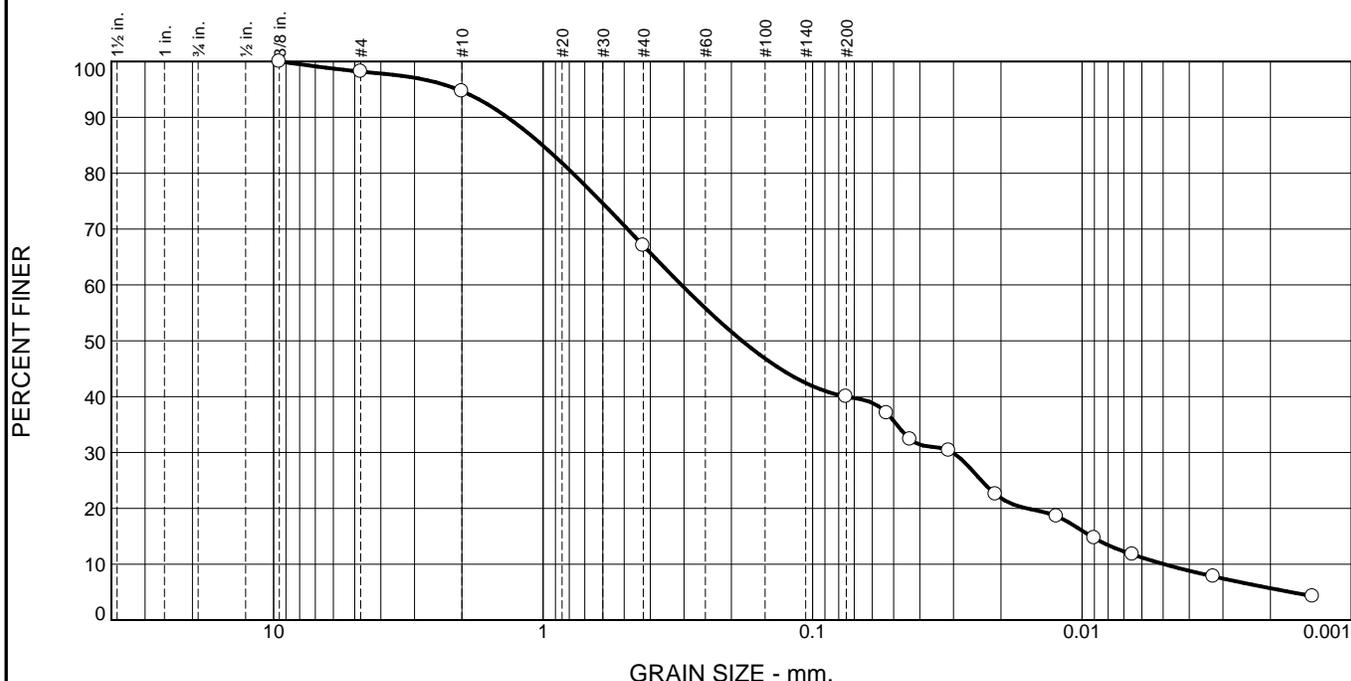
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
14.3 ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.8	3.5	27.6	27.1	30.0	10.0

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	98.2		
#10	94.7		
#40	67.1		
#200	40.0		
#270	37.1		
0.0435 mm.	32.3		
0.0312 mm.	30.4		
0.0209 mm.	22.5		
0.0124 mm.	18.6		
0.0090 mm.	14.7		
0.0065 mm.	11.7		
0.0033 mm.	7.8		
0.0014 mm.	4.3		

* (no specification provided)

Material Description

Brown/gray, dry, medium dense, micaceous, silty, fine to coarse SAND

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 1.3548 D₈₅= 1.0044 D₆₀= 0.3064
D₅₀= 0.1827 D₃₀= 0.0302 D₁₅= 0.0093
D₁₀= 0.0050 C_u= 61.80 C_c= 0.60

Remarks

USDA Class: Sandy Loam

Date Received: 3/4/13 Date Tested: 3/6/13
Tested By: K Kelley
Checked By: T Schick
Title: Branch Manager

Source of Sample: SWM-4 Depth: 8 Date Sampled: 3/4/13
Sample Number: 5

HILLIS-CARNES ENGINEERING ASSOCIATES	Client: Becker Morgan Group
DOVER, DE	Project: Graves Road Elementary School
	Project No: D12162 Figure

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location _____
 Job Number D12162
 Boring Number SWM-5

SAMPLER

Datum Topo Hammer Wt. _____ lb. Hole Diameter _____ in. Foreman K Kelley
 Surf. Elev. 291 ft. Hammer Drop _____ in. Rock Core Diameter _____ in. Classified by WT Schick
 Date Started 2/28/13 Sampler Diameter _____ in. O.D. Boring Method Excavator Date Completed 2/28/13

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	SAMPLE Blows per 6"	No.	REC.	BORING & SAMPLING NOTES
288	Light brown, moist, clayey SILT	0		ML		D		1		Approximately 8 inches of organic bearing soil (topsoil) at surface.
282	Brown/gray, moist, fine to coarse silty SAND Boring terminated at 8 feet b.e.g.	6		SM		D		2		
276		12								
270		18								
264		24								
258		30								

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

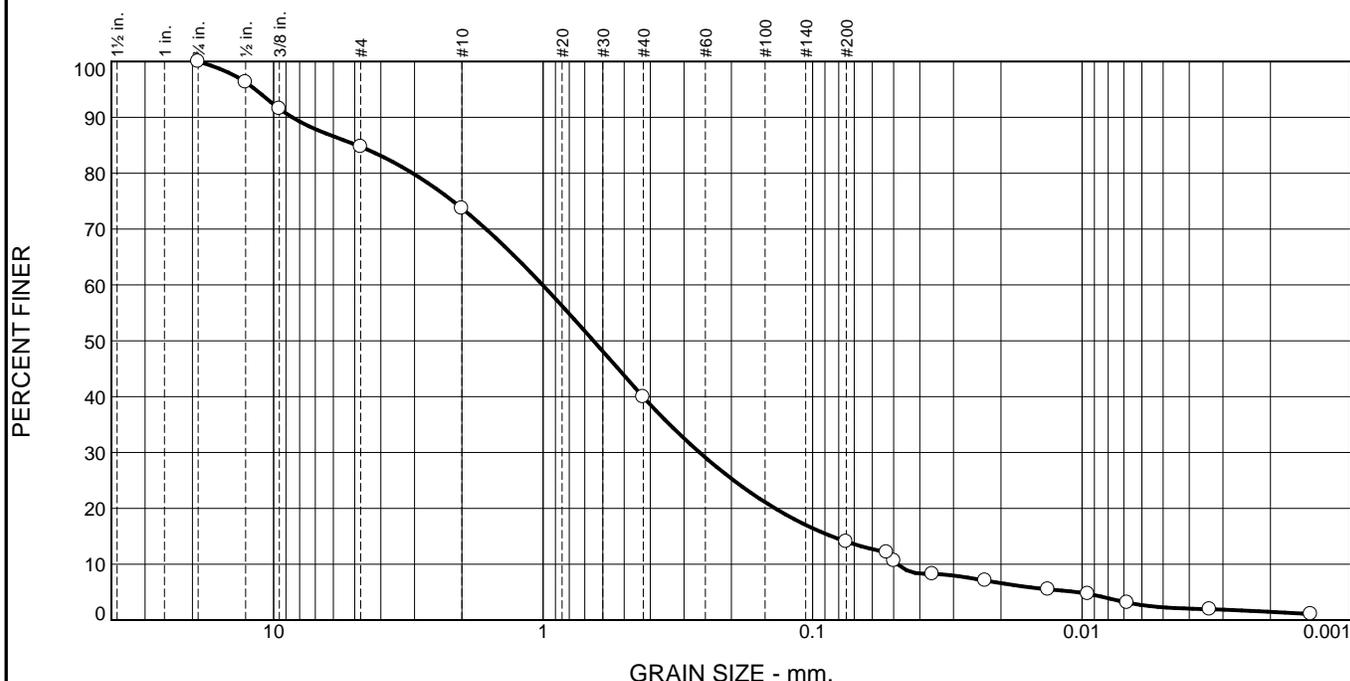
GROUND WATER
 Encountered 10 ft.
 At Completion 9 ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.3	11.0	33.8	25.9	11.7	2.3

Test Results (ASTM D 422 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75	100.0		
.50	96.3		
.375	91.6		
#4	84.7		
#10	73.7		
#40	39.9		
#200	14.0		
#270	12.2		
0.0498 mm.	10.6		
0.0359 mm.	8.3		
0.0229 mm.	7.1		
0.0134 mm.	5.5		
0.0095 mm.	4.7		
0.0068 mm.	3.1		
0.0034 mm.	1.9		
0.0014 mm.	1.1		

* (no specification provided)

Material Description

Brown/gray, moist, fine to coarse SAND, some rock fragments, some silt, trace clay

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 8.5240 D₈₅= 4.8977 D₆₀= 1.0042
 D₅₀= 0.6501 D₃₀= 0.2626 D₁₅= 0.0850
 D₁₀= 0.0484 C_u= 20.76 C_c= 1.42

Remarks

USDA Class: Loamy Sand

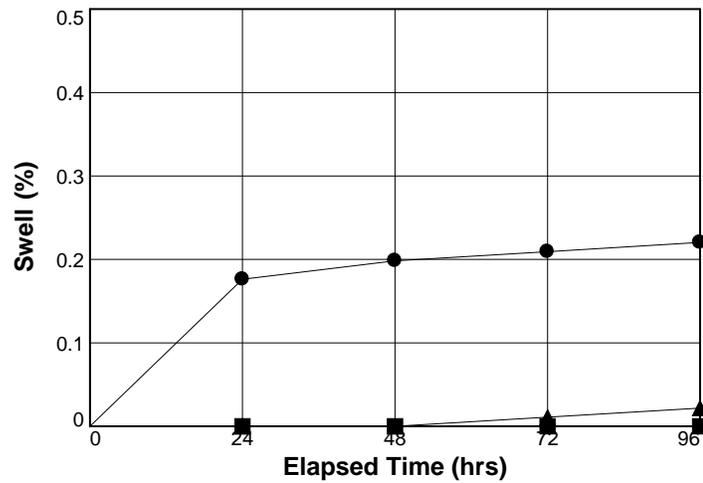
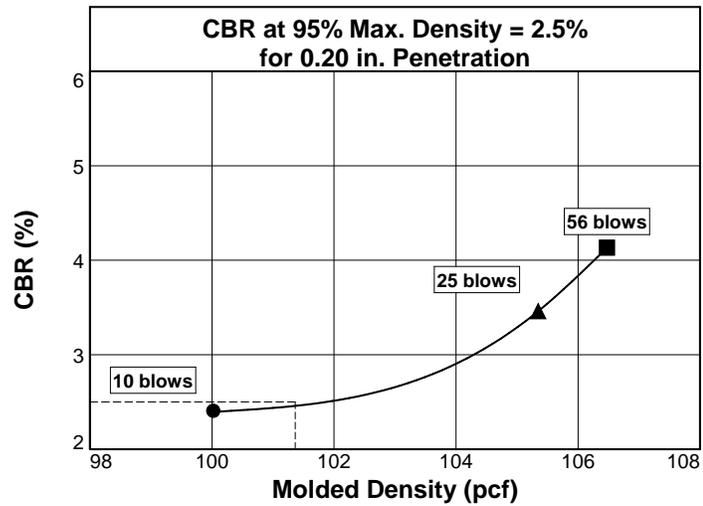
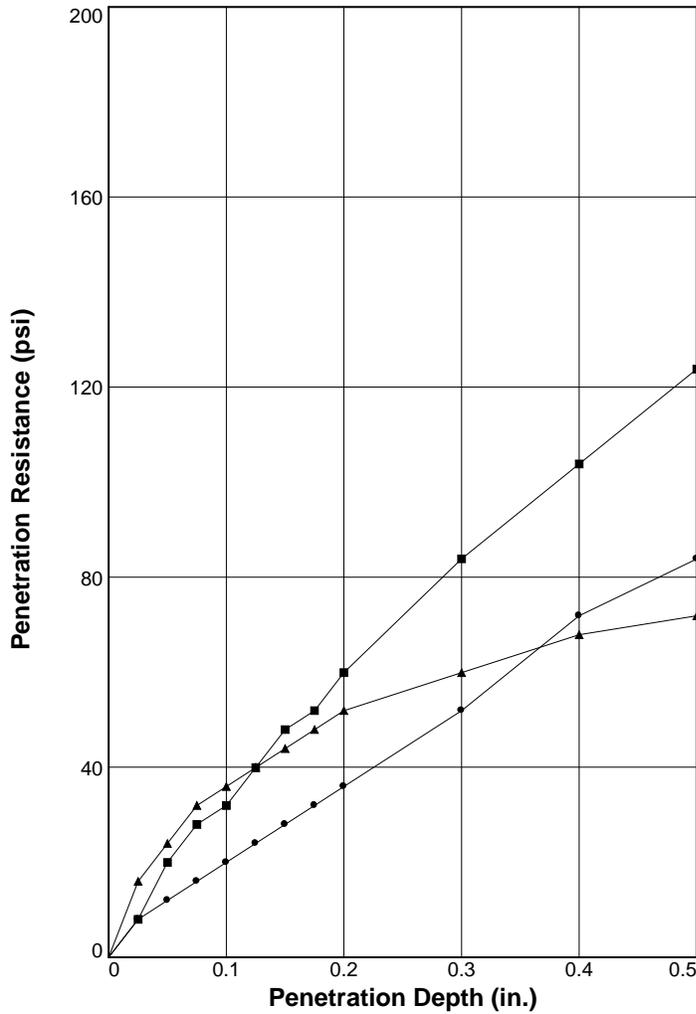
Date Received: 2/28/13 Date Tested: 3/6/13
 Tested By: K Kelley
 Checked By: T Schick
 Title: Branch Manager

Source of Sample: SWM-5 Depth: 7 Date Sampled: 2/28/13
 Sample Number: 2

HILLIS-CARNES ENGINEERING ASSOCIATES DOVER, DE	Client: Becker Morgan Group Project: Graves Road Elementary School Project No: D12162
Figure	

BEARING RATIO TEST REPORT

ASTM D 1883-99



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	100.0	93.7	20.4	99.8	93.5	22.1	2.0	2.4	0.000	22.75	0.2
2 △	105.3	98.7	20.4	105.3	98.7	20.4	3.6	3.5	0.000	22.75	0
3 □	106.5	99.8	20.4	106.5	99.8	20.1	3.5	4.1	0.009	22.75	0

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI

Project No: D12162
Project: Graves Road Elementary School
Location: CBR-1
Date: 2/19/13

BEARING RATIO TEST REPORT

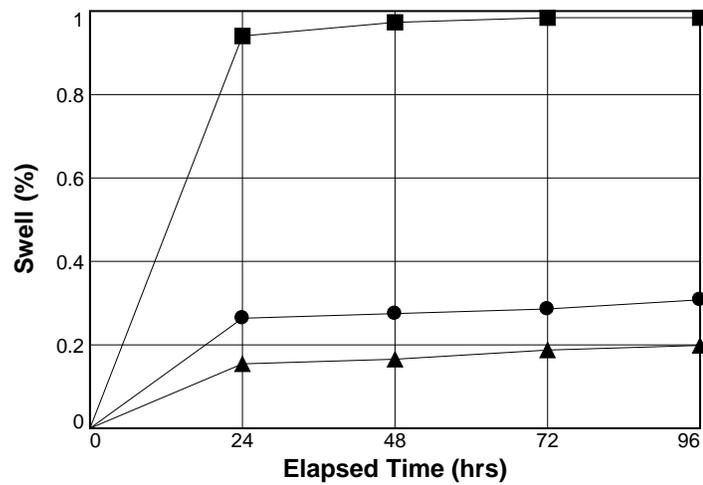
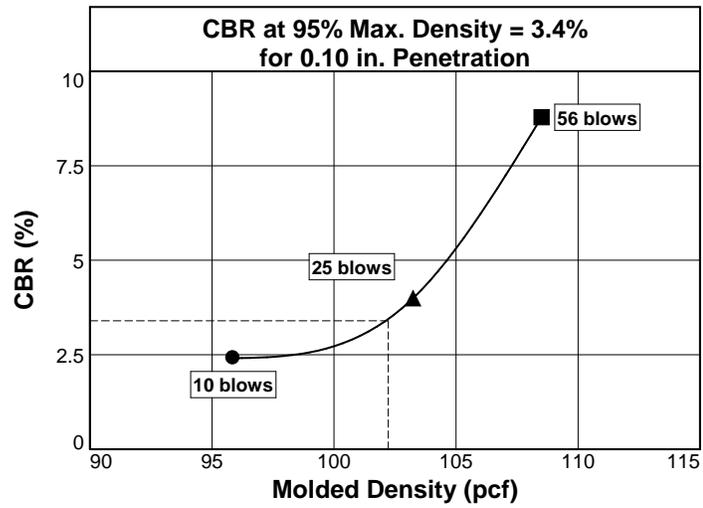
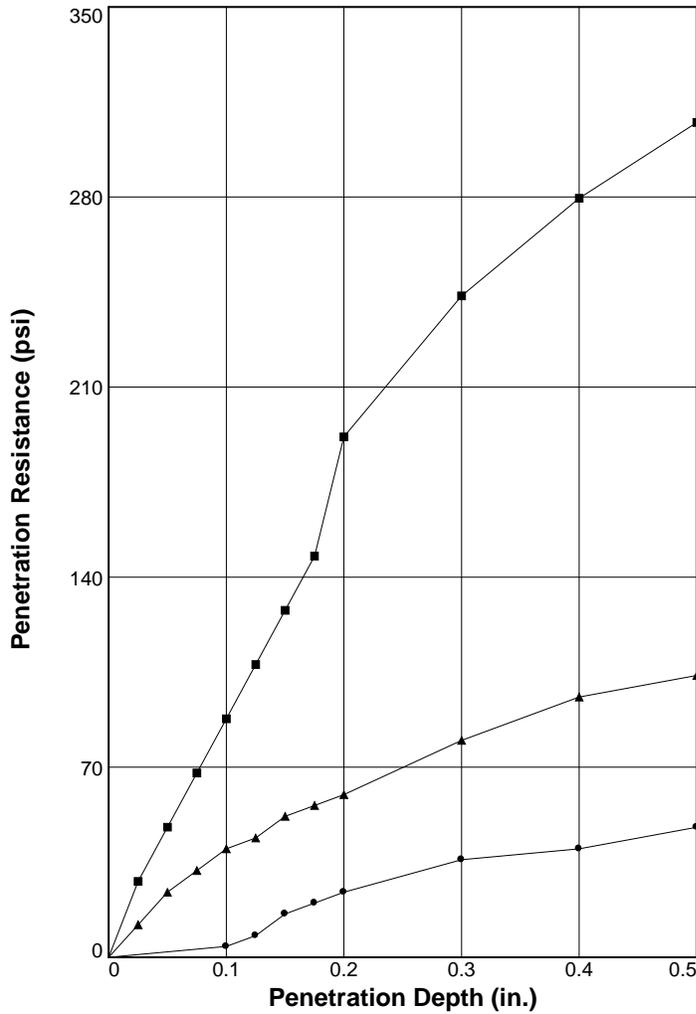
HILLIS-CARNES ENGINEERING ASSOCIATES

Test Description/Remarks:

Figure _____

BEARING RATIO TEST REPORT

ASTM D 1883-99



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	95.9	89.1	21.0	95.6	88.8	23.5	2.4	2.4	0.101	22.75	0.3
2 △	103.2	95.9	20.9	103.0	95.8	21.6	4.0	4.0	0.000	22.75	0.2
3 □	108.5	100.8	17.6	107.4	99.9	20.0	8.8	12.8	0.000	22.75	1

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI

Project No: D12162
Project: Graves Road Elementary School
Location: CBR-2

Date: 3/8/2013

Test Description/Remarks:

BEARING RATIO TEST REPORT
HILLIS-CARNES ENGINEERING ASSOCIATES

Figure _____

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-1

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 316.0 ft. Hammer Drop 30 in. Rock Core Diameter NA in. Classified by DVK
 Date Started 6/20/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/20/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75"			No.	REC.	BORING & SAMPLING NOTES
	Brown moist medium stiff SILT, some fine sand	0		ML	▲	I	2	2	3	1	78	Approx 4" of organic bearing material
313.5	Brown moist medium dense fine to medium SAND, some silt, trace of coarse sand and gravel			SM	▲	D	5	9	13	2	89	Moisture Content = 13.8%
	Brown & gray moist medium dense fine to medium SAND, some silt, trace of gravel	5.5		SM	▲	D	6	6	7	3	100	
308				SM	▲	D	6	8	9	4	89	
		11		SM	▲	D	2	6	9	5	100	
302.5	Brown and gray moist very dense fine to medium SAND, some silt			SM	▲	D	18	14	50/3"	6	100	Mottling, decomposed rock
297		16.5										
		22		SM	▲	D	33	50/2"		7	100	
291.5				SM	▲	D	50/3"			8	89	
	Auger refusal at 26.5 feet	27.5										
286												

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

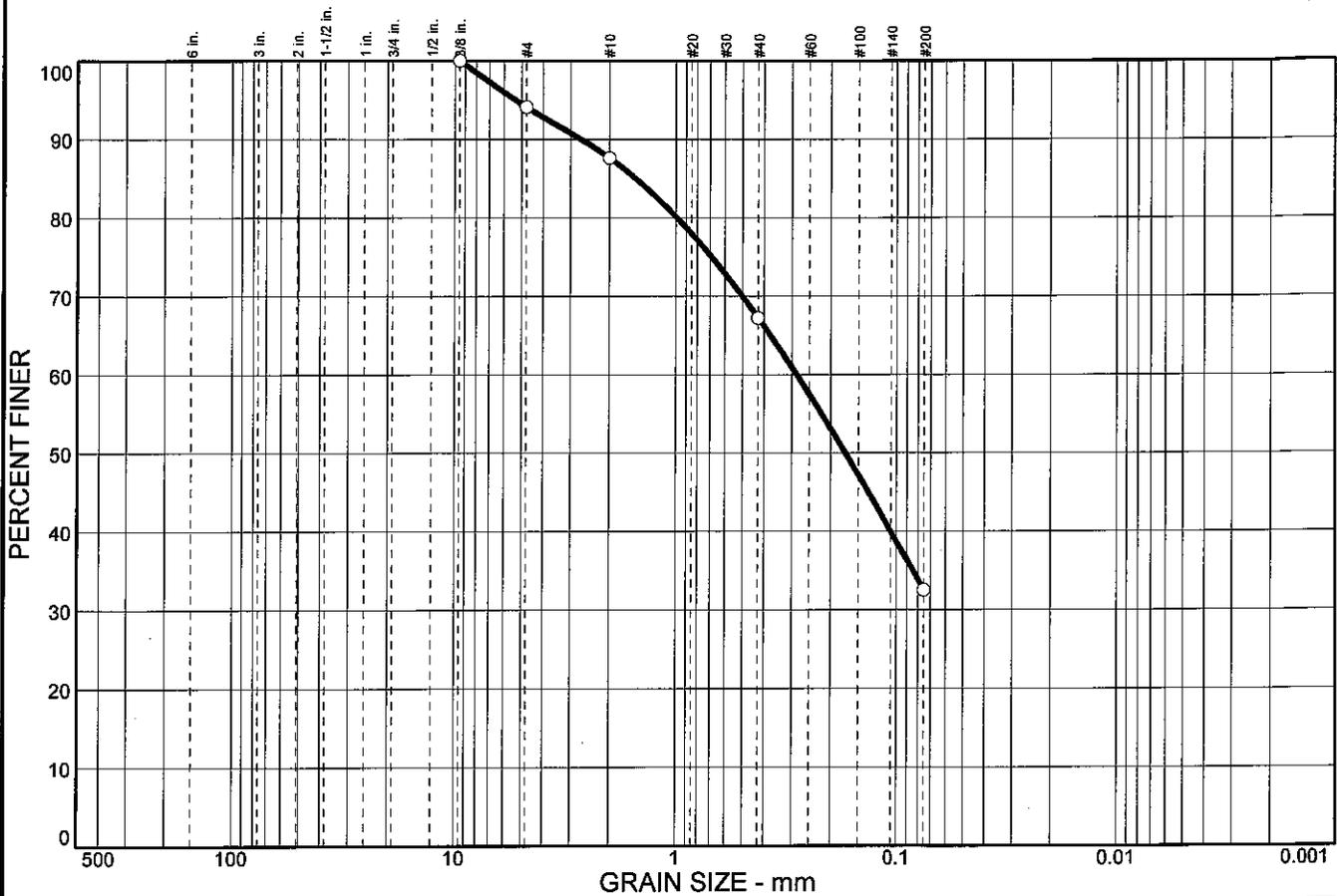
GROUND WATER
 Encountered NE ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
3.5 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	5.9	6.5	20.4	34.7	32.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	94.1		
#10	87.6		
#40	67.2		
#200	32.5		

Soil Description

Brown moist medium dense fine to medium SAND, some silt, trace of coarse sand and gravel

Atterberg Limits

PL= -- LL= -- PI= --

Coefficients

D₈₅= 1.53 D₆₀= 0.286 D₅₀= 0.172
 D₃₀= D₁₅= D₁₀=
 C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content = 13.8%

* (no specification provided)

Sample No.: 2 Source of Sample: B-1 Date: 6/22/11
 Location: Elev./Depth: 2.5

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.	Client: Studio JAED Project: Graves Road Elementary School Project No: D11026
Figure B1-S2	

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-2

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 318.4 ft. Hammer Drop 30 in. Rock Core Diameter NA in. Classified by DVK
 Date Started 6/20/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/20/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75'			No.	REC.	BORING & SAMPLING NOTES
	Brown moist medium stiff SILT, some fine sand	0		ML	▲	I	2	2	3	1	89	Approx 6" of organic bearing material
	Brown & gray moist micaceous medium dense fine to medium SAND, some silt	313.5		SM	▲	D	5	10	11	2	100	
		5.5		SM	▲	D	10	11	14	3	89	Moisture Content = 8.0% Decomposed rock
	Brown and gray moist very dense fine to medium SAND, some silt, trace of gravel and coarse sand	308		SM						4	100	
		11		SM	▲	D	20	41	43	5	100	
	Tan and brown moist very dense fine to coarse SAND, some silt	302.5		SM	▲	D	50/4"			6	100	Mottling observed Decomposed rock
	Brown, black, white, gray moist very dense coarse to fine SANDS, some silt, trace of gravel	297		SM	▲	D	28	50/2"		7	100	
		22		SM	▲	D	18	50/3"		8	100	
		291.5			▲	D	50/3"			9	17	
	Boring terminated at 30 feet											

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

	GROUND WATER	CAVE IN DEPTH
Encountered	<u>NE</u> ft.	<u>7.25</u> ft.
At Completion	_____ ft.	_____ ft.
After Auger Removal	_____ ft.	_____ ft.
Backfilled	_____ ft.	_____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	10.1	3.6	25.2	40.7	20.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	98.1		
#4	89.9		
#10	86.3		
#40	61.1		
#200	20.4		

Soil Description

Brown and gray moist very dense fine to medium SAND, some silt, trace of gravel and coarse sand

Atterberg Limits

PL= -- LL= -- PI= --

Coefficients

D₈₅= 1.68 D₆₀= 0.405 D₅₀= 0.261
 D₃₀= 0.112 D₁₅= D₁₀=
 C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content = 8.0%

* (no specification provided)

Sample No.: 4
Location:

Source of Sample: B-2

Date: 6/22/11
Elev./Depth: 7.5

HILLIS-CARNES
ENGINEERING ASSOCIATES, INC.

Client: Studio JAED
Project: Graves Road Elementary School

Project No: D11026

Figure B2-S4

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-3

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 319.6 ft. Hammer Drop 30 in. Rock Core Diameter NA in. Classified by DVK
 Date Started 6/20/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/20/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75"			No.	REC.	BORING & SAMPLING NOTES
319	Brown moist soft SILT, some fine sand	0		ML	▲	I	2	2	2	1	78	Approx 6" of organic bearing material
	Brown moist medium dense fine to medium SAND, some silt			SM	▲	D	3	6	8	2	89	
313.5	Light brown moist medium dense fine to medium SAND, some silt, trace of coarse sand and gravel	5.5		SM	▲	D	4	6	8	3	89	Moisture Content = 12.3%
	Brown and orange moist medium dense fine to medium SAND, some silt			SM	▲	D	7	11	15	4	100	
309	Brownish gray moist dense medium to fine SAND, some silt	11		SM	▲	D	10	15	19	5	100	Decomposed rock
	Dark brown moist dense fine to medium SAND, some silt			SM	▲	D	15	19	23	6	100	Decomposed rock
302.5		16.5										
	Brown and orange moist very dense fine to medium SAND, some silt and mica			SM	▲	D	26	40	50/3"	7	100	Mottling observed
297		22										
				SM	▲	D	33	50/2"		8	100	
291.5		27.5										
				SM	▲	D	50/4"			9	78	
	Boring terminated at 30 feet											

SAMPLER TYPE

DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS

D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER

Encountered NE ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH

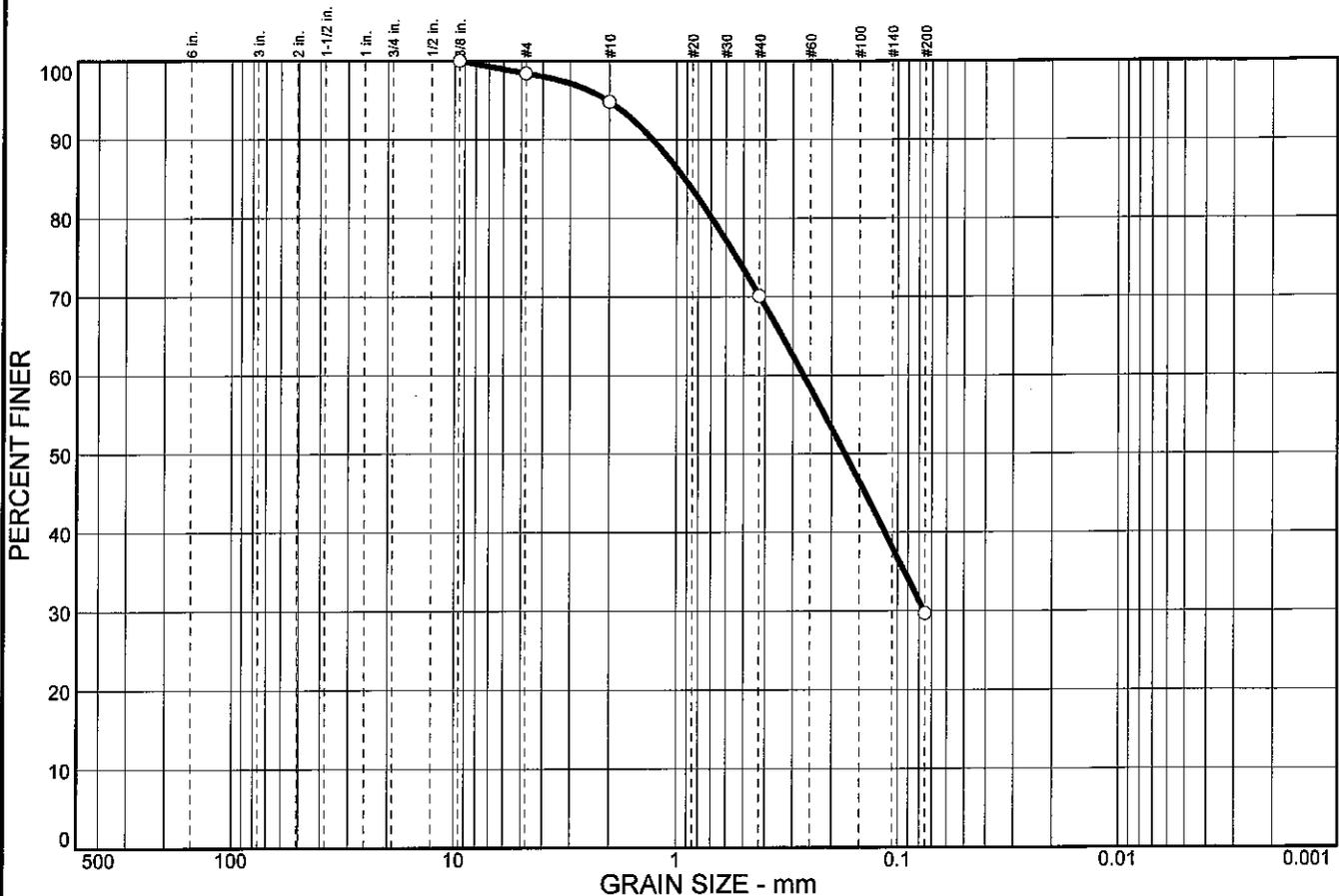
5.5 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD

HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1" WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	1.6	3.6	24.7	40.4	29.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	98.4		
#10	94.8		
#40	70.1		
#200	29.7		

Soil Description

Light brown moist medium dense fine to medium SAND, some silt, trace of coarse sand and gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 0.921 D₆₀= 0.269 D₅₀= 0.174
 D₃₀= 0.0759 D₁₅= D₁₀=
 C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content = 12.3%

* (no specification provided)

Sample No.: 3 Source of Sample: B-3 Date: 6/22/11
 Location: Elev./Depth: 5

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.	Client: Studio JAED Project: Graves Road Elementary School Project No: D11026
Figure B3-S3	

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-4

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 316.7 ft. Hammer Drop 30 in. Rock Core Diameter NA in. Classified by DVK
 Date Started 6/22/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/22/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75"			No.	REC.	BORING & SAMPLING NOTES
	Brown moist medium stiff SILT, trace of fine and medium sand	0		ML		D	2	3	4	1	78	Approx 6" of organic bearing material
313.5	Brown moist loose fine SAND, some silt			SM		D	3	4	4	2	89	Mica present
	Brown, black and gray moist medium dense to dense gravelly fine to coarse SAND, trace of silt	5.5		SP-SM		D	8	10	11	3	89	Moisture Content = 6.1%
308				SP-SM		D	16	13	12	4	67	
		11		SP-SM		D	6	8	24	5	100	
302.5	Tan and light gray moist very dense fine to coarse SAND, some silt and gravel	16.5		SM		D	20	36	50/4"	6	100	Mottling observed
297	Rock encountered; boring terminated at 20 feet	22					50/0"					
291.5		27.5										
286												

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

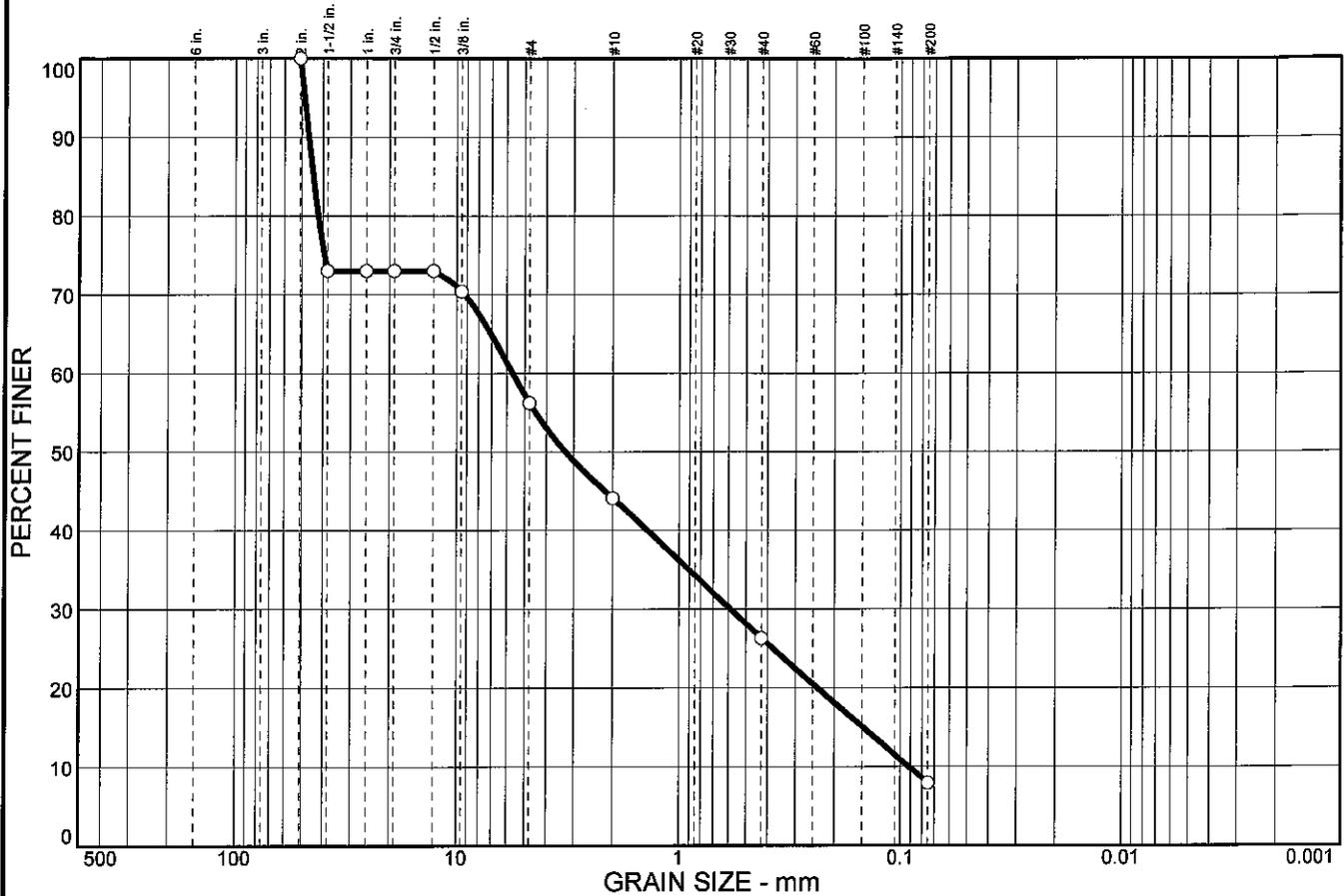
GROUND WATER
 Encountered NE ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
1.5 ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1" WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	27.0	16.8	12.1	17.8	18.4	7.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2 in.	100.0		
1.5 in.	73.0		
1 in.	73.0		
3/4 in.	73.0		
1/2 in.	73.0		
3/8 in.	70.4		
#4	56.2		
#10	44.1		
#40	26.3		
#200	7.9		

Soil Description

Brown, black and gray moist medium dense to dense gravelly fine to coarse SAND, trace of silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 44.4 D₆₀= 5.66 D₅₀= 3.28
D₃₀= 0.588 D₁₅= 0.149 D₁₀= 0.0920
C_u= 61.55 C_c= 0.66

Classification

USCS= SP-SM AASHTO= A-1-a

Remarks

Moisture Content = 6.1%

* (no specification provided)

Sample No.: 3 Source of Sample: B-4 Date: 06/24/2011
Location: Elev./Depth: 5

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.	Client: Studio JAED Project: Graves Road Elementary School Project No: D11026
Figure B4-S3	

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-5

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 320.6 ft. Hammer Drop 30 in. Rock Core Diameter NA in. Classified by DVK
 Date Started 6/22/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/22/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75"			No.	REC.	BORING & SAMPLING NOTES
319	Brown moist medium stiff SILT, some fine sand	0		ML	▲	I	2	3	4	1	78	Approx 8" of organic bearing material
	Brown moist medium dense fine to coarse SAND, some gravel and silt			SM	▲	D	6	5	6	2	78	Moisture Content = 17.9%
313.5	Brown moist loose to very dense fine to medium SAND, some silt	5.5		SM	▲	D	3	3	4	3	78	Mica present
				SM	▲	D	4	5	8	4	100	
308		11		SM	▲	D	36	50/2"		5	67	
	Brown gray moist very dense fine to medium SAND, some silt, trace of gravel and coarse sand	16.5		SM	▲	D	8	50/0"		6	33	
302.5	Boring terminated; auger refusal @ 16.5 feet											
297		22										
291.5		27.5										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

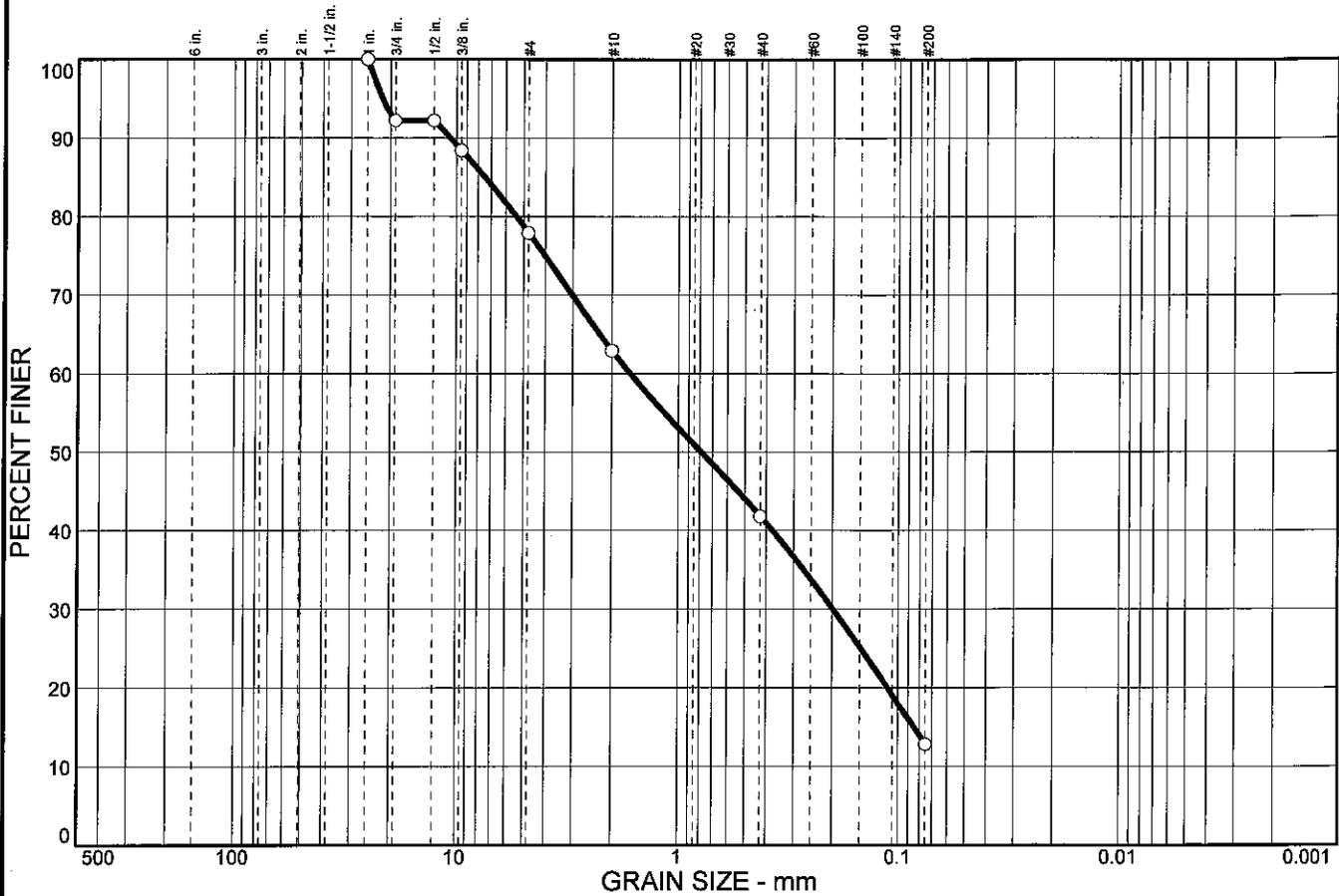
GROUND WATER
 Encountered NE ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
1.5 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	7.8	14.3	15.0	21.1	29.0	12.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
3/4 in.	92.2		
1/2 in.	92.2		
3/8 in.	88.4		
#4	77.9		
#10	62.9		
#40	41.8		
#200	12.8		

Soil Description

Brown moist medium dense fine to coarse SAND, some gravel and silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 7.48 D₆₀= 1.66 D₅₀= 0.791
D₃₀= 0.199 D₁₅= 0.0847 D₁₀=
C_u= C_c=

Classification

USCS= SM AASHTO= A-1-b

Remarks

Moisture Content = 17.9%

* (no specification provided)

Sample No.: 2
Location:

Source of Sample: B-5

Date: 06/24/2011
Elev./Depth: 2.5

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.	Client: Studio JAED Project: Graves Road Elementary School Project No: D11026
Figure B5-S2	

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-6

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 312.9 ft. Hammer Drop 30 in. Rock Core Diameter NA in. Classified by DVK
 Date Started 6/20/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/20/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75'			No.	REC.	BORING & SAMPLING NOTES	
	Brown moist medium stiff SILT, trace of fine sand	0		ML	▲	I	2	3	4	1	78	Approx 6" of organic bearing material	
308	Reddish brown moist medium dense fine to medium SAND, some silt, trace of gravel			SM	▲	D	5	8	11	2	89		
		5.5		SM	▲	D	8	15	12	3	67		
				SM	▲	D	6	9	9	4	100		Mica present
302.5	Brown and gray moist dense fine to medium SAND, some silt	11		SM	▲	D	20	22	15	5	100		Moisture Content = 7.0% Decomposed rock
297	Brown moist medium dense fine SAND, some silt	16.5		SM	▲	D	3	12	17	6	100		Mica present
291.5	Brown moist dense to very dense, fine to medium SAND, some silt, trace of gravel	22		SM	▲	D	10	18	28	7	100		
286	Auger refusal at 27 feet	27.5		SM	▲	D	34	50/2"		8	100		

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

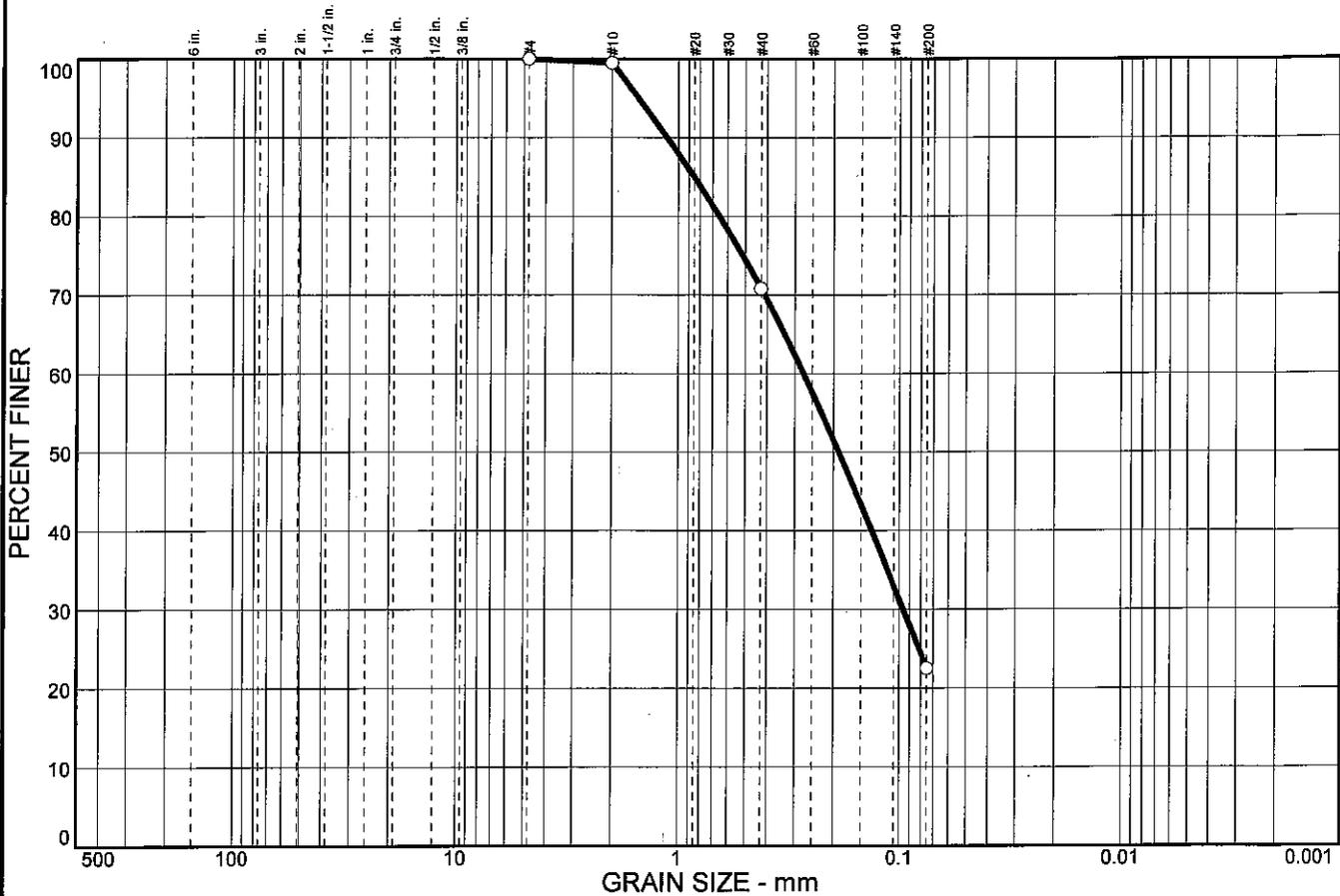
GROUND WATER
 Encountered NE ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.5	28.7	48.3	22.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.5		
#40	70.8		
#200	22.5		

Soil Description

Brown and gray moist dense fine to medium SAND, some silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 0.852 D₆₀= 0.274 D₅₀= 0.190
D₃₀= 0.0961 D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content = 7.0%

* (no specification provided)

Sample No.: 5
Location:

Source of Sample: B-6

Date: 06/24/2011
Elev./Depth: 10

HILLIS-CARNES
ENGINEERING ASSOCIATES, INC.

Client: Studio JAED
Project: Graves Road Elementary School

Project No: D11026

Figure B6-S5

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-7

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 316.4 ft. Hammer Drop 30 in. Rock Core Diameter NA in. Classified by DVK
 Date Started 6/22/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/22/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75'			No.	REC.	BORING & SAMPLING NOTES
	Brown moist soft SILT, some fine sand	0		ML	▲	I	1	2	3	1	78	Approx 4" of organic bearing material encountered
313.5	Brown wet loose silty fine to medium SAND, trace of coarse sand and gravel			SM	▲	I	4	3	6	2	78	Moisture Content = 21.8%
	Brownish gray moist medium dense to very dense fine to medium SAND, some silt	5.5		SM	▲	D	6	8	8	3	67	
308				SM	▲	D	13	8	11	4	33	Decomposed rock
		11		SM	▲	D	28	50/1"		5	67	
302.5	Auger refusal at 14.0 feet	16.5										
297		22										
291.5		27.5										
286												

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

GROUND WATER
 Encountered NE ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
2.0 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS.

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-8

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 307.5 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by DVK
 Date Started 6/6/22/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/22/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLER TYPE	CON	DCP Blows per 1.75"			No.	REC.	BORING & SAMPLING NOTES
	Brown moist medium stiff clayey SILT, some fine sand	0		ML	▲	I	2	3	4	1	78	Approx 6" of organic bearing material
	Brown moist medium dense clayey fine to medium SAND			SC	▲	D	5	6	8	2	100	
302.5	Brown, gray, and tan moist loose fine to medium SAND, some silt	5.5		SM	▲	D	3	4	6	3	100	Decomposed rock
	Brown and gray moist very dense fine to coarse SAND, some silt, trace of gravel			SM	▲	D	14	29	50/4"	4	100	Moisture Content = 7.3% Decomposed rock Mica present
297	Gray moist very dense fine to medium SAND, some silt	11		SM	▲	D	50/3"			5	30	
	Auger refusal at 12 feet											
291.5		16.5										
286		22										
280.5		27.5										

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

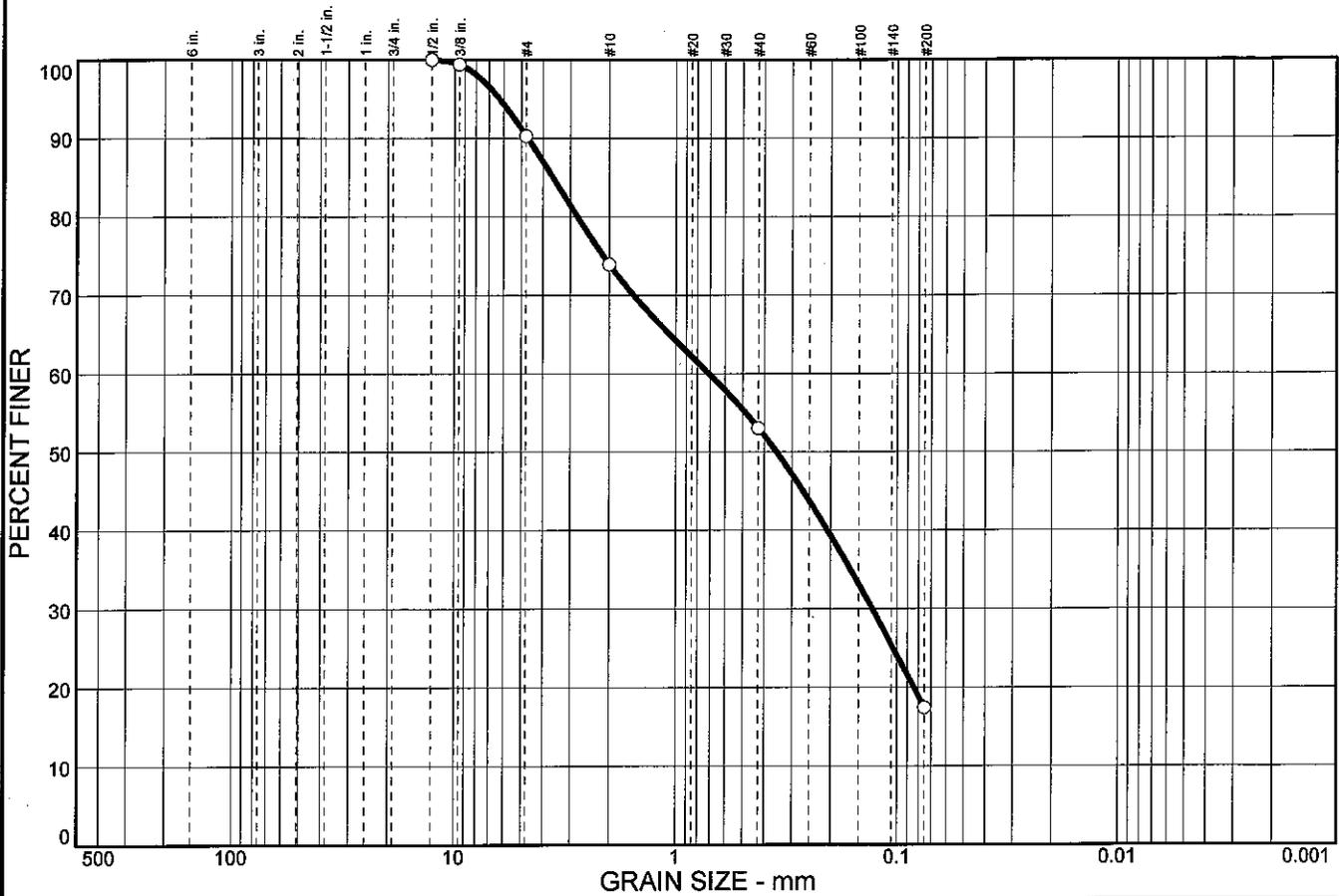
GROUND WATER
 Encountered NE ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
1.75 ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30"; COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	9.7	16.4	20.9	35.6	17.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2 in.	100.0		
3/8 in.	99.4		
#4	90.3		
#10	73.9		
#40	53.0		
#200	17.4		

Soil Description

Brown and gray moist very dense fine to coarse SAND, some silt, trace of gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 3.60 D₆₀= 0.712 D₅₀= 0.353
D₃₀= 0.130 D₁₅= D₁₀=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content = 7.3%

* (no specification provided)

Sample No.: 4 Source of Sample: B-8 Date: 06/24/2011
Location: Elev./Depth: 7.5

RECORD OF SOIL EXPLORATION
HILLIS - CARNES ENGINEERING ASSOCIATES, INC.
1277 McD Drive
Dover, Delaware 19901

Project Name Graves Road Elementary
 Location see Figure 2
 Job Number D11026
 Boring Number B-9

SAMPLER

Datum Topo Hammer Wt. 140 lb. Hole Diameter 6.0 in. Foreman KH/JM
 Surf. Elev. 292.0 ft. Hammer Drop 30 in. Rock Core Diameter _____ in. Classified by DVK
 Date Started 6/6/22/11 Sampler Diameter 2.0 in. O.D. Boring Method HSA Date Completed 6/22/11

ELEV.	Soil Description Color, Moisture, Density, Size, Proportion	STRA. DEPTH	USCS SOIL	USCS	SAMPLE TYPE	CON	DCP Blows per 1.75"			No.	REC.	BORING & SAMPLING NOTES
291.5	Brown moist medium stiff to stiff SILT, some fine sand	0		ML	I	I	2	3	4	1	89	Approx 8" of organic bearing material encountered
				ML	I	I	4	6	8	2	100	
286	Reddish brown wet medium stiff SILT, some fine sand, trace of coarse sand and gravel	5.5		ML	D	D	3	4	6	3	100	Moisture Content = 23.5%
	Tan moist medium dense fine to medium SAND, some silt, trace of coarse sand and gravel			SM	D	D	3	7	11	4	100	
280.5		11		SM	D	D	9	11	14	5	100	
275	Tan and gray moist very dense fine to coarse SAND, some silt and gravel	16.5		SM	D	D	24	39	50/2"	6	100	
269.5	Brown and tan moist very dense fine to medium SAND, some silt	22		SM	D	D	28	39	50/2"	7	100	
264	Auger refusal at 27 feet	27.5		SM	D	D	50/2"			8	33	

SAMPLER TYPE
 DRIVEN SPLIT SPOON UNLESS OTHERWISE NOTED
 PT - PRESSED SHELBY TUBE
 CA - CONTINUOUS FLIGHT AUGER
 RC - ROCK CORE

SAMPLE CONDITIONS
 D - DISINTEGRATED
 I - INTACT
 U - UNDISTURBED
 L - LOST

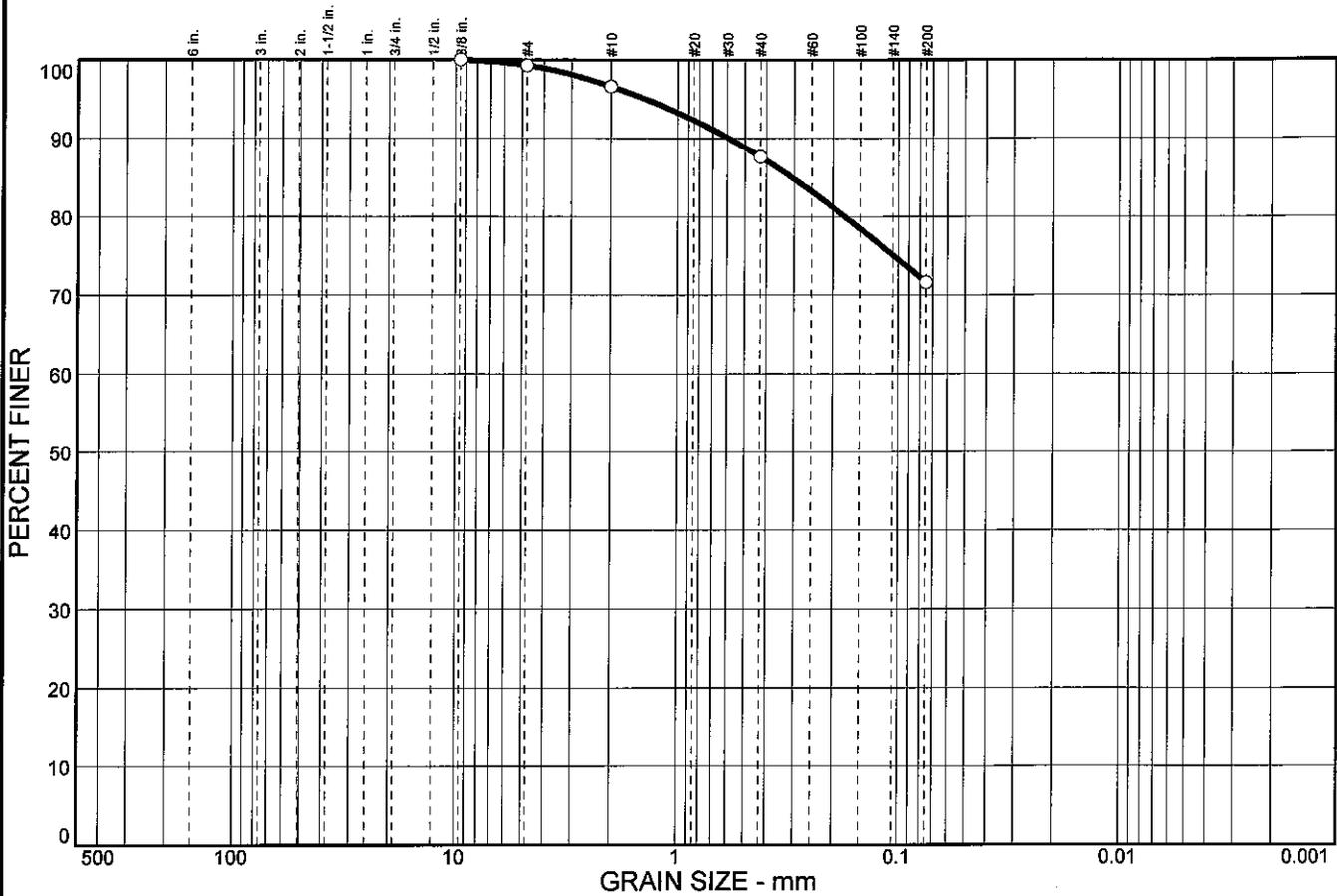
GROUND WATER
 Encountered _____ ft.
 At Completion _____ ft.
 After Auger Removal _____ ft.
 Backfilled _____ ft.

CAVE IN DEPTH
 3.25 ft.
 _____ ft.
 _____ ft.
 _____ ft.

BORING METHOD
 HSA - HOLLOW STEM AUGERS
 CFA - CONTINUOUS FLIGHT AUGERS
 DC - DRIVING CASING
 MD - MUD DRILLING

STANDARD PENETRATION TEST-DRIVING 2" O.D. SAMPLER 1' WITH 140# HAMMER FALLING 30": COUNT MADE AT 6" INTERVALS.

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.7	2.7	9.0	16.0	71.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8 in.	100.0		
#4	99.3		
#10	96.6		
#40	87.6		
#200	71.6		

Soil Description

Reddish brown wet medium stiff SILT, some fine sand, trace of coarse sand and ravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 0.308 D₆₀= D₅₀=
 D₃₀= D₁₅= D₁₀=
 C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Moisture Content = 23.5%

* (no specification provided)

Sample No.: 3 Source of Sample: B-9 Date: 06/24/2011
 Location: Elev./Depth: 5

HILLIS-CARNES ENGINEERING ASSOCIATES, INC.	Client: Studio JAED Project: Graves Road Elementary School Project No: D11026
Figure B9-S3	

Graves Road Elementary School

Wilmington, Delaware

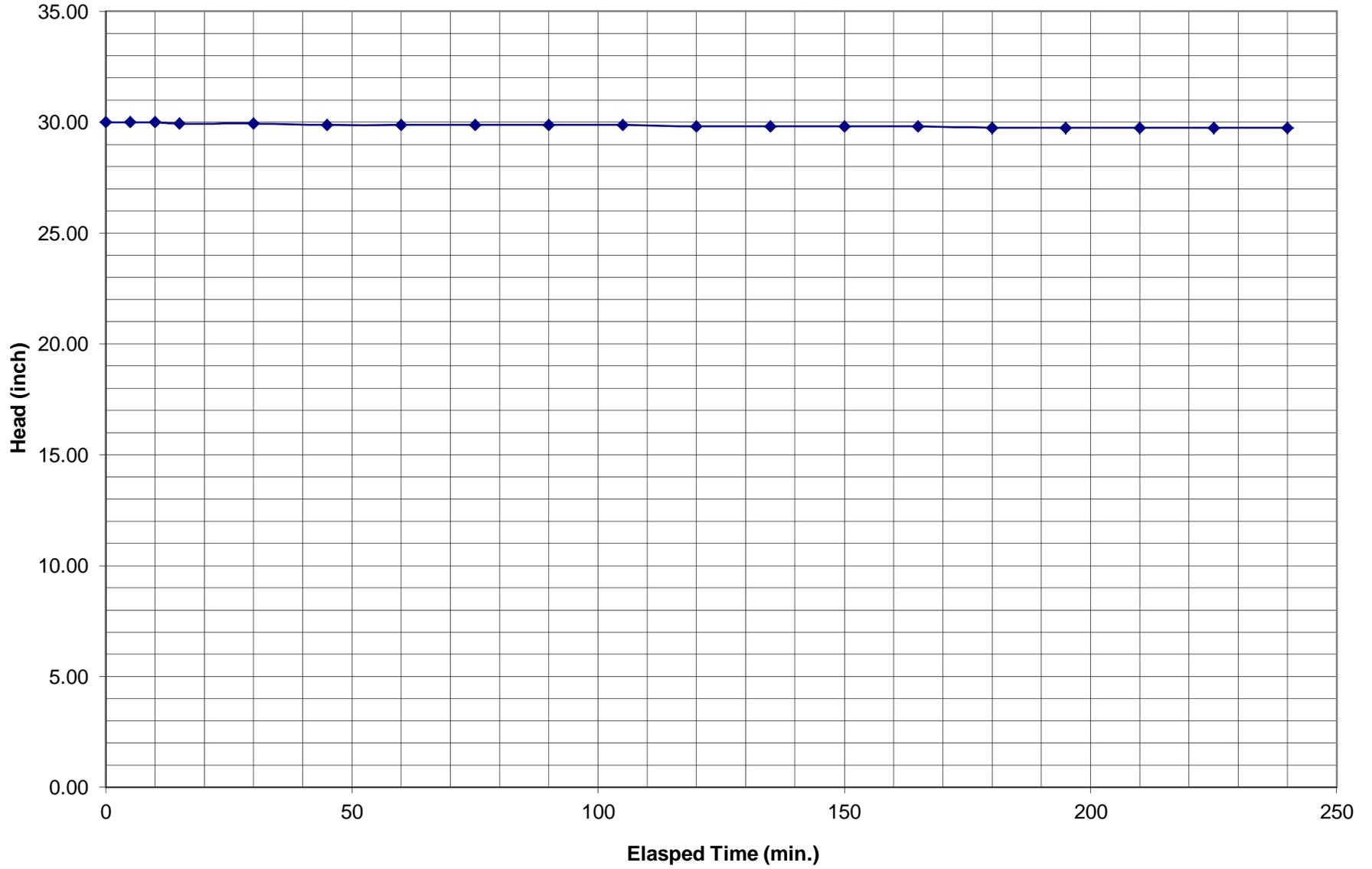
Depth Below Existing Grade	<u>SWM-1</u>	<u>SWM-2</u>	<u>SWM-3</u>	<u>SWM-4</u>	<u>SWM-5</u>
	<u>3 ft</u>	<u>4 ft</u>	<u>4 ft</u>	<u>7.5 ft</u>	<u>7.5 ft</u>
Elapsed Time (min.)	Head (inch)	Head (inch)	Head (inch)	Head (inch)	Head (inch)
0	30.000	30.000	30.000	30.000	30.000
5	30.000	30.000	29.250	29.875	29.500
10	30.000	29.988	28.750	29.500	29.000
15	29.938	29.863	28.625	29.000	28.875
30	29.938	29.770	28.500	27.500	27.000
45	29.875	29.706	27.500	26.875	25.750
60	29.875	29.613	26.500	25.000	24.250
75	29.875	29.488	25.500	23.875	22.813
90	29.875	29.238	24.375	22.625	21.000
105	29.875	29.238	23.500	21.250	20.000
120	29.813	29.238	22.675	20.500	18.500
135	29.813	29.175	21.750	18.875	17.500
150	29.813	29.113	20.750	17.500	15.625
165	29.813	28.988	19.250	16.375	14.125
180	29.750	28.863	18.625	15.375	12.875
195	29.750	28.738	17.875	13.875	11.325
210	29.750	28.550	17.250	12.500	9.875
225	29.750	28.238	16.425	11.250	8.500
240	29.750	27.925	15.800	10.125	6.875

D, in =	12	12	12	12	12
T ₁ , min =	0	0	0	0	0
T ₂ , min =	240	240	240	240	240
H ₁ , in =	30.000	30.000	30.000	30.000	30.000
H ₂ , in =	29.750	27.925	15.800	10.125	6.875

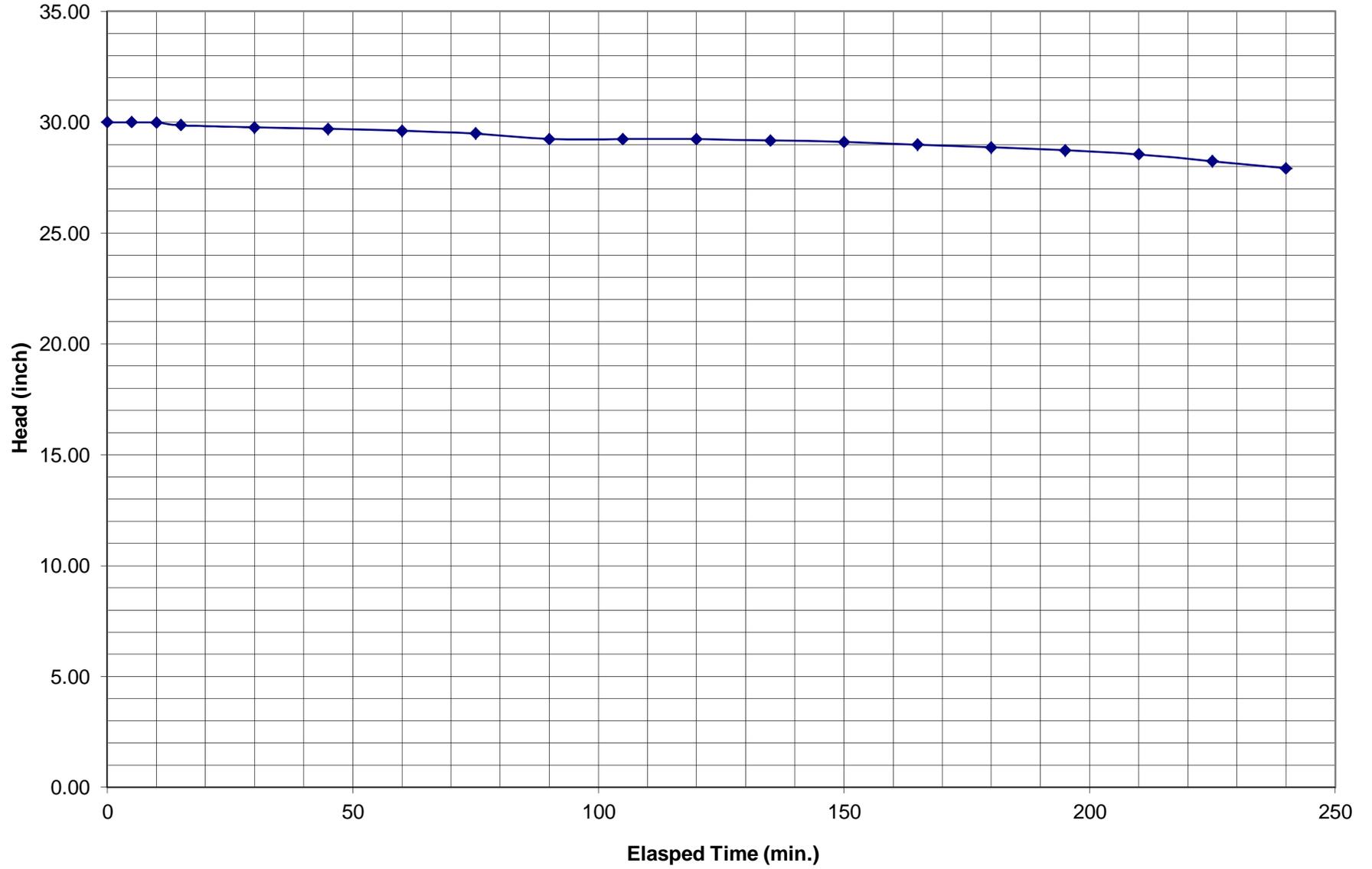
D, cm =	30.48	30.48	30.48	30.48	30.48
T ₁ , sec =	0	0	0	0	0
T ₂ , sec =	14400	14400	14400	14400	14400
H ₁ , cm =	76.2	76.2	76.2	76.2	76.2
H ₂ , cm =	75.565	70.9295	40.132	25.7175	17.4625

K = (pi * D) / (11 * (T ₂ - T ₁)) * ln (H ₁ / H ₂) =	cm/s	cm/s	cm/s	cm/s	cm/s
	5.06E-06	4.33E-05	3.88E-04	6.57E-04	8.91E-04
	cm/hr	cm/hr	cm/hr	cm/hr	cm/hr
	0.02	0.16	1.40	2.36	3.21
	in/hr	in/hr	in/hr	in/hr	in/hr
	0.01	0.06	0.55	0.93	1.26

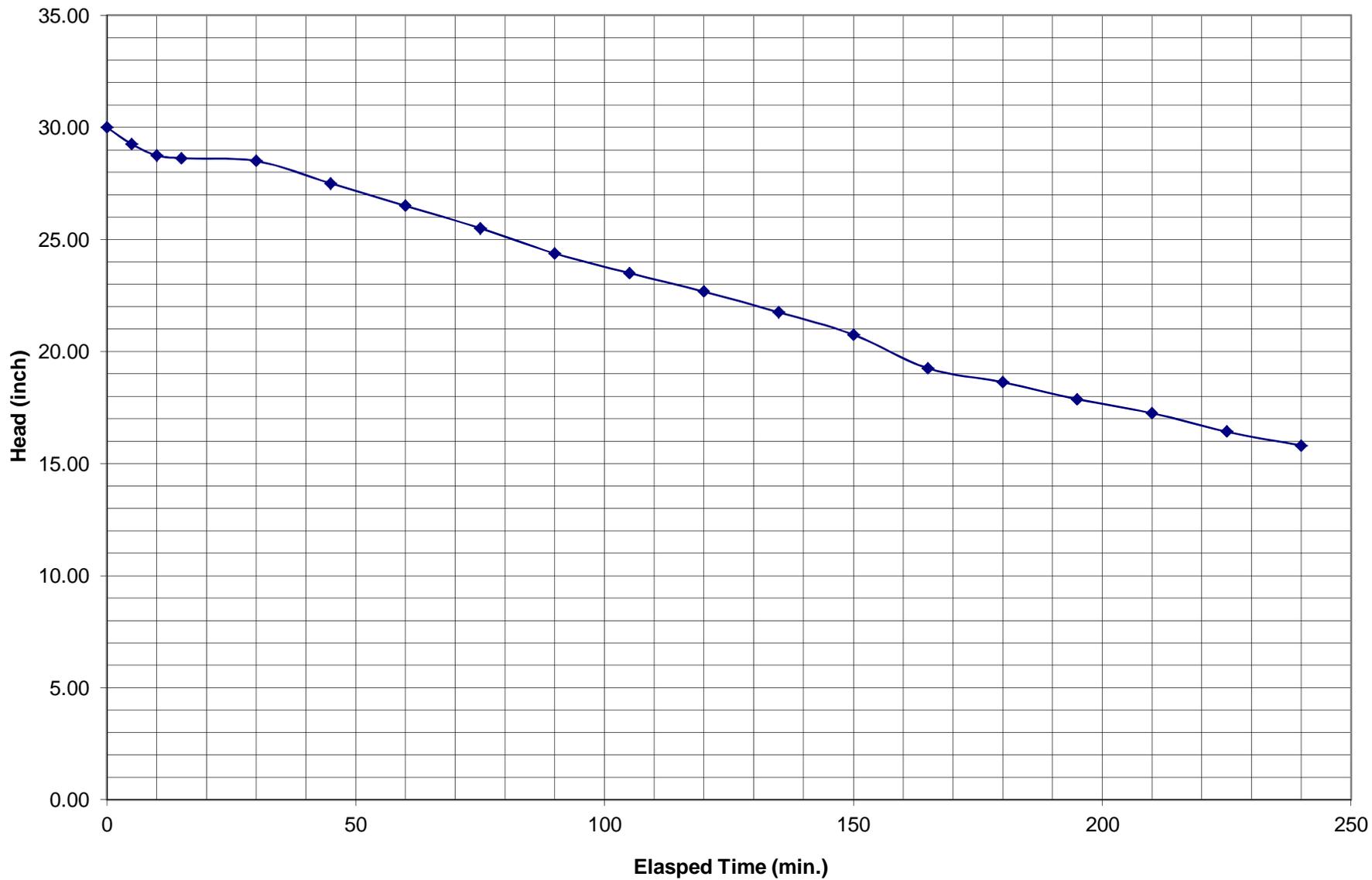
Graves Road Elementary SWM-1 (3 feet)



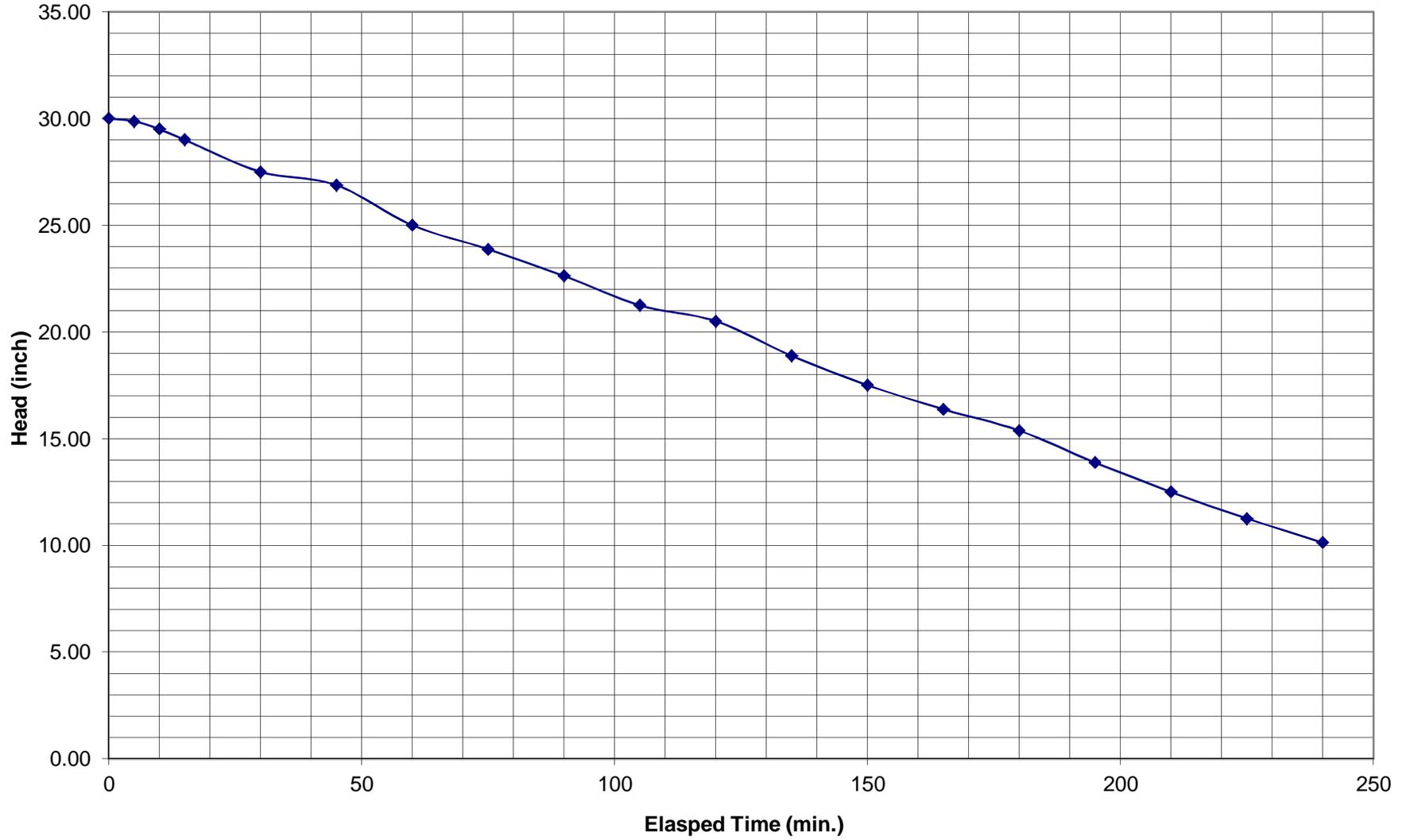
Graves Road Elementary SWM-2 (4 feet)



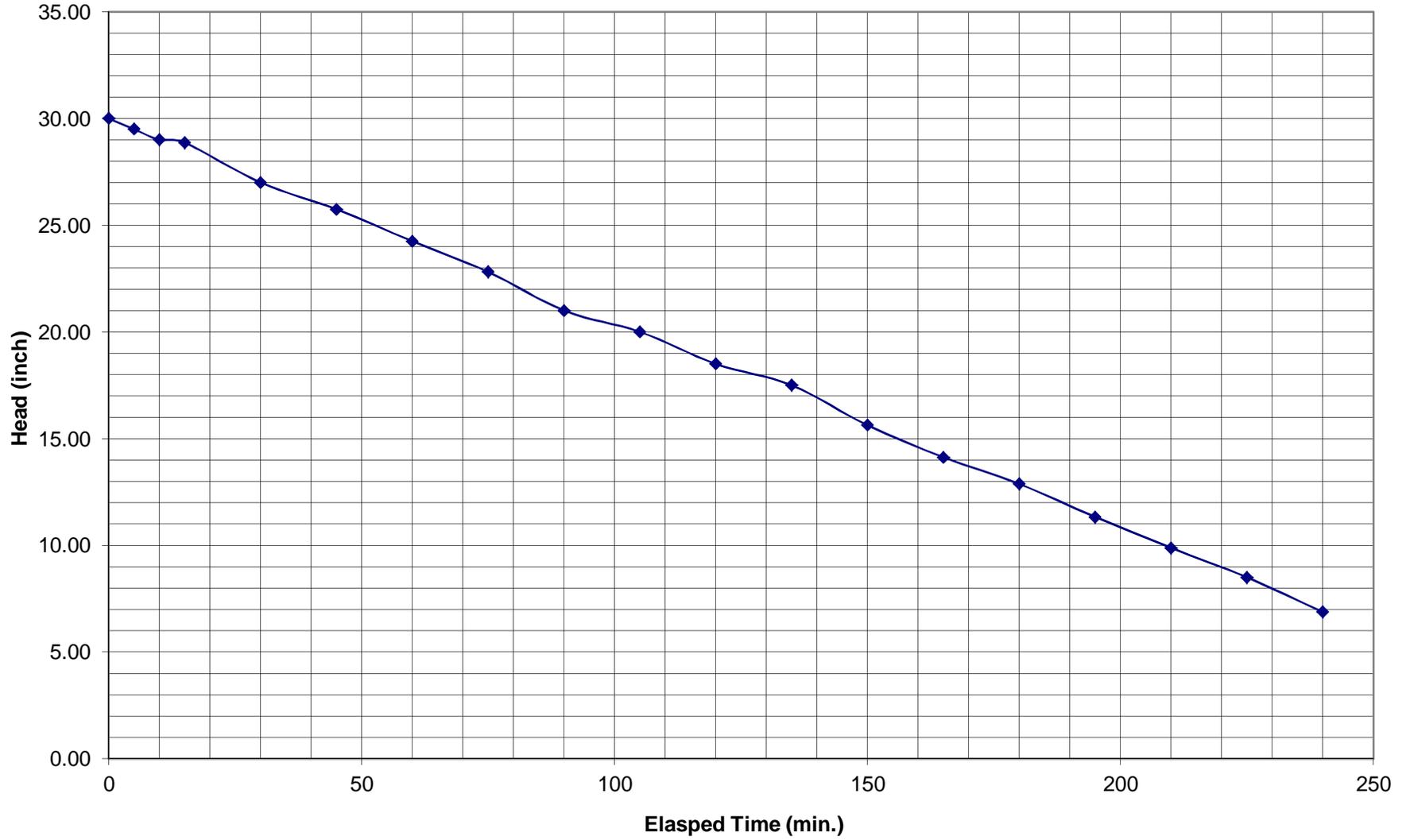
Graves Road Elementary SWM-3 (4 Feet)



Graves Road Elementary SWM-4 (7.5 Feet)



Graves Road Elementary SWM-5 (7.5 Feet)



HILLIS-CARNES ENGINEERING ASSOCIATES, Inc.
12011 Guilford Road, Suite 106 • Annapolis Junction, Maryland 20701
Phone: (410)880-4788 • Fax: (410)880-4098

Description of Soils – per ASTM D2487

Major Component	Component Type	Component Description	Symbol	Group Name
Coarse-Grained Soils , More than 50% is retained on the No. 200 sieve	Gravels – More than 50% of the coarse fraction is retained on the No. 4 sieve. Coarse = 1" to 3" Medium = 1/2" to 1" Fine = 1/4" to 1/2"	Clean Gravels <5% Passing No. 200 sieve	GW	Well Graded Gravel
		Gravels with fines, >12% Passing the No. 200 sieve	GP	Poorly Graded Gravel
			GM	Silty Gravel
		GC	Clayey Gravel	
	Sands – More than 50% of the coarse fraction passes the No. 4 sieve. Coarse = No.10 to No.4 Medium = No. 10 to No. 40 Fine = No. 40 to No. 200	Clean Sands <5% Passing No. 200 sieve	SW	Well Graded Sand
		Sands with fines, >12% Passing the No. 200 sieve	SP	Poorly Graded Sand
			SM	Silty Sand
			SC	Clayey Sand
Fine Grained Soils , More than 50% passes the No. 200 sieve	Silts and Clays Liquid Limit is less than 50 Low to medium plasticity	Inorganic	ML	Silt
		Organic	CL	Lean Clay
	Silts and Clays Liquid Limit of 50 or greater Medium to high plasticity		Inorganic	OL
		OH		Organic Clay
		Organic	MH	Elastic Silt
			CH	Fat Clay
Highly Organic Soils	Primarily Organic matter, dark color, organic odor		PT	Peat

Proportions of Soil Components

Component Form	Description	Approximate percent by weight
Noun	Sand, Gravel, Silt, Clay, etc.	50% or more
Adjective	Sandy, silty, clayey, etc.	35% to 49%
Some	Some sand, some silt, etc.	12% to 34%
Trace	Trace sand, trace mica, etc.	1% to 11%
With	With sand, with mica, etc.	Presence only

Particle Size Identification

Particle Size	Particle dimension
Boulder	12" diameter or more
Cobble	3" to 12" diameter
Gravel	1/4" to 3" diameter
Sand	0.005" to 1/4" diameter
Silt/Clay (fines)	Cannot see particle

Cohesive Soils

Field Description	No. of SPT Blows/ft	Consistency
Easily Molded in Hands	0 – 3	Very Soft
Easily penetrated several inches by thumb	4 – 5	Soft
Penetrated by thumb with moderate effort	6 – 10	Medium
Penetrated by thumb with great effort	11 – 30	Stiff
Indented by thumb only with great effort	Greater than 30	Hard

Granular Soils

No. of SPT Blows/ft	Relative Density
0 – 4	Very Loose
5 – 10	Loose
11 – 30	Medium Dense
31 – 50	Dense
Greater than 50	Very Dense

Other Definitions:

- **Fill:** Encountered soils that were placed by man. Fill soils may be controlled (engineered structural fill) or uncontrolled fills that may contain rubble and/or debris.
- **Saprolite:** Soil material derived from the in-place chemical and physical weathering of the parent rock material. May contain relic structure. Also called residual soils. Occurs in Piedmont soils, found west of the fall line.
- **Disintegrated Rock:** Residual soil material with rock-like properties, very dense, N = 60 to 51/0".
- **Karst:** Descriptive term which denotes the potential for solutioning of the limestone rock and the development of sinkholes.
- **Alluvium:** Recently deposited soils placed by water action, typically stream or river floodplain soils.
- **Groundwater Level:** Depth within borehole where water is encountered either during drilling, or after a set period of time to allow groundwater conditions to reach equilibrium.
- **Caved Depth:** Depth at which borehole collapsed after removal of augers/casing. Indicative of loose soils and/or groundwater conditions.

SECTION 004000 – BID FORM

For Bids Due: October 24, 2013

To: Red Clay Consolidated School District
1502 Spruce Avenue
Wilmington, DE 19805

Bid Package: 2-14-26-07A Roofing

Name of Bidder: _____

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

(Other License Nos.): _____

Phone 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: \$ _____ **Dollars**
(\$ _____)

ALTERNATES – See Specific Scope of Work for complete descriptions of alternate pricing :

Refer to the specifications and specific scope of work for alternates. Not all of the blanks spaces may be required. Alternate prices are to conform to applicable project specification sections or drawing details. An “ADD” or “DEDUCT” amount is indicated by the crossed out part that does not apply. If alternate does not apply to a specific bid package, insert: “Not Applicable”

ALTERNATE NO. 1A: Provide Multi-Purpose Room. Provide construction for multi-purpose room as indicated on A110 series drawings, all disciplines.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 1B: Provide quartz tile flooring in Multi-Purpose Room in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 1C: Provide rubber tile flooring in Multi-Purpose Room in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2A: Provide Second Floor Flex Space. Provide construction for second floor flex space in area framed by column lines D2 to D6 and DF to DJ as indicated on A111 series drawings, all disciplines.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2B: Provide quartz tile flooring in second floor flex space in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2C: Provide rubber tile flooring in second floor flex space in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 3: Provide soccer field grading and seeding and adjacent parking spaces as indicated on drawing C202 and C402.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 4: Provide Standing Seam Metal Roofing System at Gymnasium/Student Dining

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 5A: Provide quartz tile flooring in lieu of VCT flooring in corridors A100, B100, C100A, C100B, C100C, D100, C200, and D200.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 5B: Provide rubber tile flooring in lieu of VCT flooring in corridors A100, B100, C100A, C100B, C100C, D100, C200, and D200.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 6A: Provide quartz tile flooring in lieu of VCT flooring at all classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 6B: Provide rubber tile flooring in lieu of VCT flooring at all classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 7: Provide resilient athletic flooring in lieu of VCT flooring at gym C116 and student dining C114.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 8: Provide terrazzo flooring with patterns in lieu of quartz tile flooring at main lobby A100 and stair C100A.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 9: Provide conventional sheet metal ductwork and duct insulation in lieu of KoolDuct at all concealed ductwork locations.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 10: Provide LED site lighting in lieu of HID site lighting.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 11: Provide interior stone veneer in lieu of interior metal panels at lobby A100 and stair C100A.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 12: Provide stand-by natural gas-fired generator.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 13: Provide additional visual display surfaces in classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 14: Provide 3 color hues per 3 accent colors for flat metal panels type MWP-2 in lieu of 3 solid accent color flat metal panels.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 15: Provide decorative glazed CMU base and concrete lockers bases in lieu of metal locker bases and plates at all lockers in corridors.

Add / Deduct: _____ Dollars
(\$ _____)

UNIT PRICES – See specific Scope of Work for unit pricing description:

Unit prices conform to applicable project specification section. Refer to the specifications and/or specific scope of work for a complete description of required unit prices for this bid package. Not all of the blank spaces below may be required.

None.

I/We acknowledge the receipt of addenda as listed below and the price(s) submitted include any cost/schedule impact they may have.

Addendum Number	Date of Addendum
_____	_____
_____	_____
_____	_____
_____	_____

This bid shall remain valid and cannot be withdrawn for **Sixty (60)** 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 (REQUIRED).

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 complete all the work required in accordance with the project schedule include in specification section 013210. Should I/We be awarded this contract, and should I/We neglect, fail or refuse to complete my/our Work within the time specified in the project schedule, then I/We do hereby agree to pay the owner as liquidated damages the sum of \$1,000 per day. Liquidated damages will be assessed if final completion date, as adjusted by the Construction Manager is not met. Liquidated damages shall apply to all trade contracts. Liquidated damages will be assessed for each day beyond the scheduled date of completion for each trade contractor's item of work. Assessment will occur upon completion of all contracts and may be incurred by one or multiple contractors determined by the Construction Manager.

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: _____
(Authorized Signature)

(Printed Name and Title)

Date: _____

ATTACHMENTS

- Sub-Contractor List (See Section 00435 and any updates by addenda)
- Non-Collusion Statement
- Bid Security (Deposit or Bid Bond)

BID FORM

Bid Package #: 2-14-26-07A Roofing

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.

NOTE: Subcontractor categories specific to each bid package are listed in specification section 00435 and will be updated at the pre-bid meeting and via addendum. If no categories are requested for a bid package, then none are required to be submitted. Refer to specification section 00435 and any addenda that may modify the required listing.

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City & State) & License #</u>
<u>Flat Roofing</u>	_____	City _____ State _____ License # _____
<u>Metal Roofing</u>	_____	City _____ State _____ License # _____

BID FORM

NON-COLLUSION 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 Red Clay Consolidated School District.

All the terms and conditions of Bid #2-14-26 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 _____ 2013

My Commission expires _____. NOTARY PUBLIC _____

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

END OF SECTION 004000

SECTION 004000 – BID FORM

For Bids Due: October 24, 2013

To: Red Clay Consolidated School District
1502 Spruce Avenue
Wilmington, DE 19805

Bid Package: 2-14-26-07C Metal Panels

Name of Bidder: _____

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

(Other License Nos.): _____

Phone 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: \$ _____ **Dollars**
(\$ _____)

ALTERNATES – See Specific Scope of Work for complete descriptions of alternate pricing :

Refer to the specifications and specific scope of work for alternates. Not all of the blanks spaces may be required. Alternate prices are to conform to applicable project specification sections or drawing details. An “ADD” or “DEDUCT” amount is indicated by the crossed out part that does not apply. If alternate does not apply to a specific bid package, insert: “Not Applicable”

ALTERNATE NO. 1A: Provide Multi-Purpose Room. Provide construction for multi-purpose room as indicated on A110 series drawings, all disciplines.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 1B: Provide quartz tile flooring in Multi-Purpose Room in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 1C: Provide rubber tile flooring in Multi-Purpose Room in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2A: Provide Second Floor Flex Space. Provide construction for second floor flex space in area framed by column lines D2 to D6 and DF to DJ as indicated on A111 series drawings, all disciplines.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2B: Provide quartz tile flooring in second floor flex space in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2C: Provide rubber tile flooring in second floor flex space in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 3: Provide soccer field grading and seeding and adjacent parking spaces as indicated on drawing C202 and C402.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 4: Provide Standing Seam Metal Roofing System at Gymnasium/Student Dining

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 5A: Provide quartz tile flooring in lieu of VCT flooring in corridors A100, B100, C100A, C100B, C100C, D100, C200, and D200.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 5B: Provide rubber tile flooring in lieu of VCT flooring in corridors A100, B100, C100A, C100B, C100C, D100, C200, and D200.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 6A: Provide quartz tile flooring in lieu of VCT flooring at all classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 6B: Provide rubber tile flooring in lieu of VCT flooring at all classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 7: Provide resilient athletic flooring in lieu of VCT flooring at gym C116 and student dining C114.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 8: Provide terrazzo flooring with patterns in lieu of quartz tile flooring at main lobby A100 and stair C100A.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 9: Provide conventional sheet metal ductwork and duct insulation in lieu of KoolDuct at all concealed ductwork locations.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 10: Provide LED site lighting in lieu of HID site lighting.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 11: Provide interior stone veneer in lieu of interior metal panels at lobby A100 and stair C100A.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 12: Provide stand-by natural gas-fired generator.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 13: Provide additional visual display surfaces in classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 14: Provide 3 color hues per 3 accent colors for flat metal panels type MWP-2 in lieu of 3 solid accent color flat metal panels.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 15: Provide decorative glazed CMU base and concrete lockers bases in lieu of metal locker bases and plates at all lockers in corridors.

Add / Deduct: _____ Dollars
(\$ _____)

UNIT PRICES – See specific Scope of Work for unit pricing description:

Unit prices conform to applicable project specification section. Refer to the specifications and/or specific scope of work for a complete description of required unit prices for this bid package. Not all of the blank spaces below may be required.

None.

I/We acknowledge the receipt of addenda as listed below and the price(s) submitted include any cost/schedule impact they may have.

Addendum Number	Date of Addendum
_____	_____
_____	_____
_____	_____
_____	_____

This bid shall remain valid and cannot be withdrawn for **Sixty (60)** 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 (REQUIRED).

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 complete all the work required in accordance with the project schedule include in specification section 013210. Should I/We be awarded this contract, and should I/We neglect, fail or refuse to complete my/our Work within the time specified in the project schedule, then I/We do hereby agree to pay the owner as liquidated damages the sum of \$1,000 per day. Liquidated damages will be assessed if final completion date, as adjusted by the Construction Manager is not met. Liquidated damages shall apply to all trade contracts. Liquidated damages will be assessed for each day beyond the scheduled date of completion for each trade contractor's item of work. Assessment will occur upon completion of all contracts and may be incurred by one or multiple contractors determined by the Construction Manager.

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: _____
(Authorized Signature)

(Printed Name and Title)

Date: _____

ATTACHMENTS

- Sub-Contractor List (See Section 00435 and any updates by addenda)
- Non-Collusion Statement
- Bid Security (Deposit or Bid Bond)

BID FORM

Bid Package #: 2-14-26-07C Metal Panels

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.

NOTE: Subcontractor categories specific to each bid package are listed in specification section 00435 and will be updated at the pre-bid meeting and via addendum. If no categories are requested for a bid package, then none are required to be submitted. Refer to specification section 00435 and any addenda that may modify the required listing.

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City & State) & License #</u>
<u>Metal Panels</u>	_____	City _____
		State _____
		License # _____

BID FORM

NON-COLLUSION 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 Red Clay Consolidated School District.

All the terms and conditions of Bid #2-14-26 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 _____ 2013

My Commission expires _____. NOTARY PUBLIC _____

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

END OF SECTION 004000

SECTION 004000 – BID FORM

For Bids Due: October 24, 2013

To: Red Clay Consolidated School District
1502 Spruce Avenue
Wilmington, DE 19805

Bid Package: 2-14-26-08A Glass & Glazing

Name of Bidder: _____

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

(Other License Nos.): _____

Phone 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: \$ _____ **Dollars**
(\$ _____)

ALTERNATES – See Specific Scope of Work for complete descriptions of alternate pricing :

Refer to the specifications and specific scope of work for alternates. Not all of the blanks spaces may be required. Alternate prices are to conform to applicable project specification sections or drawing details. An “ADD” or “DEDUCT” amount is indicated by the crossed out part that does not apply. If alternate does not apply to a specific bid package, insert: “Not Applicable”

ALTERNATE NO. 1A: Provide Multi-Purpose Room. Provide construction for multi-purpose room as indicated on A110 series drawings, all disciplines.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 1B: Provide quartz tile flooring in Multi-Purpose Room in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 1C: Provide rubber tile flooring in Multi-Purpose Room in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2A: Provide Second Floor Flex Space. Provide construction for second floor flex space in area framed by column lines D2 to D6 and DF to DJ as indicated on A111 series drawings, all disciplines.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2B: Provide quartz tile flooring in second floor flex space in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 2C: Provide rubber tile flooring in second floor flex space in lieu of VCT flooring.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 3: Provide soccer field grading and seeding and adjacent parking spaces as indicated on drawing C202 and C402.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 4: Provide Standing Seam Metal Roofing System at Gymnasium/Student Dining

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 5A: Provide quartz tile flooring in lieu of VCT flooring in corridors A100, B100, C100A, C100B, C100C, D100, C200, and D200.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 5B: Provide rubber tile flooring in lieu of VCT flooring in corridors A100, B100, C100A, C100B, C100C, D100, C200, and D200.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 6A: Provide quartz tile flooring in lieu of VCT flooring at all classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 6B: Provide rubber tile flooring in lieu of VCT flooring at all classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 7: Provide resilient athletic flooring in lieu of VCT flooring at gym C116 and student dining C114.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 8: Provide terrazzo flooring with patterns in lieu of quartz tile flooring at main lobby A100 and stair C100A.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 9: Provide conventional sheet metal ductwork and duct insulation in lieu of KoolDuct at all concealed ductwork locations.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 10: Provide LED site lighting in lieu of HID site lighting.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 11: Provide interior stone veneer in lieu of interior metal panels at lobby A100 and stair C100A.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 12: Provide stand-by natural gas-fired generator.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 13: Provide additional visual display surfaces in classrooms.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 14: Provide 3 color hues per 3 accent colors for flat metal panels type MWP-2 in lieu of 3 solid accent color flat metal panels.

Add / Deduct: _____ Dollars
(\$ _____)

ALTERNATE NO. 15: Provide decorative glazed CMU base and concrete lockers bases in lieu of metal locker bases and plates at all lockers in corridors.

Add / Deduct: _____ Dollars
(\$ _____)

UNIT PRICES – See specific Scope of Work for unit pricing description:

Unit prices conform to applicable project specification section. Refer to the specifications and/or specific scope of work for a complete description of required unit prices for this bid package. Not all of the blank spaces below may be required.

None.

I/We acknowledge the receipt of addenda as listed below and the price(s) submitted include any cost/schedule impact they may have.

Addendum Number	Date of Addendum
_____	_____
_____	_____
_____	_____
_____	_____

This bid shall remain valid and cannot be withdrawn for **Sixty (60)** 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 (REQUIRED).

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 complete all the work required in accordance with the project schedule include in specification section 013210. Should I/We be awarded this contract, and should I/We neglect, fail or refuse to complete my/our Work within the time specified in the project schedule, then I/We do hereby agree to pay the owner as liquidated damages the sum of \$1,000 per day. Liquidated damages will be assessed if final completion date, as adjusted by the Construction Manager is not met. Liquidated damages shall apply to all trade contracts. Liquidated damages will be assessed for each day beyond the scheduled date of completion for each trade contractor's item of work. Assessment will occur upon completion of all contracts and may be incurred by one or multiple contractors determined by the Construction Manager.

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: _____
(Authorized Signature)

(Printed Name and Title)

Date: _____

ATTACHMENTS

- Sub-Contractor List (See Section 00435 and any updates by addenda)
- Non-Collusion Statement
- Bid Security (Deposit or Bid Bond)

BID FORM

Bid Package #: 2-14-26-08A Glass & Glazing

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.

NOTE: Subcontractor categories specific to each bid package are listed in specification section 00435 and will be updated at the pre-bid meeting and via addendum. If no categories are requested for a bid package, then none are required to be submitted. Refer to specification section 00435 and any addenda that may modify the required listing.

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City & State) & License #</u>
<u>Glass & Glazing</u>	_____	City _____
		State _____
		License # _____

BID FORM

NON-COLLUSION 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 Red Clay Consolidated School District.

All the terms and conditions of Bid #2-14-26 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 _____ 2013

My Commission expires _____. NOTARY PUBLIC _____

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

END OF SECTION 004000

SECTION 004300 – BID BOND

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 Contract No. _____, to be paid to the **State** for the use and
benefit of _____ (*insert State agency name*) 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 _____ (*insert State agency name*) 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 _____
_____ (*insert State agency name*) 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

SECTION 004320 – REQUIREMENTS FOR APPROVAL FOR LISTING AS A SUBCONTRACTOR

1. Refer to the following section 004350 for any subcontractors or material suppliers to be listed on the bid form.
2. The Construction Manager / Owner will use the following criteria to determine qualifications for any Contractor for listing as a Subcontractor in any trade area:
 - a. The Contractor regularly employs and continuously maintains on his payroll skilled craftsmen in the trade. These skilled craftsmen shall be registered in the trade when such registration is required.
 - b. The Contractor owns the tools and equipment normally associated with the trade.
 - c. The Contractor has previously performed work in the trade which is similar in scope, size, complexity and cost to the proposed construction.
 - d. The Contractor must have or must have applied for a Delaware Business License prior to bidding the project.
3. The Construction Manager / Owner may challenge or disqualify any Contractor based on failure to meet any of the above criteria for qualification for listing as Subcontractor in a trade. Bidders may be required to present such evidence as deemed necessary to evaluate qualifications. The decision to disqualify a Contractor in a given trade shall be made by the Red Clay Consolidated School District and all decisions shall be final.
4. The subcontractor listing is provided for information only to the construction manager and the owner if the subcontractor category was not requested at the pre-bid meeting or requested by the CM or owner.

END OF SECTION 004320

SECTION 004350 – LIST OF SUBCONTRACTORS OR MATERIAL SUPPLIERS

Where the Bidder intends to perform the work with his own forces, his name is listed as a subcontractor.

**This list will be updated via the pre-bid meeting.
Check addenda and bid forms for final listing.**

Fill out the required information on the bid form:

<u>BID PACKAGE #</u>	<u>BID PACKAGE DESCRIPTION</u>	<u>SUBCONTRACTOR / SUPPLIER CATEGORY TO BE LISTED ON BID FORM</u>
2-14-26-07A	Roofing	Flat Roofing; Metal Roofing
2-14-26-07C	Metal Panels	Metal Panels
2-14-26-08A	Glass & Glazing	Glass & Glazing

END OF SECTION 004350

SECTION 005200 – STANDARD FORM OF AGREEMENT BETWEEN OWNER AND
CONTRACTOR, CONSTRUCTION MANAGER AS ADVISER EDITION (AIA
132 – 2009; 11 PAGES)

END OF SECTION 005200

DRAFT AIA[®] Document A132[™] - 2009

Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition

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)

« »
« »
« »
« »

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

« »
« »
« »
« »

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

«A Blanks»
« »
« »

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

« »
« »
« »
« »

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.

This document is intended to be used in conjunction with AIA Documents A232[™]-2009, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition; B132[™]-2009, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132[™]-2009, Standard Form of Agreement Between Owner and Construction Manager as Adviser.

AIA Document A232[™]-2009 is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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TABLE OF ARTICLES

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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 Modifications, 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, mechanics' liens 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 the 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 one of the following:

(Check the appropriate box.)

Stipulated Sum, in accordance with Section 4.2 below

Cost of the Work plus the Contractor's Fee without a Guaranteed Maximum Price, in accordance with Section 4.3 below

Cost of the Work plus the Contractor's Fee with a Guaranteed Maximum Price, in accordance with Section 4.4 below

(Based on the selection above, complete Section 4.2, 4.3 or 4.4 below. Based on the selection above, also complete either Section 5.1.4, 5.1.5 or 5.1.6 below.)

§ 4.2 Stipulated Sum

§ 4.2.1 The Stipulated Sum shall be << >> (\$ << >>), subject to additions and deletions as provided in the Contract Documents.

§ 4.2.2 The Stipulated Sum is based on 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.)

<< >>

§ 4.2.3 Unit prices, if any:

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

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

§ 4.2.4 Allowances included in the Stipulated Sum, if any:

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

Item	Allowance

§ 4.3 Cost of the Work Plus Contractor's Fee without a Guaranteed Maximum Price

§ 4.3.1 The Contract Sum is the Cost of the Work as defined in Exhibit A, Determination of the Cost of the Work, plus the Contractor's Fee.

§ 4.3.2 The Contractor's Fee:

(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee.)

<< >>

§ 4.3.3 The method of adjustment of the Contractor's Fee for changes in the Work:

<< >>

§ 4.3.4 Limitations, if any, on a Subcontractor's overhead and profit for increases in the cost of its portion of the Work:

<< >>

§ 4.3.5 Rental rates for Contractor-owned equipment shall not exceed << >> percent (<< >> %) of the standard rate paid at the place of the Project.

§ 4.3.6 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)

§ 4.3.7 The Contractor shall prepare and submit to the Construction Manager for the Owner, in writing, a Control Estimate within 14 days of executing this Agreement. The Control Estimate shall include the items in Section A.1 of Exhibit A, Determination of the Cost of the Work.

§ 4.4 Cost of the Work Plus Contractor's Fee with a Guaranteed Maximum Price

§ 4.4.1 The Contract Sum is the Cost of the Work as defined in Exhibit A, Determination of the Cost of the Work, plus the Contractor's Fee.

§ 4.4.2 The Contractor's Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee.)

<< >>

§ 4.4.3 The method of adjustment of the Contractor's Fee for changes in the Work:

<< >>

§ 4.4.4 Limitations, if any, on a Subcontractor's overhead and profit for increases in the cost of its portion of the Work:

<< >>

§ 4.4.5 Rental rates for Contractor-owned equipment shall not exceed << >> percent (<< >> %) of the standard rate paid at the place of the Project.

§ 4.4.6 Unit Prices, if any:
(Identify and state the unit price, and state the quantity limitations, if any, to which the unit price will be applicable.)

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

§ 4.4.7 Guaranteed Maximum Price

§ 4.4.7.1 The sum of the Cost of the Work and the Contractor's Fee is guaranteed by the Contractor not to exceed << >> (\$ << >>), subject to additions and deductions by changes in the Work as provided in the Contract Documents. Such maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.

(Insert specific provisions if the Contractor is to participate in any savings.)

« »

§ 4.4.7.2 The Guaranteed Maximum Price is based on the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

« »

§ 4.4.7.3 Allowances included in the Guaranteed Maximum Price, if any:

(Identify and state the amounts of any allowances, and state whether they include labor, materials, or both.)

Item	Allowance

§ 4.4.7.4 Assumptions, if any, on which the Guaranteed Maximum Price is based:

« »

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Construction Manager by the Contractor, and upon certification of the Project Application and Project Certificate for Payment or Application for Payment and Certificate for Payment by the Construction Manager and Architect and issuance 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 Construction Manager not later than the « » day of a month, the Owner shall make payment of the certified amount in the Application for Payment to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Construction Manager after the application date fixed above, payment shall be made by the Owner not later than « » (« ») days after the Construction Manager receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Progress Payments Where the Contract Sum is Based on a Stipulated Sum

§ 5.1.4.1 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 and be prepared in such form and supported by such data to substantiate its accuracy as the Construction Manager and Architect may require. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.4.2 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.

§ 5.1.4.3 Subject to the 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 total 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 may be included as provided in Section 7.3.9 of the General Conditions;

- .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 Construction Manager or Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of the General Conditions.

§ 5.1.4.4 The progress payment amount determined in accordance with Section 5.1.4.3 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 « » percent (« » %) of the Contract Sum, less such amounts as the Construction Manager recommends and the Architect determines for incomplete Work and unsettled claims; and
- .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 the General Conditions.

§ 5.1.4.5 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 5.1.4.3.1 and 5.1.4.3.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

« »

§ 5.1.5 Progress Payments Where the Contract Sum is Based on the Cost of the Work without a Guaranteed Maximum Price

§ 5.1.5.1 With each Application for Payment, the Contractor shall submit the cost control information required in Exhibit A, Determination of the Cost of the Work, along with payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached and any other evidence required by the Owner, Construction Manager or Architect to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor; less (2) that portion of those payments attributable to the Contractor's Fee; plus (3) payrolls for the period covered by the present Application for Payment.

§ 5.1.5.2 Applications for Payment shall show the Cost of the Work actually incurred by the Contractor through the end of the period covered by the Application for Payment and for which the Contractor has made or intends to make actual payment prior to the next Application for Payment.

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

- .1 Take the Cost of the Work as described in Exhibit A, Determination of the Cost of the Work;
- .2 Add the Contractor's Fee, less retainage of « » percent (« » %). The Contractor's Fee shall be computed upon the Cost of the Work described in that Section at the rate stated in that Section; or if the Contractor's Fee is stated as a fixed sum, an amount which bears the same ratio to that fixed-sum Fee as the Cost of the Work bears to a reasonable estimate of the probable Cost of the Work upon its completion;
- .3 Subtract retainage of « » percent (« » %) from that portion of the Work that the Contractor self-performs;
- .4 Subtract the aggregate of previous payments made by the Owner;
- .5 Subtract the shortfall, if any, indicated by the Contractor in the documentation required by Article 5 or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and
- .6 Subtract amounts, if any, for which the Construction Manager or Architect has withheld or withdrawn a Certificate for Payment as provided in Section 9.5 of AIA Document A232™-2009, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition.

§ 5.1.5.4 The Owner, Construction Manager and Contractor shall agree upon (1) a mutually acceptable procedure for review and approval of payments to Subcontractors and (2) the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.

§ 5.1.5.5 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and shall not be deemed to represent that the Construction Manager and Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Article 5 or other supporting data; that the Construction Manager and Architect have made exhaustive or continuous on-site inspections; or that the Construction Manager and Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.

§ 5.1.5.6 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.

§ 5.1.6 Progress Payments Where the Contract Sum is Based on the Cost of the Work with a Guaranteed Maximum Price

§ 5.1.6.1 With each Application for Payment, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner or Architect to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor; less (2) that portion of those payments attributable to the Contractor's Fee; plus (3) payrolls for the period covered by the present Application for Payment.

§ 5.1.6.2 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 and be prepared in such form and supported by such data to substantiate its accuracy as the Construction Manager and Architect may require. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.6.3 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. The percentage of completion shall be the lesser of (1) the percentage of that portion of the Work which has actually been completed; or (2) the percentage obtained by dividing (a) the expense that has actually been incurred by the Contractor on account of that portion of the Work for which the Contractor has made or intends to make actual payment prior to the next Application for Payment by (b) the share of the Guaranteed Maximum Price allocated to that portion of the Work in the schedule of values.

§ 5.1.6.4 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 Guaranteed Maximum Price properly allocable to completed Work as determined by multiplying the percentage of completion of each portion of the Work by the share of the Guaranteed Maximum Price allocated to that portion of the Work in the schedule of values. Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.10 of AIA Document A232-2009;
- .2 Add that portion of the Guaranteed Maximum Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work, or if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing;
- .3 Add the Contractor's Fee, less retainage of « » percent (« » %). The Contractor's Fee shall be computed upon the Cost of the Work at the rate stated in Section 4.4.2 or, if the Contractor's Fee is stated as a fixed sum in that Section, shall be an amount that bears the same ratio to that fixed-sum fee as the Cost of the Work bears to a reasonable estimate of the probable Cost of the Work upon its completion;
- .4 Subtract retainage of « » percent (« » %) from that portion of the Work that the Contractor self-performs;
- .5 Subtract the aggregate of previous payments made by the Owner;

- .6 Subtract the shortfall, if any, indicated by the Contractor in the documentation required by Section 5.1.6.1 to substantiate prior Applications for Payment, or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and
- .7 Subtract amounts, if any, for which the Construction Manager or Architect have withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A232-2009.

§ 5.1.6.5 The Owner and the Contractor shall agree upon a (1) mutually acceptable procedure for review and approval of payments to Subcontractors and (2) the percentage of retainage held on Subcontracts, and the Contractor shall execute subcontracts in accordance with those agreements.

§ 5.1.6.6 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and shall not be deemed to represent that the Construction Manager or Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Section 5.1.6.1 or other supporting data; that the Construction Manager or Architect have made exhaustive or continuous on-site inspections; or that the Construction Manager or Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.

§ 5.1.6.7 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 of AIA Document A232-2009, and to satisfy other requirements, if any, which extend beyond final payment;
- .2 the Contractor has submitted a final accounting for the Cost of the Work, pursuant to Exhibit A, Determination of the Cost of the Work when payment is on the basis of the Cost of the Work, with or without a Guaranteed Maximum payment; and
- .3 a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect; such final payment shall be made by the Owner not more than 30 days after the issuance of the final Certificate for Payment or Project 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 A232-2009, 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.)

« »
« »
« »
« »

§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A232-2009, 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 A232-2009.

[« »] Litigation in a court of competent jurisdiction.

[« »] Other: *(Specify)*

« »

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 Where the Contract Sum is a Stipulated Sum

§ 7.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2009.

§ 7.1.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2009.

§ 7.2 Where the Contract Sum is Based on the Cost of the Work with or without a Guaranteed Maximum Price

§ 7.2.1 Subject to the provisions of Section 7.2.2 below, the Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2009.

§ 7.2.2 The Contract may be terminated by the Owner for cause as provided in Article 14 of AIA Document A232–2009; however, the Owner shall then only pay the Contractor an amount calculated as follows:

- .1 Take the Cost of the Work incurred by the Contractor to the date of termination;
- .2 Add the Contractor's Fee computed upon the Cost of the Work to the date of termination at the rate stated in Sections 4.3.2 or 4.4.2, as applicable, or, if the Contractor's Fee is stated as a fixed sum, an amount that bears the same ratio to that fixed-sum Fee as the Cost of the Work at the time of termination bears to a reasonable estimate of the probable Cost of the Work upon its completion; and
- .3 Subtract the aggregate of previous payments made by the Owner.

§ 7.2.3 If the Owner terminates the Contract for cause when the Contract Sum is based on the Cost of the Work with a Guaranteed Maximum Price, and as provided in Article 14 of AIA Document A232–2009, the amount, if any, to be paid to the Contractor under Section 14.2.4 of AIA Document A232–2009 shall not cause the Guaranteed Maximum Price to be exceeded, nor shall it exceed the amount calculated in Section 7.2.2.

§ 7.2.4 The Owner shall also pay the Contractor fair compensation, either by purchase or rental at the election of the Owner, for any equipment owned by the Contractor that the Owner elects to retain and that is not otherwise included in the Cost of the Work under Section 7.2.1. To the extent that the Owner elects to take legal assignment of subcontracts and purchase orders (including rental agreements), the Contractor shall, as a condition of receiving the payments referred to in this Article 7, execute and deliver all such papers and take all such steps, including the legal assignment of such subcontracts and other contractual rights of the Contractor, as the Owner may require for the purpose of fully vesting in the Owner the rights and benefits of the Contractor under such subcontracts or purchase orders.

§ 7.2.5 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2009; in such case, the Contract Sum and Contract Time shall be increased as provided in Section 14.3.2 of AIA Document A232–2009, except that the term 'profit' shall be understood to mean the Contractor's Fee as described in Sections 4.3.2 and 4.4.2 of this Agreement.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A232–2009 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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<< >>
<< >>
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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:

<< >>

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 A132-2009, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition.

§ 9.1.2 The General Conditions are, AIA Document A232-2009, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition.

§ 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 are:

- .1 AIA Document A132™–2009, Exhibit A, Determination of the Cost of the Work, if applicable.
- .2 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed, or the following:
- .3 AIA Document E202™–2008, Building Information Modeling Protocol Exhibit, if completed, or the following:
- .4 Other documents, if any, listed below:
(List here any additional documents which are intended to form part of the Contract Documents. AIA Document A232–2009 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.)

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A232–2009.
(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A232–2009.)

Type of Insurance or Bond	Limit of Liability or Bond Amount (\$0.00)

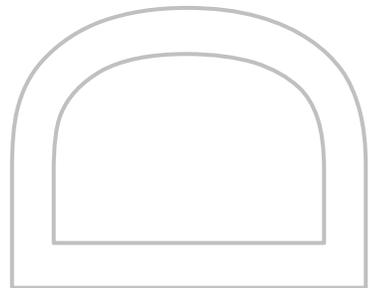
This Agreement is entered into as of the day and year first written above.

OWNER *(Signature)*

(Printed name and title)

CONTRACTOR *(Signature)*

(Printed name and title)



SECTION 005413 – SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR,
CONSTRUCTION MANAGER AS ADVISER EDITION A132-2009

The following supplements modify the “Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition,” AIA Document A132-2009. 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 Construction Manager 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 SECTION 005413

SECTION 006000 – PERFORMANCE BOND

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 _____ (“**Owner**”) (*insert State agency name*), 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 Contract No. _____ 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: _____

(SEAL)
Name:

(Corporate Seal)

By: _____
Name:
Title:

END OF SECTION 006000

SECTION 006100 – PAYMENT BOND

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 _____ (“**Owner**”) (*insert State agency name*), 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 Contract No. _____ 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:

END OF SECTION 006100

SECTION 006200 – APPLICATION & CERTIFICATE FOR PAYMENT (AIA G732 – 2009; 1 PAGE)

END OF SECTION 006200

DRAFT AIA[®] Document G732[™] - 2009

Application and Certificate for Payment, Construction Manager as Adviser Edition

TO OWNER: FROM CONTRACTOR:	PROJECT: A Blanks VIA CONSTRUCTION MANAGER: VIA ARCHITECT:	APPLICATION NO: 001 PERIOD TO: CONTRACT DATE: PROJECT NOS: / /	DISTRIBUTION TO: <table border="1" style="width:100%; border-collapse: collapse;"> <tr><td style="text-align: center;">OWNER</td></tr> <tr><td style="text-align: center;">CONSTRUCTION MANAGER</td></tr> <tr><td style="text-align: center;">ARCHITECT</td></tr> <tr><td style="text-align: center;">CONTRACTOR</td></tr> <tr><td style="text-align: center;">FIELD</td></tr> </table>	OWNER	CONSTRUCTION MANAGER	ARCHITECT	CONTRACTOR	FIELD
OWNER								
CONSTRUCTION MANAGER								
ARCHITECT								
CONTRACTOR								
FIELD								

CONTRACT FOR: General Construction

CONTRACTOR'S APPLICATION FOR PAYMENT

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

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

SUMMARY OF CHANGES IN THE WORK	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	\$0.00	\$0.00
Total approved this month including Construction Change Directives	\$0.00	\$0.00
TOTALS	\$0.00	\$0.00
NET CHANGES IN THE WORK		\$0.00

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: _____

CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on evaluations of the Work and the data comprising this application, the Construction Manager and Architect certify to the Owner that to the best of their 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.)

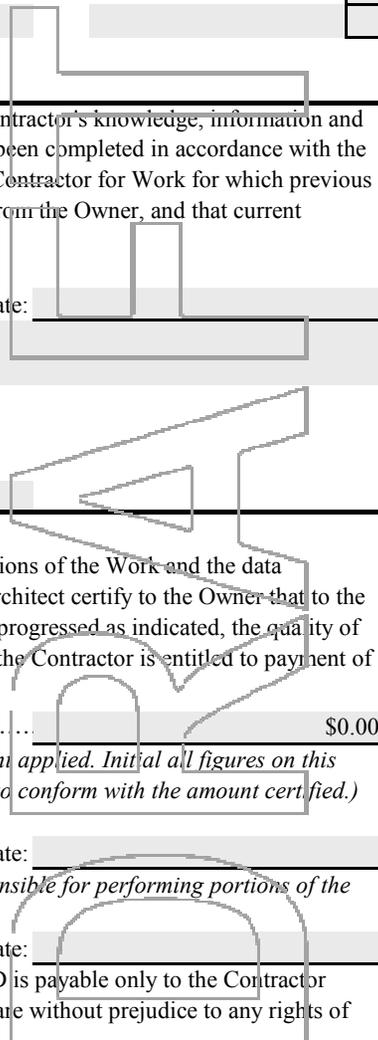
CONSTRUCTION MANAGER:

By: _____ Date: _____

ARCHITECT: (NOTE: If Multiple Prime Contractors are responsible for performing portions of the Project, the Architect's Certification is not required.)

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.



SECTION 006250 – CONTINUATION SHEET FOR G702 (AIA G703 – 1992; 1 PAGE)

END OF SECTION 006250

SECTION 007000 – GENERAL CONDITIONS TO THE CONTRACT FOR CONSTRUCTION
(AIA 232 – 2009; 43 PAGES)

END OF SECTION 007000

DRAFT AIA[®] Document A232[™] - 2009

General Conditions of the Contract for Construction, Construction Manager as Adviser Edition

for the following PROJECT:

(Name, and location or address)

<< >>
<< >>

THE CONSTRUCTION MANAGER:

(Name, legal status and address)

<< >>< >>
<< >>

THE OWNER:

(Name, legal status and address)

<< >>< >>
<< >>

THE ARCHITECT:

(Name, legal status and address)

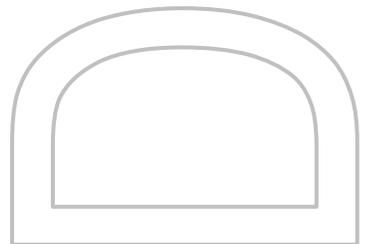
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ADDITIONS AND DELETIONS:

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.

This document is intended to be used in conjunction with AIA Documents A132[™]-2009, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition; B132[™]-2009, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132[™]-2009, Standard Form of Agreement Between Owner and Construction Manager as Adviser.



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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents. The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement), and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of addenda relating to bidding requirements).

§ 1.1.2 The Contract. The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and the Construction Manager or the Construction Manager's consultants, (3) between the Owner and the Architect or the Architect's consultants, (4) between the Contractor and the Construction Manager or the Construction Manager's consultants, (5) between the Owner and a Subcontractor or Sub-subcontractor (6) between the Construction Manager and the Architect, or (7) between any persons or entities other than the Owner and Contractor. The Construction Manager and Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of their duties.

§ 1.1.3 The Work. The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by other Multiple Prime Contractors and by the Owner's own forces, including persons or entities under separate contracts not administered by the Construction Manager.

§ 1.1.5 The Drawings. The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

§ 1.1.6 The Specifications. The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service. Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker. The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 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 only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as “all” and “any” and articles such as “the” and “an,” but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications and Other Instruments of Service

§ 1.5.1 The Architect and the Architect’s consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect, or Architect’s consultants’ reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service 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 the Architect’s consultants.

§ 1.6 Transmission of Data in Digital Form

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner’s approval or authorization. Except as otherwise provided in Article 4, the Construction Manager and the Architect do not have such authority. The term “Owner” means the Owner or the Owner’s authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of or enforce mechanic’s lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner’s interest therein.

§ 2.2 Information and Services Required of the Owner

§ 2.2.1 Prior to commencement of the Work, the Contractor may request in writing that the Owner provide reasonable evidence that the Owner has made financial arrangements to fulfill the Owner’s obligations under the Contract. Thereafter, the Contractor may only request such evidence if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) a change in the Work materially changes the Contract Sum; or (3) the Contractor identifies in writing a reasonable concern regarding the Owner’s ability to make payment when due. The Owner shall furnish such evidence as a condition precedent to commencement or continuation of the Work or

the portion of the Work affected by a material change. After the Owner furnishes the evidence, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.2 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities. Unless otherwise provided under the Contract Documents, the Owner, through the Construction Manager, shall secure and pay for the building permit.

§ 2.2.3 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.2.6 The Owner shall endeavor to forward all communications to the Contractor through the Construction Manager and shall contemporaneously provide the same communications to the Architect about matters arising out of or relating to the Contract Documents.

§ 2.3 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Construction Manager's and Architect's and their respective consultants' additional services made necessary by such default, neglect or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect, after consultation with the Construction Manager. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The plural term "Multiple Prime Contractors" refers to persons or entities who perform construction under contracts with the Owner that are administered by the Construction Manager. The term does not include the Owner's own forces, including persons or entities under separate contracts not administered by the Construction Manager.

§ 3.1.3 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.4 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Construction Manager or Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Construction Manager and Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information submitted to the Construction Manager in such form as the Construction Manager and Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Construction Manager and Architect any nonconformity discovered by or made known to the Contractor as a request for information submitted to Construction Manager in such form as the Construction Manager and Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 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 instruction concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner, the Construction Manager, and the Architect and shall not proceed with that portion of the Work without further written instructions from the Architect, through the Construction Manager. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of the Project already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Architect in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect, in consultation with the Construction Manager, and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

The Contractor warrants to the Owner, Construction Manager, and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform with the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Construction Manager or Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work or portions thereof provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices, and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Owner, through the Construction Manager, shall secure and pay for the building permit. The Contractor shall secure and pay for other permits, fees, licenses and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 **Concealed or Unknown Conditions.** If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner, Construction Manager, and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the conditions. The Architect and

Construction Manager will promptly investigate such conditions and, if the Architect, in consultation with the Construction Manager, determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect, in consultation with the Construction Manager, determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner, Construction Manager, and Contractor in writing, stating the reasons. If the Owner or Contractor disputes the Architect's determination or recommendation, either party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner, Construction Manager, and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents:

- .1 Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner and Architect through the Construction Manager, the name and qualifications of a proposed superintendent. The Construction Manager may reply within 14 days to the Contractor in writing stating (1) whether the Owner, the Construction Manager, or the Architect has reasonable objection to the proposed superintendent or (2) that any of them require additional time to review. Failure of the Construction Manager to reply within the 14 day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner, Construction Manager or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information and the Construction Manager's approval a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at

appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project schedule to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. The Contractor shall cooperate with the Construction Manager in scheduling and performing the Contractor's Work to avoid conflict with, and as to cause no delay in, the work or activities of other Multiple Prime Contractors or the construction or operations of the Owner's own forces.

§ 3.10.2 The Contractor shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter update it as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Construction Manager's and Architect's approval. The Architect and Construction Manager's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Construction Manager and Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall participate with other Contractors, the Construction Manager and Owner in reviewing and coordinating all schedules for incorporation into the Project schedule that is prepared by the Construction Manager. The Contractor shall make revisions to the construction schedule and submittal schedule as deemed necessary by the Construction Manager to conform to the Project schedule.

§ 3.10.4 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner, Construction Manager and Architect and incorporated into the approved Project schedule.

§ 3.11 Documents and Samples at the Site

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These documents shall be available to the Architect and delivered to the Construction Manager for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect and Construction Manager is subject to the limitations of Sections 4.2.9 through 4.2.11. Informational submittals upon which the Construction Manager and Architect are not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Construction Manager or Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Construction Manager Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the Project submittal schedule approved by the Construction Manager and Architect, or in the absence of an approved Project submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of other Multiple Prime Contractors or the Owner's own forces. The Contractor shall cooperate with the Construction Manager in the coordination of the Contractor's Shop Drawings, Product Data, Samples and similar submittals with related documents submitted by other Multiple Prime Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner, Construction Manager, and Architect, that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed and approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Construction Manager and Architect in writing of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Construction Manager and Architect on previous submittals. In the absence of such written notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review, approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.13 Use of Site

§ 3.13.1 The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.2 The Contractor shall coordinate the Contractor's operations with, and secure the approval of, the Construction Manager before using any portion of the site.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner's own forces or of other Multiple Prime Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner's own forces or by other Multiple Prime Contractors except with written consent of the Construction Manager, Owner and such other Multiple Prime Contractors; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the other Multiple Prime Contractors or the Owner the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 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 waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner, or Construction Manager with the Owner's approval, may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner, Construction Manager and Architect access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner, Construction Manager and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner, Architect, or Construction Manager. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect through the Construction Manager.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Construction Manager, Architect, Construction Manager's and Architect's consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 4 ARCHITECT AND CONSTRUCTION MANAGER

§ 4.1 General

§ 4.1.1 The Owner shall retain an architect lawfully licensed to practice architecture or an entity lawfully practicing architecture in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.2 The Owner shall retain a construction manager lawfully licensed to practice construction management or an entity lawfully practicing construction management in the jurisdiction where the Project is located. That person or entity is identified as the Construction Manager in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 4.1.3 Duties, responsibilities and limitations of authority of the Construction Manager and Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Construction Manager, Architect and Contractor. Consent shall not be unreasonably withheld.

§ 4.1.4 If the employment of the Construction Manager or Architect is terminated, the Owner shall employ a successor construction manager or architect as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Construction Manager or Architect, respectively.

§ 4.2 Administration of the Contract

§ 4.2.1 The Construction Manager and Architect will provide administration of the Contract as described in the Contract Documents and will be the Owner's representatives during construction until the date the Architect issues the final Certificate for Payment. The Construction Manager and Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner and Construction Manager (1) known deviations from the Contract Documents and from the most recent Project schedule prepared by the Construction Manager, and (2) defects and deficiencies observed in the Work.

§ 4.2.3 The Construction Manager shall provide a staffing plan to include one or more representatives who shall be in attendance at the Project site whenever the Work is being performed. The Construction Manager will determine in general if the Work observed is being performed in accordance with the Contract Documents, will keep the Owner reasonably informed of the progress of the Work, and will report to the Owner and Architect (1) known deviations from the Contract Documents and the most recent Project schedule, and (2) defects and deficiencies observed in the Work.

§ 4.2.4 The Construction Manager will schedule and coordinate the activities of the Contractor and other Multiple Prime Contractors in accordance with the latest approved Project schedule.

§ 4.2.5 The Construction Manager, except to the extent required by Section 4.2.4, and Architect will not have control over, or charge of, construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1, and neither will be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. Neither the Construction Manager nor the Architect will have control over or charge of or be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or of any other persons or entities performing portions of the Work.

§ 4.2.6 **Communications Facilitating Contract Administration.** Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Construction Manager, and shall contemporaneously provide the same communications to the Architect about matters arising out of or relating to the Contract Documents. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with other Multiple Prime Contractors shall be through the Construction Manager and shall be contemporaneously provided to the Architect if those communications are about matters arising out of or related to the Contract Documents. Communications by and with the Owner's own forces shall be through the Owner.

§ 4.2.7 The Construction Manager and Architect will review and certify all Applications for Payment by the Contractor, in accordance with the provisions of Article 9.

§ 4.2.8 The Architect and Construction Manager have authority to reject Work that does not conform to the Contract Documents and will notify each other about the rejection. The Construction Manager shall determine in general whether the Work of the Contractor is being performed in accordance with the requirements of the Contract Documents and notify the Owner, Contractor and Architect of defects and deficiencies in the Work. Whenever the Construction Manager considers it necessary or advisable, the Construction Manager will have authority to require additional inspection or testing of the Work in accordance with Sections 13.5.2 and 13.5.3, upon written authorization of the Owner, whether or not such Work is fabricated, installed or completed. The foregoing authority of the Construction Manager will be subject to the provisions of Sections 4.2.18 through 4.2.20 inclusive, with respect to interpretations and decisions of the Architect. However, neither the Architect's nor the Construction Manager's authority to act under this Section 4.2.8 nor a decision made by either of them in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect or the Construction Manager to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons performing any of the Work.

§ 4.2.9 The Construction Manager will receive and promptly review for conformance with the submittal requirements of the Contract Documents, all submittals from the Contractor such as Shop Drawings, Product Data and Samples. Where there are Multiple Prime Contractors, the Construction Manager will also check and coordinate the information contained within each submittal received from Contractor and other Multiple Prime Contractors, and transmit to the Architect those recommended for approval. By submitting Shop Drawings, Product Data, Samples and similar submittals, the Construction Manager represents to the Owner and Architect that the Construction Manager has reviewed and recommended them for approval. The Construction Manager's actions will be taken in accordance with the Project submittal schedule approved by the Architect or, in the absence of an approved Project submittal schedule, with reasonable promptness while allowing sufficient time to permit adequate review by the Architect.

§ 4.2.10 The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Upon the Architect's completed review, the Architect shall transmit its submittal review to the Construction Manager.

§ 4.2.11 Review of the Contractor's submittals by the Construction Manager and Architect is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Construction Manager and Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Construction Manager and Architect's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Construction Manager and Architect, of any construction means, methods, techniques, sequences or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.12 The Construction Manager will prepare Change Orders and Construction Change Directives.

§ 4.2.13 The Construction Manager and the Architect will take appropriate action on Change Orders or Construction Change Directives in accordance with Article 7. and the Architect will have authority to order minor changes in the Work as provided in Section 7.4. The Architect, in consultation with the Construction Manager, will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.14 Utilizing the documents provided by the Contractor, the Construction Manager will maintain at the site for the Owner one copy of all Contract Documents, approved Shop Drawings, Product Data, Samples and similar

required submittals, in good order and marked currently to record all changes and selections made during construction. These will be available to the Architect and the Contractor, and will be delivered to the Owner upon completion of the Project.

§ 4.2.15 The Construction Manager will assist the Architect in conducting inspections to determine the dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion in conjunction with the Architect pursuant to Section 9.8; and receive and forward to the Owner written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10. The Construction Manager will forward to the Architect a final Application and Certificate for Payment or final Project Application and Project Certificate for Payment upon the Contractor's compliance with the requirements of the Contract Documents.

§ 4.2.16 If the Owner and Architect agree, the Architect will provide one or more project representatives to assist in carrying out the Architect's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.17 The Architect will interpret and decide matters concerning performance under, and requirements of the Contract Documents on written request of the Construction Manager, Owner or Contractor through the Construction Manager. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.18 Interpretations and decisions of the Architect will be consistent with the intent of and reasonably inferable from the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions so rendered in good faith.

§ 4.2.19 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.20 The Construction Manager will receive and review requests for information from the Contractor, and forward each request for information to the Architect, with the Construction Manager's recommendation. The Architect will review and respond in writing to the Construction Manager to requests for information about the Contract Documents. The Construction Manager's recommendation and the Architect's response to each request will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include other Multiple Prime Contractors or subcontractors of other Multiple Prime Contractors.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Construction Manager for review by the Owner, Construction Manager and Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each principal portion of the Work. The Construction Manager may reply within 14 days to the Contractor in writing stating (1) whether the Owner, the Construction Manager or the Architect has reasonable objection to any such proposed person or entity or, (2) that the

Construction Manager, Architect or Owner requires additional time for review. Failure of the Construction Manager, Owner, or Architect to reply within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner, Construction Manager or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner, Construction Manager or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner, Construction Manager or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner, Construction Manager or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner, Construction Manager and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner, Construction Manager and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor Contractor or other entity. If the Owner assigns the subcontract to a successor Contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor Contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY OTHER CONTRACTORS

§ 6.1 Owner's Right to Perform Construction with Own Forces and to Award Other Contracts

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, which include persons or entities under separate contracts not administered by the Construction Manager, and to award other contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such Claim as provided in Article 15.

§ 6.1.2 When the Owner performs construction or operations with the Owner's own forces including persons or entities under separate contracts not administered by the Construction Manager, the Owner shall provide for coordination of such forces with the Work of the Contractor, who shall cooperate with them.

§ 6.1.3 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11 and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner's own forces, Construction Manager and other Multiple Prime Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner's own forces or other Multiple Prime Contractors, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Construction Manager and Architect apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the Owner's own forces or other Multiple Prime Contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs, including costs that are payable to a separate contractor or to other Multiple Prime Contractors because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of delays, improperly timed activities, damage to the Work or defective construction by the Owner's own forces or other Multiple Prime Contractors.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner, separate contractors, or other Multiple Prime Contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and other Multiple Prime Contractors shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, other Multiple Prime Contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Construction Manager, with notice to the Architect, will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Construction Manager, Architect and Contractor; a Construction Change Directive requires agreement by the Owner, Construction Manager and Architect and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 Change Orders

A Change Order is a written instrument prepared by the Construction Manager and signed by the Owner, Construction Manager, Architect and Contractor, stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Construction Manager and signed by the Owner, Construction Manager and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.7.

§ 7.3.4 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed in a proposed Change Order or Construction Change Directive so that application of such unit prices to quantities of Work proposed will cause substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Construction Manager and Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Construction Manager shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Construction Manager may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

- .1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers compensation insurance;
- .2 Costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use or similar taxes related to the Work; and
- .5 Additional costs of supervision and field office personnel directly attributable to the change.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Construction Manager and Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Construction Manager and Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Construction Manager and Architect determine to be reasonably justified. The interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Construction Manager and Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Construction Manager shall prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be effected by written order issued through the Construction Manager and shall be binding on the Owner and Contractor.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner, Owner's own forces, Construction Manager, Architect, any of the other Multiple Prime Contractors or an employee of any of them, or by changes ordered in the Work, or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control; or by delay authorized by the Owner pending mediation and arbitration, or by other causes that the Architect, based on the recommendation of the Construction Manager, determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.2 Schedule of Values

Where the Contract is based on a Stipulated Sum or Guaranteed Maximum Price, the Contractor shall submit to the Construction Manager, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Construction Manager and Architect may require. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. In the event there is one Contractor, the Construction Manager shall forward to the Architect the Contractor's schedule of values. If there are Multiple Prime Contractors responsible for performing different portions of the Project, the Construction Manager shall forward the Multiple Prime Contractors' schedules of values only if requested by the Architect.

§ 9.3 Applications for Payment

§ 9.3.1 At least fifteen days before the date established for each progress payment, the Contractor shall submit to the Construction Manager an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner, Construction Manager or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Construction Manager and Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for

Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 Where there is only one Contractor, the Construction Manager will, within seven days after the Construction Manager's receipt of the Contractor's Application for Payment, review the Application, certify the amount the Construction Manager determines is due the Contractor, and forward the Contractor's Application and Certificate for Payment to the Architect. Within seven days after the Architect receives the Contractor's Application for Payment from the Construction Manager, the Architect will either issue to the Owner a Certificate for Payment, with a copy to the Construction Manager, for such amount as the Architect determines is properly due, or notify the Construction Manager and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1. The Construction Manager will promptly forward to the Contractor the Architect's notice of withholding certification.

§ 9.4.2 Where there are Multiple Prime Contractors performing portions of the Project, the Construction Manager will, within seven days after the Construction Manager receives the Multiple Prime Contractors' Applications for Payment: (1) review the Applications and certify the amount the Construction Manager determines is due each of the Multiple Prime Contractors; (2) prepare a Summary of Contractors' Applications for Payment by combining information from each Multiple Prime Contractors' application with information from similar applications for progress payments from other Multiple Prime Contractors; (3) prepare a Project Application and Certificate for Payment; (4) certify the amount the Construction Manager determines is due all Multiple Prime Contractors; and (5) forward the Summary of Contractors' Applications for Payment and Project Application and Certificate for Payment to the Architect.

§ 9.4.3 Within seven days after the Architect receives the Project Application and Project Certificate for Payment and the Summary of Contractors' Applications for Payment from the Construction Manager, the Architect will either issue to the Owner a Project Certificate for Payment, with a copy to the Construction Manager, for such amount as the Architect determines is properly due, or notify the Construction Manager and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 9.5.1. The Construction Manager will promptly forward the Architect's notice of withholding certification to the Contractors.

§ 9.4.4 The Construction Manager's certification of an Application for Payment or, in the case of Multiple Prime Contractors, a Project Application and Certificate for Payment shall be based upon the Construction Manager's evaluation of the Work and the information provided as part of the Application for Payment. The Construction Manager's certification will constitute a representation that, to the best of the Construction Manager's knowledge, information and belief, the Work has progressed to the point indicated and the quality of the Work is in accordance with the Contract Documents. The certification will also constitute a recommendation to the Architect and Owner that the Contractor be paid the amount certified.

§ 9.4.5 The Architect's issuance of a Certificate for Payment or in the case of Multiple Prime Contractors, Project Application and Certificate for Payment, shall be based upon the Architect's evaluation of the Work, the recommendation of the Construction Manager, and information provided as part of the Application for Payment or Project Application for Payment. The Architect's certification will constitute a representation that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated, that the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified.

§ 9.4.6 The representations made pursuant to Sections 9.4.4 and 9.4.5 are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Construction Manager or Architect.

§ 9.4.7 The issuance of a separate Certificate for Payment or a Project Certificate for Payment will not be a representation that the Construction Manager or Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed the Contractor's construction means, methods, techniques,

sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Construction Manager or Architect may withhold a Certificate for Payment or Project Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Construction Manager's or Architect's opinion the representations to the Owner required by Section 9.4.4 and 9.4.5 cannot be made. If the Construction Manager or Architect is unable to certify payment in the amount of the Application, the Construction Manager will notify the Contractor and Owner as provided in Section 9.4.1 and 9.4.3. If the Contractor, Construction Manager and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment or a Project Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Construction Manager or Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of a Certificate for Payment or Project Certificate for Payment previously issued, to such extent as may be necessary in the Construction Manager's or Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from the acts and omissions described in Section 3.3.2 because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a separate contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 If the Architect or Construction Manager withholds certification for payment under Section 9.5.1, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Construction Manager and both will reflect such payment on the next Certificate for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment or Project Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Construction Manager and Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Construction Manager will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Owner, Construction Manager and Architect on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. Neither the Owner, Construction Manager nor

Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 Failure of Payment

If the Construction Manager and Architect do not issue a Certificate for Payment or a Project Certificate for Payment, through no fault of the Contractor, within fourteen days after the Construction Manager's receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents the amount certified by the Construction Manager and Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' written notice to the Owner, Construction Manager and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Construction Manager, and the Contractor and Construction Manager shall jointly prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the list, the Architect, assisted by the Construction Manager, will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the list, which is not sufficiently complete in accordance with the requirements of the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect, assisted by the Construction Manager, to determine Substantial Completion.

§ 9.8.4 When the Architect, assisted by the Construction Manager, determines that the Work or designated portion thereof is substantially complete, the Construction Manager will prepare, and the Construction Manager and Architect shall execute a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor and Construction Manager shall jointly prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect after consultation with the Construction Manager.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Construction Manager, Contractor and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon completion of the Work, the Contractor shall forward to the Construction Manager a written notice that the Work is ready for final inspection and acceptance and shall also forward to the Construction Manager a final Contractor's Application for Payment. Upon receipt, the Construction Manager will evaluate the completion of Work of the Contractor and then forward the notice and Application, with the Construction Manager's recommendations, to the Architect who will promptly make such inspection. When the Architect, finds the Work acceptable under the Contract Documents and the Contract fully performed, the Construction Manager and Architect will promptly issue a final Certificate for Payment or Project Certificate for Payment stating that to the best of their knowledge, information and belief, and on the basis of their on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Construction Manager's and Architect's final Certificate for Payment or Project Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect through the Construction Manager (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Construction Manager and Architect so confirm, the Owner shall, upon application by the Contractor and certification by the Construction Manager and Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect through the Construction Manager prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents; or
- .3 terms of special warranties required by the Contract Documents.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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 submit the Contractor's safety program to the Construction Manager for review and coordination with the safety programs of other Contractors.

The Construction Manager's responsibilities for review and coordination of safety programs shall not extend to direct control over or charge of the acts or omissions of the Contractors, Subcontractors, agents or employees of the Contractors or Subcontractors, or any other persons performing portions of the Work and not directly employed by the Construction Manager.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors;
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction; and
- .4 construction or operations by the Owner or other Contractors.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly

employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4, except damage or loss attributable to acts or omissions of the Owner, Construction Manager or Architect or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner, Construction Manager and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to, asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner, Construction Manager and Architect in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify a presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor, Construction Manager and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor, the Construction Manager and the Architect will promptly reply to the Owner in writing stating whether or not any of them has reasonable objection to the persons or entities proposed by the Owner. If the Contractor, Construction Manager or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor, the Construction Manager and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resumed upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Construction Manager, Architect, their consultants, and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is not due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Liability Insurance

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- .1 Claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;
- .2 Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- .3 Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- .4 Claims for damages insured by usual personal injury liability coverage;
- .5 Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- .6 Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle; and
- .7 Claims for bodily injury or property damage arising out of completed operations; and
- .8 Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance acceptable to the Owner shall be submitted to the Construction Manager for transmittal to the Owner with a copy to the Architect prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. An additional certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Construction Manager, the Construction Manager's consultants, the Owner, the Architect, and the Architect's

consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; 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

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 11.3 Property Insurance

§ 11.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance written on a builder's risk "all risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and Sub-subcontractors in the Project.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for the Architect's, Contractor's, and Construction Manager's services and expenses required as a result of such insured loss.

§ 11.3.1.2 If the Owner does not intend to purchase such property insurance required by the Contract and with all of the coverages in the amount described above, the Owner shall so inform the Contractor in writing prior to commencement of the Work. The Contractor may then effect insurance that will protect the interests of the Contractor, Subcontractors and Sub-subcontractors in the Work, and by appropriate Change Order the cost thereof shall be charged to the Owner. If the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain insurance as described above, without so notifying the Contractor in writing, then the Owner shall bear all reasonable costs properly attributable thereto.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Owner and the Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 **Boiler and Machinery Insurance.** The Owner shall purchase and maintain boiler and machinery insurance required by the Contract Documents or by law, which shall specifically cover such insured objects during installation and until final acceptance by the Owner; this insurance shall include interests of the Owner, Construction Manager, Contractor, Subcontractors and Sub-subcontractors in the Work, and the Owner and Contractor shall be named insureds.

§ 11.3.3 **Loss of Use Insurance.** The Owner, at the Owner's option, may purchase and maintain such insurance as will insure the Owner against loss of use of the Owner's property due to fire or other hazards, however caused. The Owner waives all rights of action against the Contractor for loss of use of the Owner's property, including consequential losses due to fire or other hazards however caused.

§ 11.3.4 If the Contractor requests in writing that insurance for risks other than those described herein or other special causes of loss be included in the property insurance policy, the Owner shall, if possible, include such insurance, and the cost thereof shall be charged to the Contractor by appropriate Change Order.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, adjoining or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Owner shall file with the Contractor a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 11.3.7 **Waivers of Subrogation.** The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees each of the other, and (2) the Construction Manager, Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as the Owner and Contractor may have to the proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Construction Manager, Construction Manager's consultants, Architect, Architect's consultants, Owner's separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Owner's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

§ 11.3.10 The Owner as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Owner's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement. If the Owner and Contractor have selected arbitration as the method of binding dispute resolution, the Owner as fiduciary shall make settlement with insurers or distribution of insurance proceeds in accordance with the direction of the arbitrators.

§ 11.4 Performance Bond and Payment Bond

§ 11.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Construction Manager's or Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by either, be uncovered for their observation and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered which the Construction Manager or Architect has not specifically requested to observe prior to its being covered, the Construction Manager or Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or one of the other Contractors in which event the Owner shall be responsible for payment of such costs.

§ 12.2 Correction of Work

§ 12.2.1 Before or After Substantial Completion

The Contractor shall promptly correct Work rejected by the Construction Manager or Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Construction Manager's and Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-year period shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors or other Multiple Prime Contractors caused by the

Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located except that, if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 Written Notice

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity or to an officer of the corporation for which it was intended; or if delivered at or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice.

§ 13.4 Rights and Remedies

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Construction Manager, Architect or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

§ 13.5 Tests and Inspections

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Construction Manager and Architect timely notice of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and

(2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Construction Manager, Architect, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Construction Manager and Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Construction Manager and Architect of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. Such costs except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Construction Manager's and Architect's services and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Construction Manager for transmittal to the Architect.

§ 13.5.5 If the Construction Manager or Architect is to observe tests, inspections or approvals required by the Contract Documents, the Construction Manager or Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 Interest

Payments due and unpaid under the Contract Documents shall bear interest from 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.

§ 13.7 Time Limits on Claims

The Owner and the Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and the Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency that requires all Work to be stopped;
- .3 Because the Construction Manager has not certified or the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor promptly, upon the Contractor's request, reasonable evidence as required by Section 2.2.1.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, repeated suspensions, delays or interruptions of the entire Work by the Owner as described in Section 14.3 constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' written notice to the Owner, Construction Manager and Architect, terminate the Contract and recover from the Owner payment for Work executed including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' written notice to the Owner, Construction Manager and Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, after consultation with the Construction Manager, and upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Construction Manager's and Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall, upon application, be certified by the Initial Decision Maker after consultation with the Construction Manager, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and the Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent:

- .1 that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of this Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 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 costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 Notice of Claims. Claims by either the Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Construction Manager and Architect, if the Construction Manager and or Architect is not serving as the Initial Decision Maker. Claims by either party must be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 Continuing Contract Performance. Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Construction Manager will prepare Change Orders and the Architect will issue a Certificate for Payment or Project Certificate for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 Claims for Additional Cost. If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.3.

§ 15.1.5 Claims for Additional Time

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.6 Claims for Consequential Damages. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 10.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of such request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect and Construction Manager, if the Architect or Construction Manager is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of an initial decision, demand in writing that the other party file for mediation within 60 days of the initial decision. If such a demand is made and the party receiving the demand fails to file for mediation within the time required, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Either party, at its sole discretion, may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as the Owner and Contractor under this Agreement.

SECTION 007300 – SUPPLEMENTARY GENERAL CONDITIONS TO THE CONTRACT

SUPPLEMENTARY GENERAL CONDITIONS A232-2009

The following supplements modify the “General Conditions of the Contract for Construction,” AIA Document A232-2009. 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
3. CONTRACTOR
4. ADMINISTRATION OF THE CONTRACT
5. SUBCONTRACTORS
6. CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
7. CHANGES IN THE WORK
8. TIME
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 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.”

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. .”

Delete Paragraph 1.5.2 in its entirety.

ARTICLE 2: OWNER

2.1 General

2.1.2 Delete Paragraph 2.1.2 in its entirety.

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.2.1 Delete the last sentence in this paragraph.

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.”

2.2.5 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

Delete the third sentence in Paragraph 3.2.4.

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 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 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 warrant all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for one year after Acceptance by the Owner, and will maintain all items in condition that conforms with the Contract Documents during the period of warranty.
- 3.5.2 Non-conforming work during the period of warranty will be corrected by the Contractor at its expense upon demand of the Owner, it being required that the Work conforms to the Contract Documents at the expiration of the warranty period.
- 3.5.3 In addition to the General Warranty there are other warranties required for certain items for different periods of time than the one year as above, and are particularly so stated in that part of the specifications referring to same. The said warranties will commence at the same time as the General Warranty.
- 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 second sentence of the paragraph, insert “indemnify and” between “shall” and “hold”.

ARTICLE 4: ARCHITECT AND CONSTRUCTION MANAGER

4.1 General

4.1.2 Insert “As required by law,” at the beginning of the first sentence.

4.2 Administration of the Contract

Delete the first sentence of Paragraph 4.2.10 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 4.2.10 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 to Paragraph 4.2.16:

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

Add to Paragraph 4.2.19 “and in compliance with all applicable codes, regulations and ordinances.” 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, Architect or Construction Manager has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner, Architect or Construction Manager 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 6.1.3 in its entirety and replace with the following:

“When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term “Contractor” in the Contract Documents in each case shall mean the Constructor who executes each separate Owner-Contractor Agreement.”

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 its rights under the Contract.
- 8.3.5 The parties agree that Paragraph 8.3.3 of the Supplementary General Conditions does not apply to the Construction Manager in the event of a delay caused by a party other than the Construction Manager.

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 G732, Continuation Sheet G703.

9.3 APPLICATIONS FOR PAYMENT

Add the following Paragraph:

- 9.3.1.3 Application for Payment shall be submitted on AIA Document G732 “Application and Certificate for Payment, Construction Manager as Adviser Edition”, supported by AIA Document G703. 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 and the Construction Manager have 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 the first reference to "seven" and insert "thirty (30)". Also strike "binding dispute resolution" and insert "remedies at law or in equity".

9.8 SUBSTANTIAL COMPLETION

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 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.

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 and its subparagraphs in their entirety and replace with the following:

11.3 The Owner 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

11.4.1 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.

12.2.2.2 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.”

Insert “except that, if the parties have selected arbitration as the method of dispute resolution, the Delaware Arbitration Act, 10 Del. C. §5701, 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

15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

Delete Paragraph 15.1.6 and its subparagraphs in their 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,”. Also strike “binding dispute resolution” and insert “remedies at law and in equity”.

15.4 ARBITRATION

Delete Paragraph 15.4 and its subparagraphs in their entirety.

END OF SUPPLEMENTARY GENERAL CONDITIONS TO THE CONTRACT

SECTION 007350 – 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 materiel or performing labor in the performance of the Contract, of all sums of money due the person for such labor and materiel. (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 judgment 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. Should I/We be awarded this contract, I/We pledge to complete all the work required in accordance with the project schedule include in specification section 013210. Should I/We be awarded this contract, and should I/We neglect, fail or refuse to complete my/our Work within the time specified in the project schedule, then I/We do hereby agree to pay the owner as liquidated damages the sum of \$1,000 per day. Liquidated damages will be assessed if final completion date, as adjusted by the Construction Manager is not met. Liquidated damages shall apply to all trade contracts. Liquidated damages will be assessed for each day beyond the scheduled date of completion for each trade contractor's item of work. Assessment will occur upon completion of all contracts and may be incurred by one or multiple contractors determined by the Construction Manager.
- 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 \$1,000,000 \$1,000,000	for each person for each occurrence aggregate
Property Damage	\$500,000 \$1,000,000	for each occurrence aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

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

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 SECTION 007350

DATE _____

I, _____
(Name of signatory party) (Title)

do hereby state:

1. That I pay or supervise the payment of persons employed by
_____ on the
(Contractor or Subcontractor)

(public project)

that during the payroll period commencing on the _____ day of
_____, 20____ and ending on the _____ day of
_____, 20____ all persons employed on said project

have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of the contractor or subcontractor from the full weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in the prevailing wage regulations of the State of Delaware.

2. That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than applicable wage rates contained in any wage determination incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work performed.

3. That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a state apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, and that the worksite ratio of apprentices to mechanics does not exceed the ratio permitted by the prevailing wage regulations of the State of Delaware.

List only those fringe benefits:

For which the employer has paid; and
Which have been used to offset the full prevailing wage rate.

(See Delaware Prevailing Wage Regulations for explanation of how hourly value of benefits is to be computed.)

HOURLY COST OF BENEFITS							
(List in same order shown on front of record)							
Employee							
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							

I hereby certify that the foregoing information is true and correct to the best of my knowledge and belief. I realize that making a false statement under oath is a crime in State of Delaware

Signature

STATE OF _____

COUNTY OF _____

SWORN TO AND SUBSCRIBED BEFORE ME, A NOTARY PUBLIC,

THIS _____ DAY OF _____, A.D. 20_____.

Notary Public

An employer who fails to submit sworn payroll information to the Department of Labor weekly shall be subject to fines of \$1,000.00 and \$5,000. for each violation.

SECTION 007400 – DELAWARE PREVAILING WAGE RATES & REPORTING FORM

ATTACHMENTS:

1. Delaware Department of Labor Payroll Report Form
2. Delaware Department of Labor Prevailing Wage Rates for Building Construction
 - Included by Reference: The State of Delaware Prevailing Wage Rate Regulations. A copy is available from the Department of Labor by calling 302-761-8200 or online on the State of Delaware's website. Contractors are required to abide by all requirements issued by the State relating to prevailing wage regulations.
 - Contractors are required to submit payroll reports to the Department of Labor. Refer to the State Prevailing Wage regulations and the instructions to bidders section 00200 Article 4.5.

END OF SECTION 007400

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

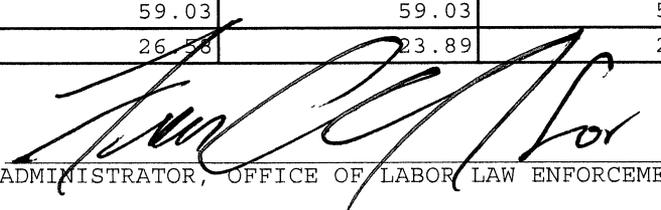
Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

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: 5/3/13

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: William F. Cook Elementary School, New Castle County

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work by Owner.
4. Work under separate contracts.
5. Owner-furnished products.
6. Access to site.
7. Work restrictions.
8. Specification and drawing conventions.
9. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: William F. Cooke, Jr. Elementary School.

1. Project Location: 2025 Graves Road, Hockessin, Delaware 19707.

B. Owner: Red Clay Consolidated School District.

1. Owner's Representative: Marcin Michalski, Manager of Facilities and Maintenance, 1798 Limestone Road, Wilmington, DE 19804, (302) 892-3284.

C. Architect: Becker Morgan Group, Inc., 309 S. Governors Avenue, Dover, DE 19904, (302) 734-7950 | 312 West Main Street, Suite 300, Salisbury, MD 21801, (410) 546-9100.

D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Fire Protection, Plumbing, Mechanical, Electrical, and Information Technology Engineers: Studio JAED, 2500 Wrangle Hill Road, Fox Run Office Plaza, Suite 110, Bear, DE 19701, (302) 832-1652.

2. Structural Engineer: Baker, Ingram & Associates: 1050S. State Street, Dover, DE 19901, (302) 734-7400.
 3. Food Services Consultant: Nyikos Associates, Inc., 18219-A Flower Hill Way, Gaithersburg, MD 20879, (240) 683-9530.
- E. Construction Manager: The Whiting-Turner Contracting Company, 131 Continental Drive, Suite 404, Newark, DE 19731, (302) 292-0676.
1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for Construction between Owner and each Contractor, according to a separate contract between Owner and Construction Manager.
 2. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.
- F. Project Web Site: A project Web site administered by Construction Manager will be used for purposes of managing communication and documents during the construction stage.
1. See Section 013100 "Project Management and Coordination." for requirements for using the Project Web site.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
1. The new construction of a two-story elementary educational facility and associated site work.
- B. Type of Contract:
1. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a description of work included under each of the multiple contracts and for the responsibilities of Project coordinator. Contracts for this Project include the following:
 - a. Contract 03A - Concrete.
 - b. Contract 04A - Masonry.
 - c. Contract 05A - Steel.
 - d. Contract 06A - Carpentry.
 - e. Contract 07A - Roofing.
 - f. Contract 07B - Caulking
 - g. Contract 07C - Metal Panels.
 - h. Contract 07D - Spray Insulation.
 - i. Contract 08A - Glass.
 - j. Contract 09A - Stud and Drywall.
 - k. Contract 09B - Ceilings.
 - l. Contract 09C - Flooring.
 - m. Contract 09D - Paint.
 - n. Contract 09E - Epoxy Floor.
 - o. Contract 11A - Kitchen Equipment.
 - p. Contract 11B - Gym Equipment.
 - q. Contract 12A - Casework.
 - r. Contract 12B - Window Treatments.
 - s. Contract 14A - Elevator.
 - t. Contract 21A - Sprinklers.

- u. Contract 23A – Mechanical.
- v. Contract 23B – Balancing.
- w. Contract 26A – Electrical.
- x. Contract 31A – Sitework.
- y. Contact 31B – Landscaping.

1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.
 - 1. Owner's Contractor(s) will install all Furniture, Fixtures, and Equipment not included under the construction contract, but requires coordination with in place work.
 - 2. Owner's Contractor(s) will install all Patch Cabling except for Wireless Access Points, all Ethernet and FO switches, and all TV Tuners.

1.6 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 contracts for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 - 1. Security & CCTV Systems Equipment and Installation: ADT Security, (302) 395-3515.
 - 2. Card Access System Equipment and Installation: Advantech, Inc., (302) 674-8405.
 - 3. Phone System Equipment and Installation: Collins Business Systems, Inc., (302) 658-1700.

1.7 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- B. Owner-Furnished Products:
 - 1. Residential Appliances.
 - 2. Toilet Accessory Dispensers: Soap, Paper Towel and Toilet Tissue.
 - 3. Kiln.
 - 4. Wireless Access Points (WAPs).
 - 5. WAP Covers.
 - 6. Interactive Projectors.
 - 7. Rear Projector at Stage.
 - 8. Kiosk at Administration Office.
 - 9. MDF Racks (2).
 - 10. IDF 1A Rack (1)
 - 11. Televisions.

1.8 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.
 - 1. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet (12.2 m) beyond building perimeter; 10 feet (3 m) beyond surface walkways, patios, surface parking, and utilities less than 12 inches (300 mm) in diameter; 15 feet (4.5 m) beyond primary roadway curbs and main utility branch trenches; and 25 feet (7.6 m) beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.

1.9 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. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- C. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- D. 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.

1.10 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 011200– SUMMARY OF CONTRACTS / SCOPES OF WORK

Bid Packages: The following is a list of Bid Packages for the RCCSD – William F. Cooke Elementary School:

UNIT OF WORK #	TITLE	BRIEF DESCRIPTION (See Specific Scope for full Description)
01A	General Scope of Work	General Scope of Work Applicable to All Trades
07A	Roofing	Metal roofing, flat roofing, roof insulation, roof blocking, copings, fascia, gutters and downspouts
07C	Metal Panels	Insulated metal panels, corrugated metal panels, flat metal panels
08A	Glass and glazing	Aluminum storefront and curtainwall

Request for clarifications: Direct all questions or concerns in writing to:
The Whiting-Turner Contracting Co., Construction Manager, Attention: Frank Lerro
via fax 302-292-0683 or email, frank.lerro@whiting-turner.com.
All responses will be in the form of an Addendum.

END OF SECTION 011200
(ATTACHMENTS FOLLOW – GENERAL SCOPE AND SPECIFIC SCOPES OF WORK)

SECTION 011200-01A – GENERAL SCOPE OF WORK

All work is to be done in accordance with the Contract Documents, including the drawings and the specifications, this scope of work, and all addenda if any. Each trade must comply fully with all sections of the Division 1 general requirements.

This scope is intended as a reference to assist in the bidding process. The Contractor is responsible for all labor, material, tools, equipment, hoisting, storage, layout, incidental work, and associated services necessary to fully complete all of the work described and shown in the Contract Documents. This contractor is responsible to review and include all items in their attached specific scope of work and to also review the work of other trades.

This work includes but is not limited to:

1. All bidders are required to provide 10% bid bond for each bid package submitted.
2. All contractors are required to provide 100% payment and performance bonds for their contract.
3. All contractor employees will be required to sign-in each day on the jobsite.
4. Work hours are 7:00 am to 3:30 pm. All contractors are required to work minimum 5 days per week, 8 hours per day. If day(s) are lost during the work week, all contractors are required to work Saturdays to make up for all lost days at no added cost.
5. Each contractor, upon award, is to forward budget costs for each individual item of work, in s.f. or l.f. costs for accounting only. A list will be forwarded to each sub from Whiting-Turner.
6. Each foreman is required to complete daily field reports and turn them into WT daily. This report states where and what work was performed. Failure to submit reports on a daily basis may delay contractor payment.
7. All deliveries must be scheduled in advance with Whiting-Turner. Major deliveries, those that may impact or disrupt the work of other trades, require seven (7) days notice to WT. Minor deliveries require two (2) days notice to WT. WT shall coordinate storage locations for all deliveries.
8. This contractor will execute an AIA contract with no changes.
9. All contractor employees will meet with the WT Superintendent for a short safety orientation upon starting their work on site. All contractor employees are required to attend this orientation.
10. The foreman and project manager will need to meet with the superintendent for a “pre-start” job meeting.
11. This contractor is responsible for all existing site conditions in existence as of the bid due date. These conditions may not be identified on the drawings or in this scope of work. Examine prior to the bid.
12. All contractors are required to perform all layout required for their work.
13. No gasoline-powered equipment can be used at any time within buildings. All equipment you plan to use must be reviewed with the Superintendent for safety concerns.
14. MSDS must be forwarded prior to starting work. No chemicals can be used at any time without properly reviewing them with WT first.
15. All contractors are required to perform any necessary dewatering in order to complete their work.
16. All subcontractors are responsible for daily cleanup of their debris to the jobsite dumpster. This means that no trash or excess construction materials can be left on site or in buildings at the end of the day.
17. The Construction Manager will supply a dumpster for the work, the contractor is responsible for placing debris in the dumpster.
18. Storage space will be limited. Materials and gang boxes cannot be in the way of other trades, traffic, fire lanes, access, etc. Review location and requirements with WT. Provide storage trailers or off site storage when necessary.
19. Furnish attic stock as required by the drawings, specifications, or the scope of work.

20. Jobsite security and security of materials, equipment, tools, etc. is the responsibility of each contractor.
21. Contractors are required to coordinate with other trades and with Whiting-Turner.
22. Contractors are required to comply with all safety regulations as required by OSHA, State of Delaware, Red Clay Consolidated School District, Whiting-Turner, and as noted in the specifications. Provide all safety devices necessary for your work.
23. All change order pricing must be accompanied by a labor and material breakdown and with subcontractor quotes.
24. Care must be taken to not mark or damage finished surfaces. Contractors will be backcharged or will need to pay for repairs to the work of others. Protect the owner's property.
25. Roof protection must be provided by any contractor working on top of the completed roof systems. Minimum protection required is 2" rigid insulation and 3/4" plywood.
26. All safety, barricades, floor opening protection, etc., installed by this contractor or by others is the responsibility of this contractor if moved or damaged by this contractor.
27. Provide all testing, guarantees, warranties, as-built drawings, O&M manuals, commissioning tests, close-out documentation, and start-up services necessary to put all work into first class operating condition per the contract documents including any final cleanup required.
28. As-built drawings must be maintained on the job-site and updated on a daily basis for review by Whiting-Turner. At contract completion, contractor must submit as-built drawings and O&M Manuals as required by specifications.
29. Owner training required by specifications. Training must be videotaped.
30. Where furnishing and installation of work is indicated by separate parties include:
 - Furnishing Party – delivery to jobsite including freight and taxes
 - Installing Party – receiving, unloading, inventory, storage, handling, and installation.
31. Core drilling, cutting & patching as required to perform work. Include restoration of surfaces to original condition if required. Cutting to be performed as to minimize patching.
32. Sealants, caulking, and firestopping integral with work.
33. Permit fees and licenses required for work, other than the building permit, shall be furnished by the contractor whose work requires such permits.
34. General temporary lighting, 120V power & water will be provided. Any contractor requiring temporary services above and beyond those noted shall provide the necessary temporary service required for their work. Refer to specific scopes of work for contractors that will be required to provide all temporary power and lighting for the duration of their work.
35. Each contractor shall provide scaffolding, hoists, lifts, cranes, and other means of access for own work.
36. Premium cost for shutdowns or any other off-hour work. All shutdowns must be scheduled at least two (2) weeks in advance.
37. Phasing and remobilization per the project schedule and as required to properly coordinate and complete the work.
38. Field measurements and verification of existing conditions.
39. Temporary weather and dust protection for own work.
40. Perform any snow removal for access to your work, beyond road areas normally maintained by State.
41. Compliance with local noise restrictions.
42. Temporary sheeting, shoring & bracing as required to perform this work. Engineering calculations/PE certifications if specified.
43. Submittals and mock-ups as specified.
44. Warrantees as specified commencing on date of substantial completion.
45. Insurance as required by specifications. Maintain throughout project. Professional liability insurance for any design/engineering work.
46. All applicable sales, use & excise taxes.

47. Surface preparation and inspection for proper installation of the work. Include clean-up, etching, flash patching, moisture testing, etc. as required per specification and manufacturers instructions. Commencement of work shall constitute acceptance of the substrate as suitable for this work.
48. Sleeves, inserts, and anchors for this work.
49. Additional reinforcement/supports for this work which is not detailed on the architectural and structural drawings.
50. Comply with all Whiting-Turner and Owner Quality Control Program requirements for this work.
51. The contractor must have on site at all times during own work a supervisor or foreman responsible to coordinate the work with all other trades to meet the project schedule, to perform the work to meet the contract documents and to effectively communicate with the construction manager and other trades. The decision of that individual shall be binding upon the contractor.
52. Attendance at foreman meetings by the supervisor or foreman is mandatory.
53. Attendance at progress meetings by your project manager is mandatory. Meetings may be tape recorded.
54. After bids are received, contractors will need to attend a scope review meeting with Whiting-Turner, the Owner, and the Architect.
55. The successful contractor must forward Whiting-Turner a copy of their safety program.
56. During this project, hot work permits will need to be obtained from Whiting-Turner prior to proceeding with any such work on a daily basis.
57. All contractors are responsible for their work as shown on any and all drawings.
58. Each contractor must have a line item on their invoice schedule of values that allows 3% of the total contract amount for close-out documents (as-builts, warranties, operations and maintenance manuals, punchlists, etc.) in addition to 5% retention.
59. Building or site commissioning is to be performed separately from owner training.
60. All subcontractor foremen and project manager are required to remain as such throughout the duration of the project unless otherwise approved by WT and RCCSD.
61. The following documents will be required at project start-up and need to be submitted with-in two weeks of the notice to proceed:
 - A. Fully executed Contract.
 - B. Copy of State of DE Business License
 - C. Insurance Certificate indicating coverage and limits, as specified in Contract Documents.
 - D. Permits or permit filing receipts as required by the contract documents, New Castle County, State of Delaware or any other regulatory agencies having jurisdiction. (Building permit is by CM)
 - E. Payment Bond and Performance Bond
 - F. Emergency Telephone Numbers for project manager and foremen
 - G. MSDS Information
 - H. Attendance of Onsite Safety Orientation
 - I. Copy of Written Safety program and policy
 - J. List of all applicable labor rates
 - K. Detailed Schedule for the work
 - L. Schedule of Values for invoicing
 - M. Subcontractor List
 - N. Supplier List
62. The following documents (other than submittals) will be required prior to billing for the close-out documents.
 - A. Signed-off copy of the punchlist.
 - B. Attic stock delivery confirmation (if required by the specifications)
 - C. As-built Drawings
 - D. Testing Reports and/or Equipment Start-up reports
 - E. Operation and Maintenance Manuals

- F. Owner Training Sessions & video tapes as specified.
- G. Standard Guarantee/Warranty for this Trade Contractor and subcontractors (attached)
- H. Specific Warranties from individual suppliers or manufacturers
- I. Affidavit that all taxes have been paid
- J. AIA Document G706 – Affidavit of Payment of Debts and Claims (Original available from AIA)
- K. AIA Document G706A – Affidavit of Release of Liens (Original available from AIA)
 - Complete and attach the ‘Trade Contractor’s Final Release and Affidavit’
 - Complete and attach the ‘Final Waiver and Release for Second Tier subcontractors and suppliers’ (1 needed from each subcontractor / supplier utilized.)
- L. AIA Document G707, Consent of Surety of Final Payment (Original available from AIA)

END OF SECTION 011200-01A

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 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.

1.4 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 Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Multipurpose Room A120

1. Base Bid: Provide construction indicated in area framed by column lines B5 to B6 and BQ to BS indicated on 101A series drawings, all disciplines.
2. Alternate 1A: Provide construction indicated on drawing A110 and related drawings by all disciplines. Work includes concrete footings, slab-on-grade, masonry, steel, carpentry, roofing, caulking, spray foam insulation, doors/frames/hardware, windows, studs and drywall, vinyl composition tile flooring, epoxy flooring, acoustical ceilings, rubber base, painting, specialties, manual roller shades, casework, sprinkler system, plumbing, HVAC, electrical and special systems.
3. Alternate 1B: Delete vinyl composition tile flooring. Provide resilient quartz tile flooring as specified in Section 096519 Resilient Tile Flooring.
4. Alternate 1C: Delete vinyl composition tile flooring. Provide rubber tile flooring as specified in Section 096519 Resilient Tile Flooring.

B. Alternate No. 2: Second Floor Flex Space D200B

1. Base Bid: Provide construction indicated in area framed by column lines D2 to D6 and DF to DJ indicated on 102D series drawings, all disciplines.
2. Alternate 2A: Provide construction indicated on drawing A111 and related drawings by all disciplines. Work includes concrete slab-on-deck, masonry, steel, carpentry, roofing, caulking, spray foam insulation, doors/frames/hardware, windows, studs and drywall, vinyl composition tile flooring, acoustical ceilings, rubber base, painting, manual roller shades, sprinkler system, HVAC, electrical and special systems.
3. Alternate 2B: Delete vinyl composition tile flooring. Provide resilient quartz tile flooring as specified in Section 096519 Resilient Tile Flooring.
4. Alternate 2C: Delete vinyl composition tile flooring. Provide rubber tile flooring as specified in Section 096519 Resilient Tile Flooring.

C. Alternate No. 3: Athletic Field Grading and Parking

1. Base Bid: Do not provide play field grading and seeding, or the pavement, curbing, striping, catch basins and storm drain piping for the 19 adjacent parking spaces indicated on drawing C202, C302 and C402. Proposed curbing on south side of entrance road shall be terminated at the beginning of the proposed parking spaces.
2. Alternate 3: Provide play field grading and seeding, and the pavement, curbing, striping, catch basins and storm drain piping for the 19 adjacent parking spaces indicated on drawing C202, C302 and C402.

- D. Alternate No. 4: Metal Standing Seam Roofing System at Gymnasium/Student Dining.
1. Base Bid: Provide EPDM roofing system with ½" per 12" slope as indicated on drawing A103 and specified in Section 075323 Ethylene-Propylene-Diene-Monomer (EPDM) Roofing.
 2. Alternate 4: Delete EPDM roofing system. Provide metal standing seam roofing system as specified in Section 074113 Standing Seam Roof Panels and detailed on drawings.
- E. Alternate No. 5: Revised Flooring in Corridors
1. Base Bid: Provide vinyl composition floor tile in Corridors A100E, B100, C100B, C100C, C100D, D100, C200 and D200 as specified in Section 096519 Resilient Tile Flooring and indicated on A106 and A107 series drawings.
 2. Alternate 5A: Delete vinyl composition floor tile flooring in Corridors A100E, B100, C100B, C100C, C100D, D100, C200 and D200. Provide resilient quartz tile flooring as specified in Section 096519 Resilient Tile Flooring and indicated on series A106 and A107 drawings.
 3. Alternate 5B: Delete vinyl composition floor Tile flooring: Provide rubber tile flooring as specified in Section 096519 Resilient Tile Flooring and indicated on series A106 and A107 drawings.
- F. Alternate No. 6: Revised Flooring in Kindergarten, First, Second, Third, Fourth and Fifth Grade Classrooms
1. Base Bid: Provide vinyl composition floor tile flooring as specified in Section 096519 Resilient Tile Flooring and indicated on series A106 and A107 drawings.
 2. Alternate 5A: Delete vinyl composition floor tile flooring at all Classrooms. Provide resilient quartz tile flooring in Classrooms as specified in Section 096519 Resilient Tile Flooring and indicated on series A106 and A107 drawings.
 3. Alternate 5B: Delete vinyl composition floor tile flooring at Classrooms: Provide rubber tile flooring as specified in Section 096519 Resilient Tile Flooring and indicated on series A106 and A107 drawings.
- G. Alternate No. 7: Resilient Athletic Flooring at Gymnasium C116 and Student Dining C114
1. Base Bid: Provide vinyl composition floor tile flooring as specified in Section 096519 Resilient Tile Flooring and indicated on drawing A106C.
 2. Alternate 7: Delete vinyl composition floor tile. Provide Resilient Athletic Flooring as specified in Section 096566 Resilient Athletic Flooring.
- H. Alternate No. 8: Terrazzo at Main Lobby A100, Corridor A100C and Stair C100A.
1. Base Bid: Provide resilient quartz tile flooring as specified in Section 096519 Resilient Tile Flooring.
 2. Alternate 8: Delete resilient quartz tile flooring at Lobby A100, Corridor A100C and Stair C100A. Provide terrazzo flooring as specified in Section 096623 Resinous Matrix Terrazzo Flooring. Provide State of Delaware Map at floor center. See drawing A106A for floor pattern and graphic.
 3. Alternate 8A: Delete resilient quartz tile flooring at Lobby A100, Corridor A100C and Stair C100A. Provide solid color stained concrete floor.

I. Alternate No. 9: Sheet Metal Ductwork

1. Base Bid: Provide KoolDuct fabricated ductwork system at all concealed ductwork locations as specified in Section 233100 HVAC Ducts and Casing. Provide metal ductwork system at all exposed ductwork areas: Stair C100A, Media Center A115, Gymnasium C116, Student Dining C114, Music C123 and Art C125.
2. Alternate 9: Delete KoolDuct. Provide sheet metal ductwork at all concealed ductwork locations as specified in Section 233100 HVAC Ducts and Casings and indicated on mechanical plans.

J. Alternate No. 10: LED Site Lighting

1. Base Bid: Provide HID Site Lighting as indicated on drawings E000 and E700 and specified in Section 265600 Exterior Lighting.
2. Alternate 10: Provide LED Site Lighting as indicated on drawing E000 and E700 and specified in Section 265600 Exterior Lighting.

K. Alternate No. 11: Interior Stone Veneer at Main Stair

1. Base Bid: Provide metal wall panels at east wall of Stair C100A.
2. Alternate 11: Delete metal wall panels at east wall of Stair C100A. Provide interior stone veneer as specified in Section 047000 Architectural Stone Veneer.

L. Alternate No. 12: Stand-By Natural Gas-Fired Emergency Generator

1. Base Bid: No Emergency Generator.
2. Alternate 12: Provide Emergency Generator and concrete pad as specified in Section 263213 Engine Generators and Section 263600 Transfer Switches, and indicated by Note UE-2 on drawing C301 and details on drawings E500, E700 and EP101C.

M. Alternate No. 13: Additional Visual Display Surfaces in Classrooms

1. Base Bid: Provide only 5' high by 16' wide magnetic marker board at primary instruction wall at each Classroom as specified in Section 101100 Visual Display Surfaces and indicated on A106 and A107 series Finish Plans and Interior Elevations.
2. Alternate 13: Provide additional 4' high by 4' wide magnetic marker board and 4' high by 4' wide tack board at secondary instruction walls at all Kindergarten and 1st Grade Classrooms. Provide additional 4' high by 8' wide magnetic marker board and 4' high by 4' wide tack board at secondary instruction walls at all 2nd, 3rd, 4th, and 5th Grade Classrooms as specified in Section 101100 Visual Display Surfaces and indicated on A106 and A107 Finish Plans and Interior Elevations.

N. Alternate No. 14: Multi-Hue Exterior Flat Metal Accent Panels

1. Base Bid: Provide 3 colors for flat metal panels type MWP-2 specified in Section 074213 Metal Wall Panels and indicated on drawings.
2. Alternate 14: Provide 9 colors - 3 hues per 3 colors – for flat metal panels type MWP-2 specified in Section 074213 Metal Wall Panels and indicated on drawings. See details on drawing A203.

O. Alternate No. 15: Decorative Glazed CMU Base at Lockers

1. Base Bid: Provide decorative glazed CMU base at CMU walls in Corridors as specified in Section 042000 Unit Masonry. At all other locations provide metal legs and base plates at lockers as specified in Section 105113 Metal Lockers and detailed on drawings.
2. Alternate 15: Delete metal legs and base plates at lockers in Corridors. Provide concrete curbs and 4" high decorative glazed CMU base as specified in Section 042000 Unit Masonry and detailed on drawings.

END OF SECTION 012300

SECTION 012500 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue 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" or comparable form.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Construction Manager 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.
 - 1. Proposal Requests issued by Construction Manager are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
 - 2. 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.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Construction Manager.
 - 1. 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.
 - 2. 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.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. 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.
 - 6. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

- C. Proposal Request Form: Use AIA Document G709 or approved comparable forms for Proposal Requests.

1.4 CHANGE ORDER PROCEDURES

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

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Construction Manager 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.
 - 1. 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.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. 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 012500

SECTION 012550 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 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.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 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.
 - 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 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.

1.5 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.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 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.
 - 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.
- B. Substitutions for Convenience: Not allowed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012550

SECTION 012650 – CHANGE ORDER REQUEST SUBMISSION FORMAT

The following is a general listing of requirements relating to change order work. Refer to the Contract, General Conditions, Supplementary Conditions, General Scope, and Specification for full requirements.

1. Refer to the Supplementary General Conditions for the Allowable overhead and profit Mark-ups.
2. Any proposed change order / request for the project must be submitted in the format example shown in this specification section.
3. All labor and material costs must be separated with their applicable mark-ups detailed.
4. Whiting-Turner, the Owner, or the Architect may request additional breakdown information, back-up, etc., at their discretion at any time.
5. Each price submitted must include the following:
 - a. Detailed description of the issue.
 - b. Location in the building.
 - c. Reason why it's extra
 - d. Drawing, Specification or other documentation references.
 - e. RFI reference
 - f. Submittal reference
 - g. WT price request reference
6. For price requests or time and material work, obtain approval from the Whiting-Turner project manager in writing prior to proceeding with the extra work.
7. Notify Whiting-Turner in writing immediately (with 24 hours) upon discovering an extra work issue.
8. Any work authorized to proceed on a time and material basis must have the T+M tickets signed daily by Whiting-Turner.
9. Extra work prices or unsigned T+M tickets forwarded after the work is completed will not be accepted.
10. For emergency work that may impact the schedule, verbal cost budgets must be submitted immediately. The work may be authorized to proceed at the Whiting-Turner project manager's and/or owner's discretion.
11. Return extra work price requests in 5 days. Finalize T+M tickets in 5 days.
12. Any item of extra work that cannot be agreed upon at a fixed price will be performed on a time and material basis that is not to exceed an agreed upon budget.

Labor Bill Rates & Change Request Submission Formats

A. Labor Billing Rate Calculation – Example

Base Rate	\$17.40
Fringe Benefits *@% of base rate	<u>8.53</u>
Subtotal Rate	\$25.93
Insurance& taxes ** @% of subtotal rate	<u>9.07</u>
Subtotal - Labor Rate	\$35.00
Overhead & Profit @ 15%***	<u>5.25</u>
Total – Hourly Billing Rate	\$40.25

NOTE:

- * The fringe benefit includes health, welfare or retirement benefits, vacation, holiday or sick leave pay.
- ** The insurance and taxes include employer payment for unemployment insurance, worker's compensation, FICA, Bonds, Gross Receipts, etc.
- *** Allowable mark-up will decrease on a scale based on the total amount of the proposed change. Refer to the supplementary general conditions for additional information. This note is typical for all of the examples above and below.

B. Change Directive Calculation

1. Trade Contractor

Labor Billing Rate\$35/hr x 50 hrs	\$1,750.00
Fee (overhead & profit) @15%***	<u>262.50</u>
Subtotal Labor	\$2,012.50
Material or Equipment	\$2,000.00
Fee (overhead & profit) @15%***	<u>300.00</u>
Subtotal Material	\$2,300.00
Total Costs	\$4,312.50

2. Subcontractor / Trade Contractor

Sub- Labor Billing Rate \$35/hr x 50hrs	\$1,750.00
Fee (sub overhead & profit) @15%***	<u>265.50</u>
Subtotal-Labor	\$2,012.50
Sub-Material or Equipment	\$2,000.00
Fee (sub overhead & profit) @15%***	<u>300.00</u>
Subtotal-Material	\$2,300.00
Total Costs-Subcontractor	\$4,312.50
Fee payable to contractor	
Subcontractor Labor and Material	\$4,312.50
Contractor overhead & profit @ 5%	<u>215.62</u>
Total Costs	\$4,528.12

3. Sub-Subcontractor / Subcontractor / Trade Contractor

Sub-subcon. Labor Billing Rate \$35/hr x 50hrs	\$1,750.00
Fee (overhead & profit) @15%***	<u>262.50</u>
Subtotal- Labor	\$2,012.50
Sub-subcon. Material or Equipment	\$2,000.00
Fee (overhead & profit) @15%***	<u>300.00</u>
Subtotal-Material	\$2,300.00
Total Costs – Sub-subcontractor	\$4,312.50
Fee payable to Sub-Contractor	
Sub-subcontractor Labor and Material	\$4,312.50
Subcontractor overhead & profit @5%	<u>215.63</u>
Total Costs – Subcontractor	\$4,528.13
Fee payable to Trade Contractor	
Subcontractor Labor and Material	\$4,528.13
Contractor overhead & profit @5%	<u>226.41</u>
Total Costs	\$4,754.54

END OF SECTION 012650

SECTION 012900 – PAYMENT PROCEDURES

1. The following documents are included in section 006200:
 - A. AIA Document G732, Application and Certification for Payment, Construction Manager as Advisor Edition
 - B. AIA Document G703, Continuation Sheet
2. A **PENCIL** (Proof) copy of the proposed Application for Payment must be submitted by the 20TH of the month to the WT Project Manager.
3. Upon approval of the Pencil copy by the WT Project Manager, the **ORIGINAL** Application for Payment must be submitted by the 25TH of the month to:
The Whiting-Turner Contracting Company
131 Continental Drive, Suite 404
Newark, DE 19713.
Faxed copies are NOT acceptable.
4. Typical errors on invoice submissions are as follows. Please review this list prior to submitting your invoice. Invoices with errors will be returned. Typical errors:
 - A. AIA forms used must be the correct documents.
 - B. AIA forms must be original documents, not copies.
 - C. Invoice should reference the School District's Purchase Order number.
 - D. Math is incorrect.
 - E. Invoice is not notarized .
 - F. Schedule of Values needs to be approved in advance prior to submission of invoice. It should be broken down by phases, floors, areas, systems, materials, labor, allowances, alternates, etc.
 - G. Schedule of Values must list a line item for close-out documents: (As-Built, Warranties, Operations and Maintenance Manuals, Training Sessions, AIA close-out documents, etc.)
 - i. \$2,500 minimum, OR
 - ii. 1% of total contract amount, which ever is greater.
 - H. Retainage amount is incorrect. Should be 5%.
 - I. Amount billed does not match work in place on site (obtain WT's prior approval)
 - J. Invoice is addressed improperly, should be addressed to:
Red Clay Consolidated School District
1502 Spruce Avenue
Wilmington, DE 19805
(But delivered to Whiting-Turner)
 - K. Insurance certificate has expired. Current insurance must be on file.
 - L. Trade Contractor's Partial Release of Liens not attached.
 - M. Invoice is billing for stored materials, copies of shipping receipts, invoices, and an insurance certificate for the building which houses the materials must be attached.
 - N. Invoice is billing for extra work that has not yet appeared on an AIA G701 Change Order.
 - O. Second tier Contractors / Suppliers Partial Release not attached .
 - P. Daily field reports or Safety meeting minutes have not been forwarded to the WT superintendent.
 - Q. Copies of Certified payroll reports have not been submitted.
 - R. Punchlist is not complete (applicable at end of project).
 - S. Close out documents not received or incomplete (applicable at end of project).

END OF SECTION 012900

PAYMENT PROCEDURES

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SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. Coordination Drawings.
 - 2. Project meetings.
- B. See Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
 - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. 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. Pre-installation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
 - 9. Project closeout activities.

1.3 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
 3. Number of Copies: Submit three opaque copies of each submittal. Architect will return one copy.
 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.4 PROJECT MEETINGS

- A. General: Coordinate, schedule and conduct meetings and conferences at Project site with the Construction Manager.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Construction Manager, Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Construction Manager, Owner and Architect, within three days of the meeting.
- B. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Construction Manager and Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. The Contract Documents.
 - b. Options.
 - c. Related requests for interpretations (RFIs).
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.

- j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- C. Progress Meetings: Conduct progress meetings at regular intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Construction Manager, Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Provide digital and hard copies of the construction schedule to the Construction Manager on a monthly basis unless indicated otherwise within the Construction Documents.
 - b. 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.
 - c. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.

- 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Requests for interpretations (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.
3. Minutes: Record the meeting minutes.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013110 – PROJECT COORDINATION

1.01 PROJECT COORDINATION

- A. Every Trade Contractor shall be responsible for the coordination of the progress of their work with the progress of all other Trade Contractor's work.
- B. Inasmuch as Project completion within the time limit is dependent upon cooperation of those engaged therein, it is imperative that each Trade Contractor perform his work at such time and in such a manner as not to delay or otherwise interfere with work progress of other Trade Contractors. If any Trade Contractor's work depends upon proper execution or results of another Trade Contractor's work, the former shall inspect the work and report any defects therein to the Construction Manager.
- C. Trade Contractors shall afford each other every reasonable opportunity for installation of their work, and shall work in conjunction with each other in order to facilitate proper and intelligent execution of work.
- D. Plans are generally diagrammatic, and each Trade Contractor shall coordinate his work with the work of others, so that interference between mechanical and electrical work and architectural and structural work does not occur. Each Trade Contractor shall furnish and install offsets, bends, turns, and the like in connection with his work to avoid interference with work of other Trade Contractors, to conceal work where required, and to secure necessary clearance and access for operation and maintenance. In case of interference or lack of clearance and access, the Construction Manager will be notified immediately, and shall, in turn, notify the Architect. The Architect will decide which work shall be relocated, regardless of which was installed first.
- E. Systems Coordination Drawings
 1. Systems Coordination Drawings are required from the Mechanical, Electrical, Fire Protection, and General Trade Contractors with the lead role assigned to the Mechanical Trade Contractor.
 2. The Mechanical Trade Contractor shall prepare 1/4" = 1ft. scale Reproducible Systems Coordination Drawings for all areas with piping and ductwork. At critical areas of coordination (risers/shafts, mechanical, electrical and communications rooms), larger scale drawings may be required as determined by all Trade Contractors. Drawings to indicate spatial relationship of all HVAC piping and ductwork.
 3. The Mechanical Trade Contractor shall prepare and submit, to the Construction Manager, a regularly updated schedule indicating the development and review of these drawings with other Trade Contractors. The drawing development and review schedule must follow the project construction schedule.
 4. The Mechanical Trade Contractor shall provide the Reproducible Systems Coordination Drawings to other Trade Contractors for their input and review. The routing is as follows: HVAC, Fire Protection, Plumbing, Electrical, and General Works with the drawings being returned to the Mechanical (HVAC) Trade Contractor.

5. Each Trade Contractor will add the work of his Contract on the System Coordination Drawings to avoid interferences. All piping, equipment, light fixtures, sprinkler heads and in-ceiling equipment, such as rolling gates, must be shown on these drawings to include elevations and dimensions. Trade Contractors shall also consider future access for maintenance clearances required around equipment. If there are items on the systems coordination drawings which modify the design of the contract drawings, each Trade Contractor must highlight these areas by clouding, numbering, and referencing them to the affected contract drawings to allow proper review by each Trade Contractor and the Architect/Engineer.
6. Prior to forwarding the Systems Coordination Drawings to the next Trade Contractor, an approval stamp, initialed and dated, should be affixed by the reviewing Trade Contractor. This approval shall signify that the Trade Contractor will install his work accordingly.
7. During the Systems Coordination Drawing process, the Construction Manager will conduct regularly scheduled meetings. Each Trade Contractor is required to attend these meetings. The Construction Manager is responsible for recording and distributing meeting minutes to all Trade Contractor and the Architect/Engineer. The purpose of the meetings will be to review and discuss interferences and conflicts which required modifications to the Systems Coordination Drawings. All resolutions of interferences and conflicts which required modifications, shall be initialed by the appropriate Trade Contractors on the Systems Coordination Drawings. Conflicts that result after the coordination drawings are signed-off will be the responsibility of the Contractor who installed the work improperly. Coordination participants that fail to cooperate in the coordination Drawings effort, will be responsible for all costs incurred for adjustments to the work made necessary to accommodate installations. Coordination drawings shall be updated on a periodic basis and shall reflect all changes. At each meeting, the Trade Contractors will review and update the Systems Coordination Drawing Schedule.
8. Once reviewed and approved by each Trade Contractor, the Mechanical Trade Contractor will prepare the Final Reproducible Systems Coordination Drawings with the work of all trades included. Submit the Reproducible drawings along with five (5) prints to the Construction Manager who will forward to the Architect for his review.
9. The Mechanical Trade Contractor shall indicate any unresolved conflicts or interferences on the Systems Coordination Drawings. Those should be delineated by clouding, number and referencing to the affected contract drawings.
10. The Architect will review and return to the Construction Manager. The Construction Manager will distribute the number of drawings to the Trade Contractors for installation of their work.
11. The Systems Coordination Drawings DO NOT REPLACE ANY SHOP DRAWINGS FABRICATION AND LAYOUT DRAWINGS REQUIRED BY SPECIFICATION SECTIONS.

1.02 FIELD ENGINEERING**A. Inspection:**

1. Each Trade Contractor shall verify locations of survey control points prior to starting work. Promptly notify Construction Manager of any discrepancies discovered.
2. The Trade Contractor shall verify all measurements of the building and shall be responsible for the correctness of same. No extra charge or compensation will be allowed on account of differences between actual dimensions and the measurements indicated on the drawings; any difference which may be found should be submitted to the Architect for consideration before proceeding with the work.

B. Survey Requirements: The Construction Manager shall secure a professional engineer or surveyor licensed in the State of Delaware to perform the following:

1. Verify grades, lines, levels, locations and dimensions as indicated. Report any errors or inconsistencies in the above, before commencing work.
2. Exercise care in laying out work to keep within lot and property lines. Be responsible for encroachments on rights or property of public or surrounding property owners.
3. Locate and layout building or facilities according to the drawings with respect to their location on property and elevation in relation to grade.
4. Provide and maintain well-built batter boards at corners (if applicable). Establish and safeguard benchmarks in at least two (2) widely separated places. As work progresses, establish benchmarks at each level. Give exact levels of various floors.
5. Maintain complete, accurate log of control and survey work as it progresses.

C. Construction Layout:

The Sitework Trade Contractor shall be responsible to perform the layout and elevations required to complete his work.

Each Trade Contractor shall layout the remainder of his own work and be responsible for all lines, levels, grades, elevations, and measurements.

1.03 TESTS

- A. The Construction Manager has employed and will pay for the services of a testing agency to perform the following tests and inspection (field):

Soil compaction
Concrete
Steel
Masonry

- B. Tests, other than those required by the Specifications to be performed by Construction Manager required by any law, ordinance, rule, regulation or order of any public authority having jurisdiction, shall be made at such time and in such manner as the public authority may require. Each Trade Contractor responsible for that Specification Section shall be solely responsible for such tests.
- C. Special tests may be ordered by the Architect in accordance with the General Conditions. Where specifications require testing by an independent testing laboratory, the Construction Manager shall be responsible for selection of the testing laboratory. The Construction Manager shall be responsible for the scheduling of all tests. Test reports should be given to the Construction Manager with copies for the Owner and Architect/Engineer.
- D. All costs of testing required by the Contract Documents shall be borne by the Trade Contractor except costs of special tests which shall be paid for as stipulated in the General Conditions or Specifications.

1.04 TRADE CONTRACTOR'S OBLIGATIONS

- A. The Trade Contractor must assume all risks and bear any loss occasioned by neglect or accident during the progress of the work until same shall have been completed and accepted by the Owner. The Trade Contractor agrees to indemnify, defend and save harmless the Owner, Architect, and Construction Manager from all suits and losses or injury to persons or property received or sustained from the Trade Contractor or his agents in the performance of the work under the progress of construction and make good all damage that may consequence the work herein specified. He must also assume all blame or loss by reason of neglect or violation of local or state laws, ordinances and regulations, encroachments upon neighbors, or from any other cause.
- B. The work, in every respect, shall be under the care of the Trade Contractor and at his risk. He shall properly safeguard against any or all injury or damage to the public, to any property, materials, or things, except where stipulated otherwise in the Specifications, and also be responsible for any such damage or injury from his undertaking of this work to any person or persons or thing connected therewith. He shall indemnify and save harmless the Owner, Architect, and Construction Manager from all claims, suits, damages, actions of law, in equity or otherwise (including the costs of defense thereof which shall be assumed by the Trade Contractor) or any kind whatsoever in connection with this work and agreement and shall, if required, show evidence of settlement of any such action before final payment is made hereunder by the Owner.

1.05 ALLOCATION OF WORK

- A. Sleeves, Hangers, and Inserts:
 - 1. Each Trade Contractor shall furnish sleeves and inserts required to accommodate his work, together with instructions regarding their placement and location in the structure. Sleeves and inserts shall be furnished promptly in accordance with the established construction schedule so that they may be built-in as construction progresses.

2. Trade Contractors to furnish all embeds, sleeves, inserts, etc., that are to be cast in concrete or built in masonry to the appropriate Trade Contractor for installation.
3. Each Trade Contractor shall furnish and install all hangers required to accommodate his work.

B. Chases and Recesses:

Each Trade Contractor shall provide all blockouts in his work shown on the Contract Documents and having either or both dimensions greater than 10". Any openings with dimensions smaller than 10" or not shown and required by Trade Contractor shall be the responsibility of the Trade Contractor to make provisions for. Each Trade Contractor shall provide chases and recesses as shown on the Contract Documents required to accommodate the work or the other Trade Contractors. It is the responsibility of the Trade Contractors requiring openings, chases, etc., of a Trade Contractor, to furnish information regarding the size and location promptly in accordance with the established construction schedule, so that they may be built-in as construction progresses and avoid delays. Failure to provide the information promptly will result in the responsible Trade Contractor incurring any costs associated with the delay.

Trade Contractors shall cooperate fully with each other in the performance of above work, as cutting and patching of new work is neither contemplated nor will it be tolerated.

C. Sealing of Penetrations:

Each Trade Contractor shall be responsible to seal his own penetrations in walls, floors, and ceilings, using fire resistant materials, as required, to achieve fire ratings as indicated.

D. Equipment Foundations:

The Concrete Contractor shall provide all foundations and housekeeping pads for equipment furnished under his contract and all interior/exterior foundations and housekeeping pads indicated on the Contract Documents (Architectural, Civil, Structural, Mechanical, Plumbing, and Electrical) for equipment provided by other Trade Contractors. All other foundations, equipment, and housekeeping pads not shown, but required, shall be by the Trade Contractor requiring the same.

Each Trade Contractor shall furnish anchor bolts and other accessories required to anchor his equipment in place, together with instructions regarding their placement and location in the foundation. Anchor bolts and other accessories shall be furnished promptly in accordance with the established construction schedule so that they may be built-in as construction progresses.

E. Roofing Penetrations:

All roofing work shall be performed by the Roofing Trade Contractor, including patching penetrations made by the Electrical, Plumbing, and HVAC Trade Contractors. Cutting of roof openings, structural reinforcement, roof curbs, and counterflashing, shall be provided and installed by each Trade Contractor whose work penetrates the roofing surface, including all additional blocking.

1.06 CORING, CUTTING AND PATCHING

A. Responsibility: A Trade Contractor requiring the cutting of openings in new work, or in the existing work installed by others shall have such openings cut and patched by the trade which installed the original work, and such cutting and patching shall be at the expense of the Trade Contractor requiring the opening.

B. Approval: Approval to do such cutting and patching shall be received from the Architect through the Construction Manager prior to proceeding with the work.

C. Inspection:

1. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
2. After uncovering, inspect conditions affecting performance of work.

D. Preparation:

Provide supports to assure structural integrity of surroundings, devices, and methods, to protect other portions of Project from damage.

Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

E. Performance:

Execute work by methods to avoid damage to other work and which provide proper surfaces to receive patching and finishing.

Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements and sight-exposed surfaces.

Restore work with new products in accordance with requirements to Contract Documents.

Fit work tightly to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

At penetrations of fire-rated wall, ceiling or floor construction, completely seal voids with fire-resistant materials as required to achieve fire-rating indicated.

Where fire protection materials are damaged or removed, reapply fire protection materials to achieve a rating equivalent to existing construction or as noted.

Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

F. Access Doors and Panels

Access doors and panels, SHOWN ON ANY DRAWING, shall be furnished and installed by the Drywall Contractor.

Access doors and panels, NOT SHOWN ON DRAWINGS, but required by the Specifications to access concealed valves, dampers, traps, devices, etc., shall be furnished by the Trade Contractor requiring the same for installation by the Drywall Contractor.

G. Final Cleaning

Final cleaning shall be performed by Construction Manager. Daily cleaning will be by the Trade Contractor(s) and their subcontractor(s).

END OF SECTION 013110

SECTION 013200 – CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Construction Schedule.
 - 2. Submittals Schedule.
 - 3. Daily construction reports.
 - 4. Field condition reports.

1.2 SUBMITTALS

- A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Name of subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled date for Architect's final release or approval.
- B. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period and a copy of the digital file on CD.
- C. Daily Construction Reports: Submit two copies at weekly monthly intervals.
- D. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

1.3 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, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals to Construction Manager, arranged in chronological order by dates required by construction schedule. Include time required for review, re-submittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 - 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - 2. Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work 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 principal 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 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.
 - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 - 4. Startup and Testing Time: Include not less than 10 days for startup and testing.
 - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- C. 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. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragments to demonstrate the effect of the proposed change on the overall project schedule.

2.3 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 commencement of the Work unless otherwise indicated. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was 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 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 REPORTS

- A. Daily Construction Reports: Prepare and issue a daily construction report recording the following information concerning events at Project site to the Construction Manager:
 - 1. List of subcontractors at Project site.
 - 2. Equipment at Project site.
 - 3. Material deliveries.
 - 4. High and low temperatures and general weather conditions.
 - 5. Accidents.
 - 6. Stoppages, delays, shortages, and losses.
 - 7. Meter readings and similar recordings.
 - 8. Orders and requests of authorities having jurisdiction.
 - 9. Services connected and disconnected.
 - 10. Equipment or system tests and startups.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit to Construction Manager a detailed report. Submit with a request for interpretation on CSI Form 13.2A or comparable form approved by Architect. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule to Construction Manager 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.
 - 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 Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Construction Manager, Architect and 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 013210 – CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 Construction Schedule

1. The following William F. Cooke Elementary School Schedule is applicable to all bidders. The durations in the schedule are based on 5 day work weeks.
2. Liquidated damages of \$1,000 per day will be assessed if final completion date, as adjusted by the Construction Manager is not met. Liquidated damages shall apply to all trade contracts. Liquidated damages will be assessed for each day beyond the scheduled date of completion for each trade contractor's item of work. Assessment will occur upon completion of all contracts and may be incurred by one or multiple contractors determined by the Construction Manager.
3. The Construction Schedule as approved by the Construction Manager and Owner will be an integral part of the Contract, and will establish interim work completion dates for the various activities.
4. The Construction Schedule may vary in accordance with construction conditions. Each Trade Contractor shall delay or expedite material and equipment deliveries, and modify the required labor forces to accommodate these varying conditions.
5. Work is to commence upon receipt of the Letter of Authorization to proceed.
6. Within fifteen (15) days after receipt of a "Letter of Authorization to proceed", each trade Contractor shall submit a detailed preliminary Construction Schedule to the Construction Manager. The schedule will include breakdowns of total man days of field labor into major categories of work, time estimates of various categories of work, and the crew size for each category.
7. Each Trade Contractor shall organize his Construction Schedule per Phase, Building, Area, and/or Floor as required by the Construction Manager.
8. The Construction Manager shall schedule a meeting with the Trade Contractor to receive the contents of each Trade Contractor's preliminary Construction Schedule, coordinate the sequence of work, and make all revisions required. The Construction Manager shall have the final authority concerning the sequence of work and durations of each activity. Each Trade Contractor shall revise his schedule in accordance with that meeting and submit his schedule to the Construction Manager for approval. The Construction Manager will then develop the Project Construction Schedule. Each Trade Contractor shall schedule and perform his work in accordance with the Construction Manager's Project Construction Schedule.
9. The Schedule shall be the basis for the dates to start and complete work for various portions of each contract, and to complete work (including changes) for the Project. It shall be the duty of the Trade Contractor to conform to the approved Schedule and to arrange his work in such a manner that it will be installed in accordance with the Schedule.
10. Each Trade Contractor shall submit two (2) copies of an updated Construction Schedule comparing the original schedule to actual work in progress and projected work along with the preliminary application for payment.
11. A representative of each Trade Contractor shall meet with the Construction Manager and furnish to him information necessary for such re-evaluating and updating and, if applicable, information with regard to changes in the work and the Trade Contractor's proposed effort to overcome any delays incurred.
12. Should any work not be started or completed within five (5) days of the stated scheduled date, the Construction Manger shall have the right to order the Trade Contractor to expedite start and completion of the work by whatever means the Construction Manager deems appropriate and necessary, without additional compensation to the Trade Contractor.

13. Should any work to ten (10) or more days behind schedule, the Construction Manger shall have the right to perform the work or have the work performed by whatever method the Construction Manager deem appropriate.
14. Costs incurred by the Construction Manager in connection with “maintaining the Construction Schedule” under this section shall be reimbursed to the Construction Manager by the Trade Contractor.
15. It is expressly understood and agreed that failure by the Construction Manager to exercise the option to either order the Trade Contractor to expedite work, or to expedite the work by other means, shall not be considered precedent-setting for any other activities.
16. The following Construction Schedule is critical to the successful completion of the Project and is an integral portion of the Construction Documents. The Construction Schedule may vary in accordance with the construction conditions. The Trade Contractor shall delay or expedite his material and equipment deliveries and modify the required work forces to accommodate these varying conditions. The attached schedule is a milestone schedule with durations that portions of the project must be completed in. A more detailed construction schedule will be generated after all contracts have been awarded. By submitting a bid, each Trade Contractor is acknowledging that they can complete this work within the durations outlined in the milestone schedule.
17. The schedule is of the essence on this project and each contractor is responsible for completion of its work in coordination with the work of all other contractors within the required sequence and time frame so that the established schedule is met. Each contractor agrees to provide sufficient labor crew size, equipment and/or work overtime, weekends, or shiftwork as necessary to meet the activity durations on this schedule.
18. The attached schedule includes “estimated” start dates for the construction activities. In the interest of the overall project, W-T reserves the right to alter the sequencing of activities in order to accommodate project conditions and/or Owner requirements. It is understood that the contractor shall be obligated to complete its activities within the specified duration regardless of the actual start date.
19. All submittals and shop drawings must be submitted within a minimum of **two (2) weeks** of the notice to proceed with this subcontract, or the dates indicated on the schedule or scope of work, whichever occurs first. All expediting of materials and equipment to meet this schedule is the responsibility of the contractor. Contractor to pay for any quick ship charges if necessary.
20. All critical path materials such as storm water structures, rebar, steel, brick, door frames, electrical gear and lighting, mechanical equipment and ductwork, roofing material, kitchen equipment, etc., must be expedited from the beginning of the project. Delays in critical path materials will not be accepted.
21. All work, or applicable portions of the work, shall be sufficiently complete for Owner’s use and occupancy and all required approvals and permits for use and occupancy shall have been issued by the appropriate authorities by the established “Date of Substantial Completion” of the work, or applicable portion thereof.
22. All punchlist work and project closeout documentation shall be completed and approved by the Owner and Architect by the “Date of Final Completion”: which shall be no later than 21 days after the Date of Substantial Completion. Any uncompleted punchlist items after this date will be completed by Whiting-Turner and backcharged to the appropriate contractor or vendor. Final invoices will not be processed until final completion of the work and certification of same by the Owner and Architect.
23. If a contractor misses any portion of a workday due to weather, manpower, or scheduling conflicts, they must make-up this lost time during the same week.

24. Sundays are not regular work days. Approval must be obtained from Whiting-Turner prior to working. It is expected that contractors will work Saturdays, Sundays, and overtime when days are lost during the week.
25. Failure to properly man the project during normal week days may result in charges for CM supervision on weekends, at the discretion of the CM.
26. The contractor must schedule their work forces to work on all available work at a given time. Therefore, if an area of the building is ready for the contractor's work to begin or continue, the contractor must have manpower onsite working. Contractors will not have the "entire" work area at one time.
27. Each contractor must request information or clarifications in a timely manner, at least two weeks prior to needing the information, so that the time required to receive the clarification does not impact the work. No delays will be accepted related to this issue.
28. Each contractor is required to include in their bid the necessary overtime costs if they are needed to meet the schedule durations in this section.

2.1 Time of Completion

1. The Trade Contractor shall commence work upon receipt of a Letter of Authorization to proceed from either Red Clay Consolidated School District or The Whiting-Turner Contracting Company.
2. All work shall be 100 percent (100%) complete and sequenced per the attached schedule unless agreed upon by the Construction Manager prior to the executing of the contract.
3. Work can be completed on Saturdays and Sundays and at extended hours during the week. The Owner shall not be responsible for additional costs for overtime.
4. Normal work hours shall be from 7:00 a.m. to 3:30 p.m., Monday to Friday, and 7:00 a.m. to 3:30 pm on Saturday, when applicable. Work may be completed beyond these hours, as approved by the Construction Manager.
5. Weather Delays: The project substantial completion date, shall only be adjusted due to weather conditions if there are delays above and beyond the following "Adverse Day" allowances based on a seven day work week:
 - A. January (12), February (10), March (5), April (5), May (4), June (2), July (4), August (3 days), September (4 days), October (3 days), November (2 days), and December (6 days). These "Adverse Days" are based on the following reference: State of Delaware Department of Transportation's Standard: "763508 Project Control System."
 - B. Delays requested due to weather must be related to the critical path activity as indicated on the Contractor's Project Schedule.
 - C. Delays due to weather must be reported by the contractor on the day they occur in a written report.
 - D. Any day lost during the week must be made up the same week by overtime and /or weekend work. If the weather is bad on the make-up day, the lost day must be made up the following week.
 - E. The allowance days listed above carry over to the next month if they are not used. Therefore, if only 1 allowance day is used in November, there are (7) days in December. Therefore, there is a total of 60 allowance days in a year.

END OF SECTION 013210

(SCHEDULE ATTACHED)

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. 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. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 3. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 4. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 5. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect'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 and Construction Manager'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. Project Website: Internet website, requiring user name and password for log in, used for the controlled transmission and exchange of project-related information and data including Requests for Information, Submittals, Field Bulletins, etc., between Owner, Contractor, Architect, and other authorized parties.
- 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.

1.4 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 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 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.
 - 1) Revisions shall be provided to Architect and Owner not less than once per month during the submittal process.
 - 2) Contractor may suspend revision of submittal schedule upon completion of required construction-phase submittals, but shall resume revisions at Architect's direction for close-out submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Submittal number.
 - b. Specification Section number.
 - c. Specification Section title.
 - d. Scheduled date for first submittal.
 - e. Scheduled date for Architect's final release or approval.
 - f. Description of the Work covered.
 - g. Name of subcontractor.
 - h. Submittal category: Action, informational.

1.5 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 upon specific request of the Contractor.
1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop 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 2004, 2007, or 2010 DWG.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
 - d. Charges for digital data files shall be as described in the data licensing agreement, and shall be the responsibility of the Contractor requesting the files
 - 1) Charge: \$200 per electronic file.
 - e. Contractor shall follow the prescribed Digital Data File request procedure.
 - 1) Contractor shall inform Architect that digital data files will be requested, including information required for Architect to complete data licensing agreement.
 - a) Name of Contractor
 - b) Name and Title of Contractor's agent will sign form.
 - c) Email address and name of person to receive digital data files.
 - d) File Format: DWG 2004, DWG 2007, DWG 2010
 - e) List of drawings for which digital data files are being requested.
 - 2) Architect will provide data licensing agreement(s) to Contractor and indicated charges.
 - 3) Contractor shall sign data licensing agreement(s) and return to Architect along with payment for charges.
 - 4) Upon receipt of signed agreement(s) and payment for charges, Architect will convert files and send to Contractor through project website.
- 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 reserves 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 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 average for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect 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 average for review of each resubmittal.
- D. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file 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 dash and then a sequential number. Resubmittals shall include an alphabetic suffix.
 3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
 4. Include the following information on an inserted cover sheet:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Name of firm or entity that prepared submittal.
 - f. Name of subcontractor.
 - g. Name of supplier.
 - h. Name of manufacturer.
 - i. Submittal number, including revision identifier.
 - j. Number and title of appropriate Specifications Section.
 - k. Drawing number and detail references, as appropriate.
 - l. Location(s) where product is to be installed, as appropriate.
 - m. Related physical samples submitted directly.
 - 1) Submittal Number and Name
 - n. Other necessary identification
- E. Options: Identify options requiring selection by Architect.
- F. Deviations: Identify deviations from the Contract Documents on submittals
1. **Deviations not explicitly noted on submittal and not explicitly approved by Architect, shall be considered disapproved regardless of whatever action is indicated for submittal.**
- G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- H. Resubmittals: Make resubmittals in same form 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 action stamp.
- I. 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.
- J. 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 action stamp.

PART 2 - PRODUCTS

2.1 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 Project Web site specifically established for Project.
 - a. Architect will return annotated file.
 - b. Annotate and retain one copy of file as an electronic Project record document file.
 - c. At conclusion of project, provide one hard copy and one electronic copy of annotated electronic Project record document files.
 - 1) Assemble into three ring, D-style binders.
 - 2) Collate by specification section and submittal number.
 - 3) Provide tab dividers and label (number only) for each specification sheet.
 - 4) Within each specification section, pages may be printed single or double sided, up to two (2) submittal pages per side of 8 1/2" x 11" printed sheet.
 - a) Large format and complex submittals shall be printed full size.
 - 5) Provide DVD or CD with annotated electronic files. Organize files into folders arranged by MasterFormat 2011 Divisions, as used in the Project Manual. Provide printed labels, identifying disc contents. Assemble DVD(s) or CD(s) in binder in CD binder sheets.
 2. Paper Copies of Submittals: Only where specifically indicated in technical specification requirements, and as a supplement to PDF electronic files, provide two paper copies of each submittal for Architect's use. Unless otherwise indicated, Architect will not return copies.
 3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

4. 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. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 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, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 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.

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 will retain one Sample set; 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 sets of paired units that show approximate limits of variations.
 - 3) In addition to samples, submit transmittal form, submittal identification and information sheet, and other relevant information in PDF electronic file. Architect will indicate selection through electronic submittal.

- 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.

- F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

- G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

- K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

- L. 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.

- M. 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.
- N. 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.
- O. 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.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. 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.
- S. 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.
- T. 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.
- U. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 section "Quality Requirements."
- 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. Maintenance Data: Comply with requirements specified in Division 01 section "Operation and Maintenance Data."
- Z. 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.

2.2 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 and three 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.

PART 3 - EXECUTION

3.1 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.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "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.

3.2 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, as follows:
1. Approved: No further action on submittal is required.
 2. Approved as Noted: Incorporate corrections and comments noted into Work and indicate in record drawings. If corrections cannot be incorporated into Work, resubmit with explanation of why corrections cannot be complied with and indicate proposed response to address intent of corrections.
 3. Received for Record / Not Reviewed: Submittal provided to satisfy record submittal requirement from previous submittal notes or Contract Documents, or submittal not required by Contract Documents and not reviewed. Any notes provided are for Contractor's reference, but do not imply any level of review by Architect.
 4. Revise and Resubmit: Incorporate corrections and comments noted in Work and resubmit.
 5. Disapproved: Submittal does not meet intent of Contract Documents. Correct deficiencies noted and resubmit.
- 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 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

SECTION 013500 – SPECIAL PROJECT PROCEDURES

1.0 PROCEDURES1.1 CONSTRUCTION MANAGER

- A. The Construction Manager shall control, enforce, direct, instruct, and otherwise implement regulations and restrictions as set forth in this section.

1.2 OWNER'S REPRESENTATIVE

- A. All communications with the owner and owner's representative(s) and consultant(s) shall be through the Construction Manager unless otherwise noted in the General Conditions.

1.3 NOISE CONTROL

- A. The Contractor shall execute the Work in this Contract as quietly as practicable to avoid unnecessary disturbances.
- B. Any complaints duly registered by the Construction Manager of unacceptable noise levels shall be cause for the use of special precautions and methods of operation by the Contractor to reduce noise to acceptable levels.
- C. The Owner and Construction Manager shall be the sole judge of the tolerability of noise levels.
- D. Use of portable radios or tape recorders will not be allowed on the premises other than two-way communication radios.
- E. The Contractor shall prepare a "Noise Schedule" as soon as practicable indicating the type of noise inducing work showing the dates, times and duration of such work. The Contractor should note any special instruction and/or time requirement in Scopes of Work.

1.4 PERSONNEL IDENTIFICATION

- A. All employees of the Contractor and all subcontractors may be required to wear numbered identification badges while on the premises of existing buildings.
- B. The identification badges shall be conspicuously fixed to outer garments above elbow level.
- C. Any of the Contractor's personnel or subcontractor's personnel who do not comply with this requirement at all times will be denied access to the facility or will be escorted off the premises by Security Guards or owner representative(s).

1.5 PERSONNEL PARKING

- A. At no time shall the employees of the Contractor or subcontractor employed by Contractor be allowed to park their vehicles on-site without prior approval from the Construction Manager.

2.0 LIMIT OF OPERATIONS

- A. It shall be noted that, adjacent streets will remain open throughout the duration of this Project. The Construction Manager will provide a perimeter fence, which will establish limits of operation.
- B. The Contractor's normal limit of operations shall be confined within the Limits of Work Area as designated on the drawings.
- C. The Owner, Architect, and other Contractors performing Work within these limits of operation, shall be allowed access at all times.
- D. Construction operations must be planned and executed in a manner which allows emergency access to project.

3.0 SCHEDULING AND COORDINATION

3.1 SCHEDULING

- A. All arrangements for work which will involve interference with normal Owner or adjacent properties functions, particularly in occupied areas, or adjacent thereto, shall be scheduled a minimum of 14 days in advance with the Construction Manager to provide for minimum of disruption and inconvenience.

3.2 OUTAGES

- A. Utility and service outages shall be kept to a minimum, and will be permitted only with written approval of the Construction Manager and the Owner.
- B. All requests for the outages shall be made a minimum of fourteen working days in advance of their need.
- C. Requests for outages will not be considered unless they include an identification of all areas which will be affected by the proposed outage. Blank outage forms will be provided by the Construction Manager upon request.
- D. All outages shall occur **after normal working hours**. All costs including premium time shall be included in the Bid amounts.

END OF SECTION 013500

SECTION 013520 – SAFETY REQUIREMENTS AND LOSS CONTROL

The major goal of the Loss Control Program is to prevent losses. Prevention of accidents and elimination of hazards will, in turn, prevent pain, suffering and direct loss in terms of dollars. A safe work place must be maintained for all employees and visitors. High quality work standards and on-time performance are facilitated by an effective Loss Control Program.

Controlling conditions which result in losses is the responsibility of all parties. The Construction Manager will designate a job site safety officer responsible for program management. The responsibility for program implementation is the responsibility of all employees of the Owner, Construction Manager, Contractors and all Subcontractors. The following summary identifies objectives requiring a firm commitment to insure a continuing and comprehensive Loss Control Program.

Construction Manager Duties:

1. Designate jobsite safety officer.
2. Loss reporting and summaries.
3. Accident investigation.
4. Establish project procedures.
5. Inspections, notifications and follow-up.
6. Weekly "Tool Box" talks.
7. Weekly Superintendents meetings.
8. Monthly summary report.

Contractors Duties:

1. Designate on-site safety representative.
2. Consult with insurance carrier for construction operations.
3. Involve foreman and employees.
4. Safety training of all employees.
5. Adherence to safety standards, rules and government regulations.
6. Report conditions or practices which might cause injury or damage.
7. Report all safety related incidents.
8. Participate in all accident investigations.
9. All employees attend weekly Tool Box talks.
10. Attend weekly Superintendents/Foreman's Meetings.
11. Request permission to move barricades and floor opening protection. *
12. Maintain fire watch for all burning operations *
13. Properly store and protect hazardous chemicals and flammable substances.
14. Insure performance of these duties by subcontractors.
15. Maintain good housekeeping practices.
16. Prohibit the use of drugs and/or intoxicating beverages.
17. Maintain equipment in safe condition.

* See the Whiting-Turner Forms for these issues in the On-Site Safety Orientation Package

In order for our accident prevention program to be effective, management at all levels must personally take a serious interest in the prevention of accidents. They must also provide the leadership to which supervisory personnel and employees will respond by developing a positive safety attitude.

THE WHITING-TURNER CONTRACTING COMPANY
SAFETY/HARASSMENT POLICY

I. SAFETY REQUIREMENTS

The Contractor agrees to fully comply with all applicable standards of the Occupational Safety and Health Administration, all safety codes, laws or ordinances applicable to any public authority and to ensure that its employees and Sub-Contractors abide by the same regulations. The Contractor further agrees that if so ordered by the Whiting-Turner Project Manager or Superintendent, it will immediately stop work and correct any serious safety violations immediately before resuming work. The Contractor expressly agrees and understands that Contractor shall be solely responsible for the safety conditions of its work areas and working forces.

The Contractor further agrees to comply with the following specific safety rules of Whiting-Turner which shall in no way limit the Contractor’s liability for safety.

Each contractor and their subcontractors are to designate a safety representative, in writing, and provide a written safety program which identifies their organization and safety policies. All contractors are required to review the following rules and requirements with their on site employees:

CONTAINERS

- A. No glass containers allowed on site.

CRANES

- A. All lifts must use tag lines.
- B. No open hooks used on lifts.

EQUIPMENT

- A. Absolutely no riding on equipment not equipped with proper seating.
- B. Site Speed not to exceed 10 MPH.

FIRE CONTROL

- A. No open fires, fire barrels, or hot boxes.
- B. Fire extinguishers in:
Trailers/offices minimum 10 lb ABC
Equipment minimum 5 lb ABC
Fire Watch minimum 20 lb ABC

HARDHATS

- A. Wear on site at all times, must have Z89.1 rating.
- B. No metal hardhats or bump caps authorized.

FOOT PROTECTION

- A. Substantial leather boots required.
- B. Loafers, sandals, tennis shoes (including steel toe type) are not allowed.

LADDERS

- A. No metal ladders allowed on site.
- B. Damaged ladders must be immediately removed from site or destroyed.

SCAFFOLDING

Full handrails, mid-rails, toeboards, full decking required on all scaffolds, according to standards.

SIGNAGE

- A. Post safety or hazard signs (bilingual if necessary).
- B. Use Whiting-Turner Supplied (Do Not Remove) signs on floor openings.

TRUCKS

- A. No more than three (3) persons in cab of truck.
- B. No riding in back of truck unless truck is equipped with seats and safety belts.

WORK CLOTHING

- A. All shirts must have a minimum four (4) inches sleeve length over shoulders.
- B. No shorts, cut offs, tank tops, net shirts, etc.

ELECTRICAL PROTECTION

- A. No cut, frayed or damaged extension cords permitted.
- B. All extension cords must have a U.L. approved GFCI (Ground Fault Circuit Interpreter)

SAFETY ORIENTATION / SAFETY MEETINGS

- A. Each employee is required to attend a safety orientation and wear a sticker on his or her hardhat.
- B. Each Foreman is required to hold weekly safety meetings with their employees and forward copies of the sign-in sheet.

DAILY REPORTS

- A. Foreman are required to turn in a daily report for their work at the end of each workday. All employees are required to sign this sheet.

PARKING

- A. Parking is limited on site – Coordinate with WT Superintendent for locations.
- B. NO PARKING at the adjacent properties or roadways or any property not owned by the project owner.
- C. Do not block handicap spaces or fire lanes.
- D. Obtain necessary parking permits if applicable.

PERMITS

- A. HOT WORK Permit must be filled out for any burning, welding, soldering, cutting, etc. that may generate a spark.
- B. SAFE WORK Permit must be filled out for any other potentially dangerous work. Crane lifts, shaft cutting, hazardous chemicals, off-hour work, etc. If work occurs in an OSHA defined confined space, obtain a confined space permit.

- C. SAFETY BARRICADE / FALL PROTECTION Permit must be filled out when creating an open hole or removing fall protection.
- D. UTILITY SHUTDOWN Permit must be filled out when turning off any utilities to the building. A two-week notice is required for all outages.
- E. ALL PERMITS must be filled out with Whiting-Turner in advance and posted in the work area.

ASBESTOS / HAZARDOUS MATERIALS

- A. It is possible that there could be existing unforeseen asbestos or other hazardous materials either buried underground or laying on the project site from previous activities on the property.
- B. It is possible that a hazardous material could be brought to the site by others.
- C. Anyone who uncovers or notices a suspected hazardous material should leave it undisturbed and notify WT immediately.
- D. An authorized contractor must dispose of asbestos or other hazardous materials or contaminated debris.

MISCELLANEOUS RULES

- A. Do not block any hallways, stairs or exit doors. Maintain fire egress.
- B. Use all proper personal protection equipment (hard hats, gloves, glasses, etc.)
- C. Smoking is prohibited within the building once 50% of the building façade is covered (new building construction). For renovation projects, smoking is prohibited at all times inside the building, on the roof, or within 20' of the building. Violators will be warned in writing one time. Written warning will be copied to their office. The second violation will result in removal from project. Designated smoking areas will be established outside of the building.
- D. Eating in designated areas only
- E. Use temporary toilets only
- F. Clean the work site daily, trash and debris to the dumpster daily
- G. Alert WT to any emergency
- H. Report any damage to building components or site items
- I. No gasoline-powered or carbon monoxide exhaust equipment can be used at any time in the building after it is enclosed, use propane instead. All equipment you plan to use must be reviewed with the WT Superintendent for safety concerns.

NOTE: THESE ABOVE SAFETY RULES ARE IN ADDITION TO OSHA REQUIREMENTS.

II. CONTRACTOR'S SAFETY PROGRAM

The Contractor will provide a competent safety person who will be responsible for administering the Contractor's safety program and enforcing the safety rules. The following are recommended suggestions for establishing an effective Contractor's safety program.

- A. Establish a schedule of safety meetings conducted by Contractor's foreman for discussing specific topics, such as safety rules, hazards or specific jobs, safe practices, etc.
- B. Establish a plan for Contractor's foreman to contact each employee under his supervision at least once per week on safety.
- C. Establish a procedure for the prompt investigation of all personal injuries and property damage by Contractor's management.
- D. Establish a schedule for periodic inspection by Contractor's management of "hazards" on job site.
- E. Establish a plan for the periodic inspection of tools and equipment by Contractor's management.
- F. Develop basic safety rules for job, instruct employees and enforced compliance.

III. INDEMNIFICATION (RELATED TO OSHA VIOLATIONS)

To the fullest extent permitted by law the Contractor shall indemnify and hold harmless Whiting-Turner, the Owner, and the Architect and their agents and employees from and against all claims, including citations and penalties imposed by the Occupational Safety and Health Administration, damages, losses, expenses and judgments including, but not limited to attorney's fees, arising out of or resulting from performance of the work in an area which is unsafe, harmful, dangerous, or hazardous and which is caused in whole or in part by any act of omission of the Contractor, anyone directly or indirectly employed by it, or any one for whose acts it may be liable, regardless of whether the claim, citation, penalty, damage, loss, expense or judgment results from unsafe, harmful, dangerous, hazardous or toxic materials or substances or whether from any other unsafe, harmful, dangerous or hazardous conditions.

IV. SEXUAL HARASSMENT POLICY

The Construction Manager and Owner will not accept any behavior deemed to be a form of sexual harassment and actively seeks to eliminate such behavior from the jobsite environment.

Definition of Sexual Harassment

The Construction Manager and Owner officially defines sexual harassment as "any unwelcome sexual advances or requests for sexual favors and other verbal or physical conduct of a sexual nature that has the effect or purpose of unreasonably interfering with an individual's work or academic environment, or of affecting an individual's employment or academic status." Sexual harassment is not only a clear violation, it is illegal and a form of discrimination, covered under Title VII of the Civil Rights Act of 1964.

Be Aware

Sexual harassment takes many forms, but includes any unwanted sexual attention such as:

- staring, leering, and ogling
- sexual teasing
- jokes and gestures
- repeatedly asking for dates after being refused
- lewd remarks
- whistles
- references to someone's anatomy
- inappropriate touching
- attempts to kiss or fondle
- coerced sexual intercourse

The sexual harassment policy will be strictly enforced. Any reported incident will be dealt with swiftly and severely. The offending party, if identified will be dismissed from the project and property and not allowed to return. Repeated incidents by employees of a particular firm can result in cancellation of that contract. The victim of the abuse retains the legal right to prosecute. All employees of these contracting firms should be apprised of this policy before working on this project.

END OF SECTION 013520

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.
- C. Related Requirements:
 - 1. Section 012100 "Allowances" for testing and inspecting allowances.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where

indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

- D. **Testing and Inspection:** In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
- E. **Continuous Inspection of Workmanship:** Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. **Monitoring and Documentation:** Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

- A. **Test and Inspection Reports:** Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. **Manufacturer's Technical Representative's Field Reports:** Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. 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 the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- K. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1.9 QUALITY CONTROL

- A. **Owner Responsibilities:** Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. **Contractor Responsibilities:** Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

- F. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.

- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- 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.

1.3 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.

1.4 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 Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- 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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org.
 - 8. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 9. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 10. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 11. AGA - American Gas Association; www.aga.org.
 - 12. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 14. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 15. AIA - American Institute of Architects (The); www.aia.org.
 - 16. AISC - American Institute of Steel Construction; www.aisc.org.
 - 17. AISI - American Iron and Steel Institute; www.steel.org.
 - 18. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 19. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 - 20. ANSI - American National Standards Institute; www.ansi.org.
 - 21. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 - 22. APA - APA - The Engineered Wood Association; www.apawood.org.
 - 23. APA - Architectural Precast Association; www.archprecast.org.
 - 24. API - American Petroleum Institute; www.api.org.
 - 25. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
 - 26. ARI - American Refrigeration Institute; (See AHRI).
 - 27. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.

28. ASCE - American Society of Civil Engineers; www.asce.org.
29. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
30. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
31. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
32. ASSE - American Society of Safety Engineers (The); www.asse.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASTM - ASTM International; (American Society for Testing and Materials International); www.astm.org.
35. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
36. AWEA - American Wind Energy Association; www.awea.org.
37. AWI - Architectural Woodwork Institute; www.awinet.org.
38. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
39. AWPA - American Wood Protection Association; (Formerly: American Wood-Preservers' Association); www.awpa.com.
40. AWS - American Welding Society; www.aws.org.
41. AWWA - American Water Works Association; www.awwa.org.
42. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
43. BIA - Brick Industry Association (The); www.gobrick.com.
44. BICSI - BICSI, Inc.; www.bicsi.org.
45. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.com.
46. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
47. BOCA - BOCA; (Building Officials and Code Administrators International Inc.); (See ICC).
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bwfbadminton.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics & Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).

69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; www.ec-central.org.
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECA).
73. EIA - Electronic Industries Alliance; (See TIA).
74. EIMA - EIFS Industry Members Association; www.eima.com.
75. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
76. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
77. ESTA - Entertainment Services and Technology Association; (See PLASA).
78. EVO - Efficiency Valuation Organization; www.evo-world.org.
79. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
80. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
81. FM Approvals - FM Approvals LLC; www.fmglobal.com.
82. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
83. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
84. FSA - Fluid Sealing Association; www.fluidsealing.com.
85. FSC - Forest Stewardship Council U.S.; www.fscus.org.
86. GA - Gypsum Association; www.gypsum.org.
87. GANA - Glass Association of North America; www.glasswebsite.com.
88. GS - Green Seal; www.greenseal.org.
89. HI - Hydraulic Institute; www.pumps.org.
90. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
91. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
92. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
93. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
94. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
95. IAS - International Approval Services; (See CSA).
96. ICBO - International Conference of Building Officials; (See ICC).
97. ICC - International Code Council; www.iccsafe.org.
98. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
99. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
100. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
101. IEC - International Electrotechnical Commission; www.iec.ch.
102. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
103. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
104. IESNA - Illuminating Engineering Society of North America; (See IES).
105. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
106. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
107. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
108. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
109. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
110. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
111. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).

112. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
113. ISO - International Organization for Standardization; www.iso.org.
114. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
115. ITU - International Telecommunication Union; www.itu.int/home.
116. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
117. LMA - Laminating Materials Association; (See CPA).
118. LPI - Lightning Protection Institute; www.lightning.org.
119. MBMA - Metal Building Manufacturers Association; www.mbma.com.
120. MCA - Metal Construction Association; www.metalconstruction.org.
121. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
122. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
123. MHIA - Material Handling Industry of America; www.mhia.org.
124. MIA - Marble Institute of America; www.marble-institute.com.
125. MMPA - Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); www.wmmpa.com.
126. MPI - Master Painters Institute; www.paintinfo.com.
127. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
128. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
129. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
130. NADCA - National Air Duct Cleaners Association; www.nadca.com.
131. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
132. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
133. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
134. NCMA - National Concrete Masonry Association; www.ncma.org.
135. NEBB - National Environmental Balancing Bureau; www.nebb.org.
136. NECA - National Electrical Contractors Association; www.necanet.org.
137. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
138. NEMA - National Electrical Manufacturers Association; www.nema.org.
139. NETA - InterNational Electrical Testing Association; www.netaworld.org.
140. NFHS - National Federation of State High School Associations; www.nfhs.org.
141. NFPA - NFPA; (National Fire Protection Association); www.nfpa.org.
142. NFPA - NFPA International; (See NFPA).
143. NFRC - National Fenestration Rating Council; www.nfrc.org.
144. NHLA - National Hardwood Lumber Association; www.nhla.com.
145. NLGA - National Lumber Grades Authority; www.nlga.org.
146. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
147. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
148. NRCA - National Roofing Contractors Association; www.nrca.net.
149. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
150. NSF - NSF International; (National Sanitation Foundation International); www.nsf.org.
151. NSPE - National Society of Professional Engineers; www.nspe.org.
152. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
153. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
154. NWFA - National Wood Flooring Association; www.nwfa.org.
155. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
156. PDI - Plumbing & Drainage Institute; www.pdionline.org.

157. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; www.redwoodinspection.com.
161. SAE - SAE International; (Society of Automotive Engineers); www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association; www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
167. SIA - Security Industry Association; www.siaonline.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating and Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
178. STI - Steel Tank Institute; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; (Formerly: Tile Council of America); www.tileusa.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
184. TIA - Telecommunications Industry Association; (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
185. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
186. TMS - The Masonry Society; www.masonrysociety.org.
187. TPI - Truss Plate Institute; www.tpinst.org.
188. TPI - Turfgrass Producers International; www.turfgrasssod.org.
189. TRI - Tile Roofing Institute; www.tilerroofing.org.
190. UBC - Uniform Building Code; (See ICC).
191. UL - Underwriters Laboratories Inc.; www.ul.com.
192. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
193. USAV - USA Volleyball; www.usavolleyball.org.
194. USGBC - U.S. Green Building Council; www.usgbc.org.
195. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
196. WASTEC - Waste Equipment Technology Association; www.wastec.org.
197. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
198. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
199. WDMA - Window & Door Manufacturers Association; www.wdma.com.

200. WI - Woodwork Institute; (Formerly: WIC - Woodwork Institute of California); www.wicnet.org.
201. WMMPA - Wood Moulding & Millwork Producers Association; (See MMPA).
202. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
203. WPA - Western Wood Products Association; www.wwpa.org.

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. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

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. Information is subject to change and is up-to-date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; <http://dodssp.daps.dla.mil>.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; <http://eetd.lbl.gov>.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeia; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from Department of Defense Single Stock Point; <http://dodssp.daps.dla.mil>.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CBHF - State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
2. CCR - California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
3. CDHS - California Department of Health Services; (See CDPH).
4. CDPH - California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
5. CPUC - California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD - South Coast Air Quality Management District; www.aqmd.gov.
7. TFS - Texas Forest Service; Forest Resource Development and Sustainable Forestry; <http://txforests-service.tamu.edu>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 – TEMPORARY FACILITIES AND CONTROLS

Refer to the specific scopes of work for clarification of responsibility of the items specified herein.

PART 1 – GENERAL INFORMATION1.01 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 0 and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection, and shall be subject to the Construction Manager's approval.

A. Temporary utilities required include, but are not limited to:

- Water service and distribution
- Temporary electric power and light
- Telephone service
- Storm and sanitary sewer

B. Temporary construction and support facilities required include, but are not limited to:

- Dewatering facilities and drains
- Temporary heating, ventilating, humidification, and air conditioning
- Field offices and storage facilities
- Temporary roads and paving/construction parking/mud/snow and ice clean-up
- Sanitary facilities, including drinking water
- Temporary enclosures
- Hoists and temporary elevator use
- Temporary project identification signs and bulletin boards
- Waste disposal service and progress cleaning
- Construction aids and protection

C. Security and safety facilities required include, but are not limited to:

- Temporary fire protection
- Barricades, warning signs, lights
- Enclosure fence and security maintenance
- Environmental protection
- Safety requirements

D. Controls

Workday
Lunch wagons
Erosion control
Excavation material
Excavation training
Material inventories
Deliveries

1.03 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

Municipal and Labor & Industry Building Code requirements
Health and safety regulations
Utility company regulations
Police, Fire Department and Rescue Squad rules
Environmental protection regulations

- B. Inspections: Arrange for authorities, having jurisdiction, to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.04 PROJECT CONDITIONS

- A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on the site. They shall be removed, relocated as required by the progress of the work, or directed by the Construction Manager.

- B. Existing Utilities and Systems:

1. Existing systems shall be maintained at all times unless approved (48 hrs. notice of shutdown) by Owner. Permanent heating, plumbing and electrical systems shall be activated and maintained during owner occupancy of existing facilities. Facilities shall be maintained at 70°F.
2. Trade Contractors interrupting services due to their construction operations shall provide temporary utility lines, as required, to maintain services.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Provide new materials; if acceptable to the Construction Manager, undamaged, previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

- B. Lumber and Plywood: Comply with requirements in Division-6 Section "Rough Carpentry."
- C. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride fire retardant tarpaulins.
- D. Water: Provide potable water approved by local health authorities.
- E. Open-Mesh Fencing: Provide 11-gauge, galvanized two inch, chain link fabric fencing, six (6) feet high with galvanized steel pipe posts, 1-1/2" I.D. for line posts and 2-1/2" I.D. for corner posts.

2.02 EQUIPMENT

- A. General: Provide new equipment; if acceptable to the Construction Manager, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.
- B. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light, for connection of power tools, equipment, and GFI breakers.
- D. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress.
- E. Electrical Welding Outlets: These will not be provided. Each Trade Contractor will be responsible for his own welding power.
- F. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- G. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.
- H. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.
- I. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustions type, properly vented and fully enclosed with a glass fiber, reinforced polyester shell or similar nonabsorbent material.
- J. First Aid Supplies: Comply with governing regulations.

- K. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

Comply with NFPA 10 classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION/SCOPE RESPONSIBILITIES

3.01 INSTALLATION (BY APPLICABLE TRADE CONTRACTORS)

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

3.02 TEMPORARY UTILITY INSTALLATION(BY APPLICABLE TRADE CONTRACTORS)

- A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.
1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, each Trade Contractor shall provide trucked-in services at their expense as required to complete their work.
 3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.

Use Charges:

Cost or use charges for temporary facilities are to be paid by the Trade Contractor requiring or providing the temporary facility unless noted otherwise.

Owner will pay utility consumption costs during construction for construction activities only.

- B. Water Service: The Plumbing Contractor shall install water service and distribution piping of sizes and pressures adequate for construction. Provide 3/4" hose bib termination at each story of construction work, located so that any area of building construction can be reached with a 100 ft. length of hose. Water service may be run from a temporary or permanent source.

1. Sterilization: Sterilize temporary water piping prior to use.
2. Protect system from freezing.
3. Maintain 30 psig. water pressure with 5 gpm. flow rate.
4. Owner shall pay for cost of water consumed during construction. Trade Contractor shall take the necessary steps not to be wasteful.

C. Temporary Electricity Power Service:

1. After start of work at project site, when requested by the Construction Manager, the Electrical Contractor shall provide a temporary electrical power distribution system sufficient to accommodate temporary lighting and construction operations, including the use of power tools, and start-up of specified building equipment which must be tested, started or placed into use prior to completion of its permanent power connections. Provide 480 volts, 3 phase, 3 wires, 60 hertz and an equipment grounding conductor as well as 120 volts, 1 phase, 15 amperes, 60 hertz for lighting. Provide weatherproof, grounded wiring with overload protection; with direct wired connections, where feasible, and for voltages up to 220/208 volts. Locate multiple outlets for 120 volt power, not less than 4 gang, at each story of construction, spaced so that the entire area of construction can be reached by power tools on a single extension cord of 100' maximum length. Maximum 20 Amp circuit breaker, four (4) receptacles per circuit breaker.
2. The Owner will pay for cost of all electric energy used for construction activities.
3. The Electrical Trade Contractor shall provide and pay for maintenance, servicing, operation, and supervision of lines installed.
4. Provide service with ground fault circuit interrupter feature, as per NEC and OSHA requirements. The Electrical Trade Contractor shall have a cord inspection program in place. He shall maintain the inspection records on site.
5. As permanent power distribution system is accepted as substantially complete, either entire system or usable portions thereof, the Electrical Trade Contractor shall make suitable provisions for temporary use thereof, and remove unused portions of temporary system.
6. If required, provide meters for electrical power.
7. When temporary electrical lines are no longer required, they shall be removed by the Electrical Trade Contractor and any part, or parts, of the grounds or buildings disturbed or damaged shall be brought back to their original condition.
8. Electricity from existing lines may be used at no charge to the Trade Contractor. Each trade shall provide extension cords from the existing facilities, as required, for the execution of the Work. Electrical power for welding equipment will not be available.

9. The Electrical Trade Contractor shall maintain and operate permanent electrical supply and distribution system until time of final acceptance and transfer of operation to Owner's personnel.
10. The Electrical Trade Contractor shall install switching controls for all lighting which will enable turning off temporary lighting during off-construction hours.
11. Temporary power supplies to the Construction Manager's Office Conference/Office Complex shall be installed with service connection by the Electrical Trade Contractor.
12. The Electrical Trade Contractor will provide power for oil or gas fired temporary heaters, if required by the Construction Manager. It will be connected so that it can remain "live" when the lighting has been turned off.
13. The Electrical Trade Contractor will provide 24-hour temporary power to any heat tape (installed by others) on temporary water and/or fire lines. All temporary heat work will comply with existing OSHA requirements.
14. Construction circuits shall be separate and independent from temporary lighting.

- D. Temporary Lighting: Whenever overhead floor of roof deck has been installed, the Electrical Trade Contractor shall provide temporary lighting with local switching.

The Electrical Trade Contractor shall provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight and general lighting as stated below:

1. Provide uniformly spaced general lighting utilizing one (1) 150 watt incandescent lamp equivalent to 1.0 watts/sq. ft. of floor areas (minimum one (1) lamp per room), and one (1) 100 watt lamp per 50' of corridor or per flight of stairs.
2. Limit lighting installations to intensities which will accommodate normal access and workmanship requirements, recognizing that each entity performing work requiring higher intensity lighting will provide supplementary plug in temporary lighting and localized areas where such work is in progress.
3. As permanent lighting system is substantially complete for each story or usable portion thereof, the Electrical Trade Contractor shall make suitable provisions for temporary use thereof and remove unused portions of temporary lighting system.
4. The Electrical Trade Contractor shall maintain and operate permanent lighting system until the time of final acceptance and transfer of operation to Owner's personnel, including turning off lighting during off-construction hours.
5. The Electrical Trade Contractor shall replace bulbs that are burned out or substantially dimmed by substantial hours of use.
6. Special lighting required for construction activities shall be provided by contractor requiring it.

7. The Electrical Trade Contractor shall provide safety lighting in the stairways, hallways, and exterior security lighting (as required) on a 24-hour basis.
8. The Electrical Trade Contractor will provide a termination box in the Trade Contractor's office trailer area for hook-up of the Trade Contractor's trailers. Cost for individual Trade Contractor trailer hook-up will be born by the Trade Contractor requiring this service. Use of electric heaters in those trailers and shanties will not be permitted.

E. Temporary Telephones:

1. Each Trade Contractor shall be responsible for and provide for his own temporary telephone service.

F. Storm Sewers and Drainage:

1. If storm sewers are available, the Sitework Trade Contractor shall provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available, or cannot be used, Sitework Trade Contractor shall provide drainage ditches, dry wells, stabilization ponds and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, Sitework Trade Contractor provide containers to remove and dispose of effluent off the site in a lawful manner.
2. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.
3. Comply with the soil erosion and sedimentation control plan and local authorities having jurisdiction.

3.03 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION
(BY APPLICABLE TRADE CONTRACTORS)

A. General:

1. Locate field offices, storage, sanitary facilities and other temporary construction and support facilities for easy access after approval from the Construction Manager.
2. Provide incombustible construction for offices, shops and sheds located within the construction area, or within 30 feet of building lines.

B. Dewatering Facilities and Drains:

1. For temporary drainage and dewatering facilities, and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division-2 Sections. Where feasible, utilize the same facilities.
2. The Sitework Trade Contractor shall be responsible to maintain the site, excavations and construction free of water. Review contract scopes for dewatering requirements for each Trade Contractor.

3. Plumbing Trade Contractor shall provide temporary storm water drainage from the building and the Sitework Trade Contractor shall control roof drainage from building on site.
4. Sitework Trade Contractor shall be responsible to drain or pump water and remove debris from the site so as not to delay his continuous work or progress. This shall include operating pumps during second shift in order to facilitate next-day continuation of work.
5. Sitework Trade Contractor shall excavate in a manner that prevents all surface water from flowing into the building area. Sitework Trade Contractor shall be responsible to remove any runoff water or debris which enters the building area.
6. Sitework Trade Contractor shall continue to drain site and remove debris until designed grades are obtained.
7. Upon completion of building foundations, each Trade Contractor shall be responsible to remove water and debris required to complete his work.

C. Temporary Heating, Ventilating & Air Conditioning:

1. Temporary heating shall be provided and maintained by the Trade Contractor performing the work if the outside temperature falls below 40°F at anytime during the day or night for all exterior work or work performed prior to the building being generally enclosed by walls and roof.
2. Each Trade Contractor shall furnish temporary heat by acceptable means to provide sufficient heat to maintain a temperature of 55°F, 24 hours a day throughout the entire area of the work for which the Trade Contractor is responsible.

Except where use of the permanent system is authorized, provide vented, self-contained LP gas or fuel oil heaters with individual space thermostatic control. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited. Temporary heating may not be provided using electrical heating equipment if using electrical power supplied by the Owner.

3. As soon as the building, or portions thereof, is generally enclosed with walls and roof and temporary heat is required for scheduled work, or required to facilitate proper workmanship, and permanent heating system is not yet operable or authorized for use, the Mechanical Trade Contractor shall provide temporary heat or air conditioning service for every entity authorized to do work at the project site. The Mechanical Trade Contractor shall maintain temperatures as indicated by other Specification Sections for each type of work to be performed. The Construction Manager shall be the sole arbiter of when the building is considered generally enclosed.
4. The Carpentry Trades shall install, maintain, and remove temporary enclosure of windows, doors and roof openings until the permanent materials are in place when such enclosures will result in the building being generally enclosed.

5. After the conditions of construction require continuous 24 hour heat in the building, as determined by the Construction Manager, the Mechanical Trade Contractor shall provide, operate, and maintain temporary radiation or unit heaters to provide required temperatures (minimum 55°F) for the conduct of the work. This service shall be continued until the permanent heating system has been completely installed and is in operation and the buildings of the project completed. The Mechanical Trade Contractor shall furnish and pay for all fuel as required for providing temporary heat and air conditioning after the building is generally enclosed. The Owner shall pay for all fuel costs incurred to operate the permanent HVAC systems for temporary purposes. As permanent heating/cooling system is substantially complete and operational for each story or usable portion thereof, the Mechanical Trade Contractor shall make suitable provisions for use thereof in temporary heating and cooling. The Mechanical Trade Contractor shall maintain and operate permanent system for temporary heating/cooling purposes, including service to occupied areas, if any, until time of final acceptance or transfer of operation to Owner's personnel, for major parts of system if not for entire heating system.
6. All permanent heating and air conditioning equipment used to supply temporary heat and air conditioning shall be completely cleaned and reconditioned by the Mechanical Trade Contractor prior to final acceptance. NOTE: All permanent equipment shall receive required scheduled maintenance while use for temporary service. Radiator traps and valves used in the heating system during the period of its operation to supply temporary heat shall not be reinstalled in the permanent system. Install new disposable filters and clean non-disposable filters prior to final acceptance. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
7. The Mechanical Trade Contractor shall remove all soot, smudges, and other deposits from walls, ceilings, and all exposed surfaces which are the result of the use of any temporary heating equipment including the use of the permanent heating system for temporary heat purposes. Finish work shall not be done until all such surfaces are properly cleaned.
8. Temporary Ventilation: A Trade Contractor requiring ventilation for work shall provide fans or other necessary equipment to condition air, provided prior approval has been obtained from the Construction Manager.
9. Humidification: Where control of ambient humidity is required for proper performance of the work, or for curing/drying of installed work, or for protection of installed work from deterioration due to variations in ambient conditions, each Trade Contractor shall provide his own temporary humidification or dehumidification equipment to maintain the required conditions. Coordinate the use of the equipment with temporary heating to produce the required conditions with a minimum overall use of energy.
10. Permanent electrical power needed to operate permanent heating system must be provided by the Electrical Trade Contractor in conjunction with building enclosure, or the Electrical Trade Contractor shall furnish adequate temporary power to operate permanent heating system and bear all cost associated to provide that power.

D. Field Offices:

1. Trade Contractors shall provide offices for their own personnel. All type and location of jobsite offices and equipment will be approved by the Construction Manager. Trade Contractor's offices shall be a maximum of 40' in length.
2. Storage and Fabrication Sheds: Each Trade Contractor shall provide storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces. All steps and platforms connected to shelters must be per OSHA regulations.
3. All offices and sheds must have the Trade Contractor's identification on them.

E. Temporary Roads and Paving, Construction Parking:

1. Sitework Trade Contractor shall construct and maintain temporary roads, to adequately support the indicated loading and to withstand exposure to traffic during the construction period. Locate temporary paving for roads, storage areas and parking where the same permanent facilities will be located.
2. Snow removal will be performed by the Sitework Contractor for access roads and storage areas. Each Trade Contractor shall provide any additional snow removal required to maintain the schedule.

F. Sanitary Facilities:

1. The Construction Manager shall provide temporary toilets. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

Provide toilet tissue for each facility.

2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit type privies will not be permitted. Provide means of locking facilities when construction is not in progress.

Provide separate facilities for male and female personnel when both sexes are working in any capacity on project site.

Provide one unit for use of Owner representative's office/conference meeting complex.

3. Drinking Water Facilities: Each Trade Contractor shall provide containerized tap-dispenser bottled-water type drinking water units, including paper supply. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45° to 55°F (7° to 13°C).

G. Temporary Enclosures:

1. All temporary enclosures required for protection of exterior construction in progress and completed from exposure, bad weather, other construction operations, and similar activities and to maintain the progress schedule, shall be provided by each contractor as necessary to protect their work.
2. Prior to the building being enclosed, all temporary enclosures required for protection of interior construction in progress and completed from exposure, bad weather, other construction operations, and similar activities and to maintain the progress schedule, shall be provided by each contractor as necessary to protect their work.
3. Where heat is needed and the permanent building enclosure is not complete (windows, doors, and roof openings not complete), the Carpentry Contractor shall provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
4. Install tarpaulins securely with noncombustible wood framing and other materials. Close openings of 25 sq. ft. or less with plywood or similar materials.
5. Each Trade Contractor is required to construct, maintain, and remove dust partitions required to prevent dust from entering adjacent areas.

H. Temporary Lifts and Hoists:

1. Each Trade Contractor shall be responsible for their own hoisting.
2. Existing Elevators:
 - A. N/A
3. New Elevators:
 - A. N/A

I. Project Identification and Temporary Signs

1. The Construction Manager shall prepare project identification and other signs, as approved by the Owner of the size indicated; install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood or steel.
2. Provide on (1) sign erected on the site, where directed, to identify the project. Sign shall include Project name, Owner's name, Architect's name, and Construction Manager's name. Size shall be 4' x 8'; color and lettering style shall be as designed by the Architect.
3. Engage an experienced sign painter to apply graphics.

4. Temporary Signs: The Construction Manager shall prepare signs to provide directional information to construction personnel and visitors as required by the Construction Manager.
5. The Construction Manager shall erect weathertight bulletin boards adjacent to the office/conference complex. Size of the boards shall be equivalent to 32 sq. ft., visible area.

J. Waste Disposal Services:

1. The Construction Manager will provide trash collection containers for construction debris, exclusive of masonry, rock, earth, etc., and pay for all debris disposal costs for them. Each Trade Contractor on the project will be required to clean up, and deposit in the dumpster, all debris generated by his trade contract work on a daily basis. This requirement shall be enforced by the Construction Manager and will result in cost assessment against a Trade Contractor who fails to perform daily clean-up. Each Trade Contractor will be responsible for flattening or crushing all trash as necessary when placed into the dumpster. Hazardous material shall not be placed in the collection container.

K. Construction Aids, Protection and Facilities

1. The Carpentry Trades Contractor shall provide temporary ladders, ramps, and walkways required to access upper levels until permanent systems are installed. They shall be installed and maintained throughout the duration of the project and comply with all OSHA requirements. Removal of these shall be by the Carpentry Contractor when requested by the Construction Manager.
2. The Concrete Contractor shall be responsible for providing safety railings around basement area prior to completion of metal deck and slab. Concrete Contractor shall also provide railing around floor opening for floor hatch into basement once concrete has been poured.
3. Each Trade Contractor will be responsible for protecting any floor openings that have been opened for work under his trade.
4. Each Trade Contractor, upon working in any of the area named in the above paragraph, shall remove the safety covering and handrail to perform his work. Upon completion of his work for the day, lunch, or breaks, or any time when the individual Trade Contractor is not working in that opening, the safety covering and handrail must be replaced by the Trade Contractor removing it. At the end of each day, each Trade Contractor will inspect the site and install all safety coverings and handrails. IF coverings and handrails are not being reinstalled by Trade Contractors responsible for replacement, then Construction Manager will replace at Trade Contractor's expense. At the end of the project, or in order to install permanent construction, the Construction Manager shall remove all coverings and handrails.

5. The Carpentry Trades Contractor shall provide safe, temporary stairs, constructed of secure, dimensional lumber, with all railings and closures according to OSHA regulations, until permanent stairs are installed. Temporary stairs must be provided at the point when above grade floors are framed and decked, and require access by trades, in addition to the steel erection crews.
6. The Trade Contractors requiring access to above grade work are responsible for providing ladders, scaffolding and appropriate methods to access their work. Trade Contractors desiring use of in place above grade work platforms must arrange directly with the party that owns the equipment and make all rental and insurance arrangements directly with that party.
7. All work platforms, scaffolding, etc., on the project shall be available for access by the Owner, Architect, Municipal Authority, Test Agency and/or Construction Manager, and these parties shall be insured and held harmless when using these facilities by the Owner of the facility.
8. Each Trade Contractor shall be responsible for maintaining safe walkway and stair traffic areas, using anti-skid methods, routine sweeping, snow, mud and/or ice removal, and any other reasonable method for safe usage.

3.04 SECURITY AND SAFETY FACILITIES INSTALLATION

A. Temporary Fire Safety

1. Shall be maintained in place until permanent fire protection system is available for use. The Fire Protection Trade Contractor shall provide the permanent sprinkler fire protection system for use at the earliest possible date after building enclosure and 55°F temperatures are maintained to protect the building.
2. Until fire protection needs are supplied by permanent facilities, the Construction Manager shall install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers."
3. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
4. Store combustible materials in containers in fire-safe locations.
5. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas. Prohibit smoking within the enclosure building.
6. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

- B. Barricades, Warning Signs and Lights: (Protection of Trade Contractors Work)
1. The responsible Trade Contractor shall comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against.
- C. Building Security Enclosure and Lockup:
1. Each Trade Contractor shall be responsible for assisting the Construction Manager in maintaining a secure building at all times.
 2. Each Trade Contractor is responsible for the secure storage of their own material and equipment on and off the site.
- D. Environmental Protection:
1. To the fullest extent permitted by law, the Trade Contractor shall indemnify and hold harmless the Owner and Construction Manager, their employees and agents, from claims, losses, damage, and expenses including, but not limited to, attorney's fees arising out of performance of the work at it relates to any type of pollution related situations. This would apply to bodily injury, sickness, disease, or death, or to damages or destruction or contamination of tangible property arising out of the acts or omission of the Trade Contractor or the joint negligent acts of the Owner or Construction Manager, or anyone for whose acts the Trade Contractor may be liable.
 2. The Construction Manager will designate area available for construction storage.
 3. Each Trade Contractor shall provide protection, operate temporary facilities, and conduct construction in ways and methods that comply with all environmental regulations, and minimize the possibility that air, water, and soil become contaminated or polluted as a result of work or storage so supplies and materials, or equipment usage.
 4. Each Trade Contractor will designate and train a responsible employee in environmental contamination procedures, including, but not limited to, emergency responses, material and waste inventories, spills and leak precautions and responses, inspections, housekeeping, security, and external factors.
 5. Open burning will not be permitted.
- E. Safety Requirements
1. All work shall be performed in accordance with rules, regulations, procedures and safe practice and/or OSHA and all other Government agencies having jurisdiction over the project.

2. Safety precautions and programs:
 - a. Each container shall be responsible for initiating, maintaining and supervising safety precautions and programs in connection with the work. The name of the safety officer for each contractor shall be provided by the Construction Manager.
 - b. All Trade Contractors shall comply with the provisions of the “Specific Safety Requirements of the Construction Safety Act,” the “Occupational Safety and Health Act,” and Federal, State and local requirements.
 - c. If a contractor fails to maintain the safety precautions required by law or directed by the Construction Manager, the Construction Manager may take such action as necessary and charge the Trade Contractor for all incurred costs.
 - d. The failure of the Construction Manager to take any such action shall not relieve the Trade Contractor of his obligations.
 - e. The Trade Contractor individually shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods, and for any damage which may result from their failure or their improper construction, maintenance or operation.
 - f. Prior to mobilizing to the job, the Trade Contractor shall submit to the Construction Manager, in writing, a description of his safety program for review and comment. During the conduct of the work, the Trade Contractor shall immediately notify the Construction Manager, in writing, of all accidents and shall submit a written report describing in detail the circumstances of each accident within 24 hours of its occurrence.
 - g. All Trade Contractors shall notify the Construction Manager of any flammable, combustible and/or toxic materials intended for use on the project and shall furnish the Construction Manager with literature pertinent to the use and control of all materials, including, but limited to, MSDS sheets.
 - h. Each Trade Contractor shall delegate one representative who shall be responsible to maintain all safety requirements of the Trade Contractor, and shall attend all project safety meetings scheduled by the Construction Manager.
 - i. Each Trade Contractor shall conduct weekly safety discussions which shall be attended by all employees assigned to this project. A written safety given to the Construction Manager on a weekly basis.
3. Safety of persons and property:
 - a. The Trade Contractor shall take all reasonable precautions for the safety or, and shall provide all reasonable protection to prevent damage of loss to:
 1. All employees on the work site and all other persons may be affected thereby.

2. All the work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody, or control of the Trade Contractor or any of his Subcontractors or Sub-Contractors.
 3. Other property at the site or adjacent thereto, including, but not limited to, trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction and underground property.
- b. The Trade Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority, including the Owner's department of protective services, bearing on the safety of persons or property or their protection from damage, injury or loss.
 - c. The Trade Contractor shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection, from his work, including danger signs and other warnings against hazards. He shall comply with safety regulations and notify the Construction Manager of possible effects on adjacent facilities. If the Trade Contractor fails to so comply, he shall, at the direction of the Construction Manager, remove forces from the project without cost or loss to the Owner or Construction Manager, until he is in compliance.
 - d. The Trade Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by the Trade Contractor, his subcontractors, his Sub-subcontractors, or anyone directly employed by any of them, or by anyone for whose acts any of them be liable.
 - e. The Trade Contractor shall not load or permit any part of the work to be loaded so as to endanger its integrity and safety.
 - f. The use of audio equipment and headsets will not be permitted on the construction site.
4. Emergencies:
 - a. In any emergency affecting the safety of persons or property, the Trade Contractor shall act, at his discretion, to prevent threatened damage, injury or loss and shall immediately notify the Construction Manager of such emergency conditions. Any claims made by the Trade Contractor for additional compensation or extension of time on account of emergency work shall be processed in accordance with the Contract Documents.
5. Indemnification:
 - a. The Trade Contractor shall indemnify and hold harmless the Owner, the Construction Manager, the Architect/Engineer, all municipal authorities, and their agents and employees, from and against all claims, damages, losses, and expenses including, but limited to, attorney's fees arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to

injury, sickness, disease or death, or to injury to or destruction of tangible property (other work than the work itself) including the loss of use resulting therefrom, and (2) is caused in whole or part by any negligent act or omission of the Trade Contractor, any Subcontractor, anyone directly or indirectly employed by any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

- b. In any and all claim against the Owner, the Construction Manager, the Architect/Engineer, or any of their agents or employees, by any employee of the Trade Contractor, and Sub-Contractor, anyone directly or indirectly employed by any of them may be liable, the indemnification obligation under this paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the type of damages, compensation or any Subcontractor under Worker's Compensation Acts, disability benefit acts or other employee benefit acts.
- c. The obligations of the Trade Contractor under this paragraph shall not extend to the liability of the Architect/Engineer or the Construction Manager, his agents or employees arising out of (1) the preparation of approval of maps, drawings, opinions, reports, surveys, design or specifications, or (2) the giving of or failure to give directions or instructions by the Architect/Engineer or the Construction Manager, their agents or employees provided such giving or failure to give is the primary cause of the injury or damage.
- d. No provision of this Subparagraph shall give rise to any duties on the part of the Architect or the Construction Manager not otherwise provided for by contract or by law.
- e. In the event that any party is requested but refuses to honor the indemnity obligations hereunder, then the party refusing to honor such requests shall, in addition to all other obligations, pay the cost of bringing any such action, including attorney's fees to the party requesting indemnity.

3.05 CONTROLS

A. Workday:

1. The workdays for the project are defined as 7:00 a.m. – 4:30 p.m., Monday through Friday, & 7-3:30 Saturday, with lunch period from 12:00 – 12:30 p.m. The progress schedule may require contractors to perform work other than the normal workday and in addition to the normal workday, to meet milestones in the progress schedule for the project, or to make up time previously lost to regain the progress schedule requirements or to prevent interruption of the Owner's ongoing operation.
2. Working times other than the normal workday or in addition to the normal work day, must be arranged in advance with the Construction Manager.
3. Trade Contractors who require additional workday hours to regain work time previously lost to meet the requirements of the project schedule shall be assessed for all costs including Construction Manager supervision and other Trade Contractor cost necessary for the performance of their work.

B. Lunch Wagons:

1. Lunch wagons, catered events of other non-construction related functions shall not be permitted on the project site, except by the written permission of the Owner and Construction Manager.
2. No alcoholic beverages or controlled substances shall be allowed on the project at any time.

C. Erosion Control:

1. The Sitework Trade Contractor shall employ all methods required to comply with Local, State, and Federal requirements to control erosion from the project site, including drainage control ditches, sediment basins, straw bale dykes and silt fencing.

D. Excavation Training:

1. Any Trade Contractor performing excavation shall have an OSHA trained person on site during all excavation operations. This person shall evaluate soil types and conditions to determine the required shoring and excavation methods.

E. Material Inventories:

1. Contractors shall coordinate the delivery and storage on the jobsite of all significant materials
2. Each Trade Contractor shall be responsible for the proper location, secure, and weather resistant storage as required of all materials. This includes placement of materials not to obstruct passage on site or within building structures or in any way which causes impediment or obstruction to other Trade Contractors.
3. All material inventories must be stored by the Trade Contractor to avoid excessive loads on building structure.
4. When directed by the Construction Manager, a Trade Contractor shall remove or relocate material inventories as required for the progress of the project.

F. Deliveries:

1. All contractors are required to properly instruct material suppliers and vendors to address deliveries to them specifically by named responsible party at the jobsite and require advance notice.
2. All deliveries addressed to the project in general, the Owner, Architect or Construction Manager, will be refused and returned to shipper.
3. The Owner will not be responsible for receipt, handing, or loss of any materials which are shipped to the Owner in error and received unknowing of relationship to the project.

4. Contractor receiving materials at the jobsite shall be responsible for prevention of any mud or other deposits on public roadways or other areas outside project limit lines, which may result due to methods of material delivery. Trade Contractor shall instruct delivery conveyor to take appropriate measures to prevent depositing mud or other construction deposits outside contract limit lines. Total responsibility of cleanup of mud or other construction deposit outside of contract limit lines will be the responsibility of the Trade Contractor receiving the delivery.

3.06 OPERATION, TERMINATION AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended use to minimize waste and abuse.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.
 2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Termination and Removal: Unless the Construction Manager requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or not later than Substantial Completion. Complete or, if necessary restore, permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities that constitute temporary facilities are property of the Trade Contractor. The Owner reserves the right to take possession of Project identification signs.
 2. The Sitework Trade Contractor shall remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt, and other petrochemical compounds, and other substance which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances, as required by the governing authority.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for 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. Section 012100 "Allowances" for products selected under an allowance.
 - 2. Section 012300 "Alternates" for products selected under an alternate.
 - 3. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 4. Section 014200 "References" for applicable industry standards for products specified.

1.3 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.

1.4 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 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 Section 013300 "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 Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 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.

1.6 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.

1.7 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 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 other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 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. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. 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 Section 012500 "Substitution Procedures" for proposal of product.

D. 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.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect may consider Contractor's request for comparable product when the following conditions are satisfied. The Architect is the sole determiner whether a proposed product is comparable or a substitution. If a product submitted is determined to be a substitution, Contractor shall provide documentation as required by Section 012500 "Substitution Procedures." If the following conditions are not 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.
- B. Timing: Requests for substitution for convenience shall be submitted not less than 10 days prior to bid. Request for substitution received after Bid will not be reviewed.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes 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.

- B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "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. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

1.5 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 Architect of locations and details of cutting and await directions from Architect 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
 - 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.
 - 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.
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Equipment supports.
 - e. Piping, ductwork, vessels, and equipment.
 - f. 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. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 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.
- 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.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and 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 Section 013100 "Project Management and Coordination."

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

3.4 FIELD ENGINEERING

- A. 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 Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. 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.

3.5 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 (2440 mm) in occupied spaces and 90 inches (2300 mm) 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.
- 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.

3.6 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 Section 011000 "Summary."
- F. 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.
 - 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 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.
- G. 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.

H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.8 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 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

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 Section 017419 "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.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "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 Section 014000 "Quality Requirements."

3.10 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 017700 – CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Warranties.
 - 3. Final cleaning.
- B. See Volume I "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- C. See Division 1 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- D. See Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
- E. See Division 1 Section "Demonstration and Training" for requirements for instructing Owner's personnel.
- F. See Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 7. Make final changeover of permanent locks. Advise Owner's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems.
 - 9. Submit test/adjust/balance records.

10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Construction Manager and Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the 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.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report and warranty.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect 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. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies 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. Use CSI Form 14.1A or approved comparable form.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.5 WARRANTIES

- A. Submittal Time: 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.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 1. Bind warranties and bonds in heavy-duty, 3-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.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 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.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Provide 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 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.
 - 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; shampoo 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. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017750 – CLOSEOUT REQUIREMENTS

1. The following documents are included in this section:
 - A. Trade Contractors Partial Release of Lien (to be submitted with each invoice)
 - B. Partial Release of Lien – 2nd tier subcontractors and suppliers (to be submitted by every subcontractor and supplier when the contract is 50% billed)
 - C. Trade Contractors Final Release of Lien (to be submitted with final invoice)
 - D. Final Release of Lien – 2nd tier subcontractors and suppliers (to be submitted by every subcontractor and supplier prior to or with final invoice)
 - E. Affidavit Taxes have been paid. (to be submitted prior to or with final invoice)
 - F. Guarantee and Warranty (to be submitted prior to or with final invoice)
 - G. AIA Document G706, Contractors Affidavit of Payment of Debts and Claims (to be submitted prior to or with final invoice)
 - H. AIA Document G706A, Contractors Affidavit of Release of Liens (to be submitted prior to or with final invoice)
 - I. AIA Document G707, Consent of Surety to Final Payment (to be submitted prior to or with final invoice)

END OF SECTION 017750
(ATTACHMENTS FOLLOW)

**TRADE CONTRACTOR'S PARTIAL RELEASE,
WAIVER OF LIEN AND AFFIDAVIT**

TO: Red Clay Consolidated School District
1502 Spruce Avenue
Wilmington, DE 19805

RE: Red Clay School District Contract No.:
CM: Whiting-Turner Contracting Company
PROJECT: William F. Cooke Elementary School
CURRENT INVOICE NO.: _____
FOR THE PERIOD ENDING: _____

The undersigned Contractor, in consideration of the payments previously made and payment for the period covered by the current invoice set forth above, hereby waives and releases all mechanic's, materialman's or other liens and, to the fullest extent permitted by law, all rights to file any such liens in the future, and all claims and demands against Owner, Construction Manager, and the real property on which the project is located, in any manner arising out of work, labor, services, equipment or materials, performed or furnished by Contractor, its subcontractors and suppliers, in connection with the Project and trade contract, through the period covered by the current invoice and all previous invoices. The release does not apply to retention, nor to extra work which Contractor has been authorized to proceed with by the Construction Manager, but for which payment has not yet been approved.

Except as noted below, Contractor acknowledges and represents that for the period and work covered by all previous invoices for which Contractor has received payment:

1. Contractor has paid in full all amounts for subcontracts, labor, materials and rented equipment.
2. Contractor has properly applied previous payments to pay all outstanding invoices related to the Project.
3. Contractor is aware of no claims nor any circumstances that could give rise to any future claims against Owner, Construction Manager, Architect or other Trade Contractor on the Project.
4. All payroll, withholding, sales and other taxes, union benefits, insurance premiums and any other amount required by law, regulation or agreement to be paid in connection with labor, materials, and equipment for the Project have been paid in full.

List exceptions, if any:

Contractor represents that the amounts set forth below are correct and that the amount of the current payment due will be applied promptly to full payment of all outstanding amounts due from Contractor to others in connection with the Project.

Contract Sum to Date	\$ _____
Total Completed and Stored to Date	\$ _____
Total Retention to Date	\$ _____
Total Earned Less Retention	\$ _____
Less Previous Payments	\$ _____
Current Payment Due	\$ _____

BY: _____
(Name of Subcontractor)

BY: _____
(Signature, Printed Name and Title), Duly Authorized Agent of Subcontractor

STATE OF _____)
(CITY)(COUNTY)OF _____) to wit:

On this _____ day of _____, 20____, appeared before me _____ and he/she made oath in due form of law that the facts, information and representations set forth in the foregoing Trade Contractor's Partial Release, Waiver of lien and Affidavit, are true and accurate to the best of his/her knowledge, information and belief.

Notary Public My commission expires: _____

**PARTIAL WAIVER AND RELEASE
FOR SECOND TIER SUBCONTRACTORS AND SUPPLIERS**

TO: Red Clay Consolidated School District(Owner)

DATE: _____

CONSTRUCTION MANAGER: The Whiting-Turner Contracting Co.

PROJECT: William F. Cooke Elementary School

CONTRACTOR: _____

The undersigned Company, a subcontractor or supplier to the Trade Contractor named above, and hereinafter referred to as the "Company", in consideration of payments previously received and in consideration of payment for work performed through the current date set forth below, hereby waives and releases all mechanics', materialman's, or other liens and, to the fullest extent permitted by law, all rights to file any such liens in the future, and all claims and demands against the Owner, the Construction Manager and the real property on which the Project is located, and any claims arising out of work, labor, services, equipment or materials, performed or furnished by the Company, its subcontractors and suppliers, in connection with the Project, through the period covered by the current invoice.

Except as noted below, the Company further acknowledges and represents that all persons and entities which have provided labor or material, or rented equipment, for or through the Company in connection with the project have been paid in full, for the periods covered by previous payments, that previous payments to the Company have been properly applied to pay all outstanding invoices relating to the Project, that the Company is not aware of any claims, or circumstances which could give rise to future claims, against the Owner, the Construction Manager or the Project, and that all payroll, withholding and other taxes, union benefits, insurance premiums or other amounts required by law, regulation or agreement to be paid in connection with labor for the project have been paid in full through the last date of work covered by the current invoice.

List exceptions, if any:

Last date of work period covered by current Invoice: _____

(Name of Company)

BY: _____
Signature, Duly Authorized Agent of Company

Address: _____

Printed Name and Title

STATE OF _____)
(CITY)(COUNTY)OF _____)

)to wit:

On this _____ day of _____, _____, appeared before me _____ and he/she made oath in due form of law that the facts, information and representations set forth in the foregoing Company's Partial Waiver and Release, are true and accurate to the best of his/her knowledge, information and belief.

Notary Public

My commission expires: _____

TRADE CONTRACTOR'S FINAL RELEASE AND AFFIDAVIT

TO: Red Clay Consolidated School District(OWNER) DATE:
1502 Spruce Avenue
Wilmington, DE 19805

FROM: (Trade Contractor)

RE: DATED:

CONSTRUCTION MANAGER: The Whiting-Turner Contracting Company

PROJECT: William F. Cooke Elementary School

The undersigned Trade Contractor, in consideration of final payment as set forth herein, hereby waives all mechanic's liens and rights to file mechanic's liens and generally releases, and agrees to indemnify and save harmless, the above Owner, the construction manager, their successors and assigns, from all causes of action, suits, debts, contracts, damages, judgments, decrees, claims, demands, liens, rights to assert liens, awards and expenses, including attorneys' fees, in law, equity or otherwise, which Trade Contractor, its subcontractors and suppliers, their successors and assigns and any persons claiming through them or based upon their acts or omissions ever had, now have or hereafter may have against the above Owner, the construction manager, and any real property or improvements of Owner, from the beginning of the world to the date of this Release, in any manner relating to or arising in connection with the above referenced contract or project.

Trade Contractor represents that the amounts set forth below are correct and that the amount of the current payment due will promptly be applied to full payment of all outstanding amounts due from Trade Contractor to others in connection with the Project.

Final Contract Amount \$
Less Previous Payments \$
Final Payment Due \$

I hereby certify, under penalties of perjury, that the information and representations set forth above are true and accurate to the best of my knowledge, information and belief.

Trade Contractor
BY: Address:

Signature, Duly Authorized Agent of Trade Contractor

Printed Name and Title

STATE OF)
(CITY)(COUNTY)OF) to wit:

On this ___ day of ___, 20___, appeared before me ___ and he/she made oath in due form of law that the facts, information and representations set forth in the foregoing Trade Contractor's Final Release and Affidavit, are true and accurate to the best of his/her knowledge, information and belief.

(Notary Public) My commission expires: ___

**FINAL WAIVER AND RELEASE
FOR SECOND TIER SUBCONTRACTORS AND SUPPLIERS**

OWNER: Red Clay Consolidated School District

DATE: _____

CONSTRUCTION MANAGER: The Whiting-Turner Contracting Co.

PROJECT: William F, Cooke Elementary School

CONTRACTOR: _____

The undersigned Company, a subcontractor or supplier to the contractor named above, and hereinafter referred to as the "Company", in consideration of payments previously received and in consideration of final payment set forth below, hereby waives and releases all mechanics', materialman's, or other liens and, to the fullest extent permitted by law, all rights to file any such liens in the future, and all claims and demands against the Owner, the Construction Manager and the real property on which the Project is located, and any claims arising out of work, labor, services, equipment or materials, performed or furnished by the Company, its subcontractors and suppliers, in connection with the Project, from the beginning of the world to the date of this Waiver and Release.

Except as noted below, the Company further acknowledges and represents that all persons and entities which have provided labor or material, or rented equipment, for or through the Company in connection with the project have been paid in full, that previous payments to the Company have been properly applied to pay all outstanding invoices relating to the project, that the Company is not aware of any claims, or circumstances which could give rise to future claims, against the Owner, the Construction Manager or the Project, and that all payroll, withholding and other taxes, union benefits, insurance premiums or other amounts required by law, regulation or agreement to be paid in connection with labor for the project have been paid in full.

Final Payment Due: \$ _____

(Name of Company)

BY: _____
Signature, Duly Authorized Agent of Company

Address: _____

Printed Name and Title

STATE OF _____)
(CITY)(COUNTY)OF _____)

)to wit:

On this _____ day of _____, _____, appeared before me _____ and he/she made oath in due form of law that the facts, information and representations set forth in the foregoing Company's Final Waiver and Release, are true and accurate to the best of his/her knowledge, information and belief.

(Notary Public)

My commission expires: _____

AFFIDAVIT THAT ALL TAXES HAVE BEEN PAID

RE: William F. Cooke Elementary School

Date: _____

TO: RED CLAY CONSOLIDATED SCHOOL DISTRICT
1502 SPRUCE AVENUE
WILMINGTON, DE 19805

The undersigned certifies that all federal, state and local taxes (including sales, consumer, use and excise taxes) applicable to the work and services performed and materials and equipment incorporated into the work, in each case pursuant to the contract referred to above, have been paid in full.

SUPPLIER/CONTRACTOR: _____

By: _____

Date: _____

Title: _____

STATE OF _____)

COUNTY OF _____)

On this ____ day of _____, _____, before me personally came _____
_____, to me known who, being by me duly sworn, did depose and say that
he resides at _____ that
he is _____ of _____
the corporation that executed the foregoing instrument and that he signed his name thereto by order of the Board of
Directors of said corporation.

Notary Public

My Commission Expires: _____

GUARANTEE AND WARRANTY

WHEREAS, _____, hereinafter called the "Guarantor," entered into a contract dated _____, hereinafter called the "Contract," with the Christina School District, hereinafter called the Owner, for the construction of the William F. Cooke Elementary School (hereinafter referred to as the "Work"), located at 2025 Graves Road, Hockessin, Delaware 19707.

WHEREAS, the Owner has performed, kept, observed and fulfilled each and every one of the obligations, promises, stipulated, terms and conditions on its part, and

WHEREAS, by the terms of the Contract, one of the conditions precedent to the making of final payment is the execution and delivery by the Grantor of this guarantee and warranty; and

WHEREAS, the Guarantor is now desirous of obtaining payment pursuant to the terms of said Contract and as a condition precedent to such payment, furnishes this separate guarantee and warranty for all work and material included in said Contract,

NOW THEREFORE, in consideration of the premises and of the payments made to the Guarantor under said Contract and in further consideration of final payment, the Guarantor does hereby for itself and its successors, heirs and assigns, guarantee and warrant to the Owner, its successors and assigns, that the Guarantor has performed all the work required by said Contract in accordance with the terms thereof including but not limited to satisfactory operation of all equipment by means or acceptance tests, correction of items on punchlists prepared by the Architect, and that all portions of the work completed under the Contract are perfect as to materials and workmanship and will so remain from _____ for a period of one (1) year; and

The Guarantor does hereby further guarantee and warrant that the Guarantor will make good and replace at its own cost and expense all defects in material and workmanship appearing during the period aforesaid and the Guarantor will be responsible for all damage caused to the Owner by such defects or by the work required to remedy such defects. All corrections to material and workmanship shall be made at the convenience of the Owner and shall be performed in a good workmanlike manner.

The Guarantor does hereby warrant and represent that it has obtained warranties and guarantees from its material and equipment suppliers and from its subcontractors to the fullest extent possible and as customary in the various trades and has delivered all assignable warranties and guarantees to the Owner.

It is understood that this guarantee shall in no way be construed to limit in any manner any of the provisions of the Contract or to modify or limit any of the obligations, liabilities and duties of the Guarantor thereunder.

It is further understood that his guarantee shall remain binding and irrevocable during the above stated period and that the Guarantor shall not contest the validity of, or in any way attempt to revoke or withdraw from, this guarantee for any cause whatsoever, whatever arising before or after the execution of the Contract or this guarantee.

IN WITNESS WHEREOF, the Guarantor has caused this instrument to be signed and executed this _____ day of _____, 20____.

(GUARANTOR)

WITNESS:

BY: _____

TITLE: _____

STATE OF _____)
COUNTY OF _____)

On this _____ day of _____, 20____, before me personally came _____, to me known who, being by me duly sworn, did depose and say that he resides at _____, that he is _____ of _____, the corporation that executed the foregoing instrument and that he signed his name thereto by order of the Board of Directors of said corporation.

NOTARY PUBLIC

My Commission Expires: _____

DRAFT AIA[®] Document G706[™] - 1994

Contractor's Affidavit of Payment of Debts and Claims

PROJECT: (Name and address)

ARCHITECT'S PROJECT NUMBER:

TO OWNER: (Name and address)

CONTRACT FOR: General Construction

CONTRACT DATED:

OWNER:
ARCHITECT:
CONTRACTOR:
SURETY:
OTHER:

STATE OF:
COUNTY OF:

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose

Indicate Attachment Yes No

The following supporting documents should be attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.
3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: (Name and address)

BY: _____

(Signature of authorized representative)

(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:

My Commission Expires:

DRAFT AIA[®] Document G706A[™] - 1994

Contractor's Affidavit of Release of Liens

PROJECT: *(Name and address)*

ARCHITECT'S PROJECT NUMBER:

CONTRACT FOR: General
Construction

CONTRACT DATED:

TO OWNER: *(Name and address)*

OWNER:

ARCHITECT:

CONTRACTOR:

SURETY:

OTHER:

STATE OF:
COUNTY OF:

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

CONTRACTOR: *(Name and address)*

BY:

(Signature of authorized representative)

(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:

My Commission Expires:

DRAFT AIA[®] Document G707[™] - 1994

Consent Of Surety to Final Payment

PROJECT: *(Name and address)*

ARCHITECT'S PROJECT NUMBER:

OWNER:

CONTRACT FOR: General Construction

ARCHITECT:

TO OWNER: *(Name and address)*

CONTRACT DATED:

CONTRACTOR:

SURETY:

OTHER:

In accordance with the provisions of the Contract between the Owner and the Contractor as indicated above, the
(Insert name and address of Surety)

, SURETY,

on bond of
(Insert name and address of Contractor)

, CONTRACTOR,

hereby approves of the final payment to the Contractor, and agrees that final payment to the Contractor shall not relieve the
Surety of any of its obligations to
(Insert name and address of Owner)

, OWNER,

as set forth in said Surety's bond.

IN WITNESS WHEREOF, the Surety has hereunto set its hand on this date:
(Insert in writing the month followed by the numeric date and year.)

(Surety)

(Signature of authorized representative)

Attest:
(Seal):

(Printed name and title)

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for 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. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 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.

1.4 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 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. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Engineer will comment on whether general scope and content of manual are acceptable.
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. One paper copy. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return copy to contractor.
- C. 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.
1. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return copies to contractor.
 2. Electronic copy, PDF file format.
 - 1) Provide 3 copies of manual on DVD / CD organized in binder w/ digital media file sheets.

PART 2 - PRODUCTS

2.1 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."

2.2 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.
 - 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, post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) 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 (215-by-280-mm) 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.
 - 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.

2.3 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. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. 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.

2.4 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.
 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.

2.5 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.

2.6 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

3.1 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.
- 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 Section 017839 "Project Record Documents."
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and of file prints.
 - 2) 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 three set(s) of prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.

- B. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- C. 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

2.1 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.
 - 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 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.
- B. 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.
 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 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 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

3.1 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 reference during normal working hours.

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 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.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet

with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.

3. 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.
4. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals and in PDF electronic file format on compact disc.

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "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.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.

- f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.2 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 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. 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.

3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
 - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
 - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:

- a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 017900



ARCHITECTURE
P L A N N I N G

Date:

William F. Cooke, Jr. Elementary School
New Castle County, Delaware
2012080.00

Release for use of Digital Media

Revised to include Building Information Modeling

Pursuant to your request, the Digital Media being provided is forwarded in accordance with the following terms.

Definitions:

- a. The Work: the instrument of professional services of the Firm including but not limited to the design drawings, sketches, renderings, photographs, models, specifications.
- b. Digital Media: the electronic, electromagnetic and/or optical storage media, (i.e. physical media) on which the Work is stored.
- c. Digital Information: the information stored on Digital Media or sent via an electronic exchange method (email and FTP) known as the Work of the contracted design professional, Becker Morgan Group, Inc. and their consultants, herein after referred to as the Firm.
- d. Digital Documents: the collective Digital Information that constitutes equivalent physical documents or Work of the Firm. Digital Documents may include one or more electronic files produced by Computer Aided Design (CAD) software applications.

Terms:

1. In accepting and utilizing Digital Information on any form of Digital Media generated and provided by the Firm, the Recipient covenants and agrees that all such Digital Information are instruments of service of the Firm prepared solely for use in connection with the single project for which they were prepared, who shall be deemed the author of the Digital Information, and shall retain all common law, statutory law and other rights, including copyrights.
2. The Digital Documents are provided as a convenience to the Recipient for informational purposes only in connection with the Recipient's performance of its responsibilities and obligations relating to the Project. The Digital Documents do not replace or supplement the printed copies of the Drawings and Specifications that are, and remain, the Contract Documents for the Project.
3. The Digital Information is provided only as a design record prior to construction and for reference to the Recipient. The information in no way shall be used for "as-built" or record purposes.
4. The Recipient agrees not to use this Digital Information, in whole or in part for any purpose or project other than the specific project for which the Recipient and the Firm have a prior Professional Services Agreement. It is further understood and agreed that only printed copies of the Instruments of Services shall be signed and sealed by Architect or its sub-consultants in accordance with the laws of the state in which the project is built.

5. The Work cannot be distributed, altered, reused, sold, leased, printed, plotted, or duplicated without the expressed written consent of the Firm.
6. For Shop Drawings - Where the Recipient has received specific permission to use the Digital Documents in connection with Recipient's obligation to prepare certain documents for the Project, Recipient shall, in addition to the other obligations set forth herein, be obligated to remove Architect's or Architect's Consultant's title block from the copy of the Digital Documents used by Recipient. It is understood and agreed that the Digital Documents are not to be used by any contractor or any of its subcontractors of any tier or any material supplier or vendor as a shop drawing or any other type of submittal or as the basis for preparing such shop drawing or submittal. The sole exception to this prohibition shall be that the Recipient may use the Digital Documents as backgrounds upon which to prepare its shop drawing or other submittal when it is specifically permitted in technical section of project specification. When these digital documents are used as backgrounds in the preparation of shop drawings or other submittals, the Recipient agrees to confirm the accuracy of the digital documents before using them, Recipient agrees to accept all responsibility for any errors or inaccuracies and to release the Architect and its sub-consultants from any liability or claims for recovery of damages or expenses arising as the result of such errors or inaccuracies.
7. Under no circumstances shall transfer of the Digital Information for use by the Recipient be deemed a sale by the Firm. The parties agree that the Digital Documents are not, nor shall they be construed to be, a product. The Firm makes no warranties, either express or implied, of the Digital Media or the Digital Information as to merchantability or fitness for any particular purpose the Recipient may need.
8. The Digital Information submitted by the Firm to the Recipient is submitted for an acceptance period of sixty days. Any defects the Recipient discovers during this period shall be reported to the Firm and may be corrected as part of the Firm's Basic Scope of Services. Correction of defects detected and reported after the acceptance period will be compensated for as Additional Services.
9. The Digital Information is not guaranteed as to accuracy and completeness of all dimensions and details. Information contained in the signed and sealed printed documents should be deemed to be correct and superior to digital information.
10. The Digital Information is not guaranteed as to compatibility, in so far as incompatibilities may be present now or in the future with the Recipient's computers, storage devices, software, and output systems.
11. The Digital Media on which the Digital Information is provided cannot be guaranteed as to its durability, completeness or usability, in so far as instabilities may be present in the Digital Media, and in the transferring, archiving, recording or translating systems now and in the future. The Firm is not liable in any way for the perpetuation of this Digital Information on released digital media or on digital media retained by the Firm for its archives. Recipient agrees to accept all responsibility for any errors or inaccuracies and to release Architect and its sub-consultants from any liability or claims for recovery of damages or expenses arising as the result of such errors or inaccuracies.
12. Provision of the Information to the Recipient in no way limits the Firm to the further use of the Digital Information for the Firm's benefit.
13. Recipient agrees to waive any and all claims and liability against Architect and its sub-consultants resulting in any way from any failure by Recipient to comply with the requirements of this Agreement for the Delivery of Documents in Digital Format. The Recipient agrees, to the fullest extent permitted by law, to indemnify and hold the Firm harmless from any damage, liability or cost, including reasonable attorney's fees and costs of defense, arising from any changes made by anyone other than the Firm or from any reuse of the Digital Information without the prior written consent of the Firm. Recipient further agrees to indemnify and save harmless the Owner, Architect and its sub-consultants and each of their partners, officers, shareholders, directors and employees from any and all claims, judgments, suits, liabilities, damages, costs or expenses (including reasonable defense and attorney's fees) arising as the result of either: 1) Recipient's failure to comply with any of the requirements of this Agreement for the Delivery of Documents in Digital Format; or 2) a defect, error or omission in the Digital Documents or the information contained therein, which defect, error or omission was not contained in the Contract Documents

as defined in Paragraph 2 or where the use of such Contract Documents would have prevented the claim, judgment, suit, liability, damage, cost or expense.

The Recipient agrees to a \$200 charge per each of the following drawing sheets listed below, created within a CAD digital file, payable to this office prior to release of any Digital Information. NOTE: All sheets are available for release.

List Requested Drawing Sheets:

The Recipient agrees to a \$500 charge per each of the following groups of CAD digital files or RVT models checked below, payable to this office prior to release of any Digital Information. NOTE: Only those file groups listed below are available for release.

Check Requested Files:

- S101-series, S102-series, and S103-series (DWG)
- A101-series, A102-series, A103, A104, A106-series, A107D, A110, A111 (DWG)
- P101-series, P102, P103, P201-P207 (DWG)
- M101-series, M102D, MP101-series, MP102D (DWG)
- EP101-series, EP102D, EL101-series, EL102D EMP101-series, EMP102D, EFA101-series, EFA102 (DWG)
- T101-series, T102D (DWG)
- Structural model (RVT)
- Architectural model (RVT)
- Mechanical, Plumbing, Electrical model (RVT)

Please sign and return one copy of any release forms required by Consultants.

Please sign below and return one copy of this form with a check for the total payment made out to Becker Morgan Group.

Recipient sign here>

Accepted - signature

Date

Name/Title – printed

Company

BMG Principal - signature

Date

BMG Principal – printed

Prepared by – printed

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Suspended slabs.
 - 5. Concrete toppings.
- B. Related Sections:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
 - 2. Section 321313 "Concrete Paving" for concrete pavement and walks.
 - 3. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 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, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. 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.
- C. 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, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement.
 - 6. Waterstops.
 - 7. Curing compounds.
 - 8. Floor and slab treatments.
 - 9. Bonding agents.
 - 10. Adhesives.
 - 11. Vapor retarders.
 - 12. Semirigid joint filler.
 - 13. Joint-filler strips.
 - 14. Repair materials.
- C. 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.
- D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- E. Field quality-control reports.
- F. Minutes of preinstallation conference.

1.6 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 C 94/C 94M 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 C 1077 and ASTM E 329 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 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."
 - 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.
- G. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 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.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.

- b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. 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.
- 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
- 1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars, assembled with clips.
- D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn or galvanized.
- E. Deformed-Steel Wire: ASTM A 496/A 496M.

- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

- A. 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 and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F or C.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3M 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 inch (25 mm) nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. 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 C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
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. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
 - b. Fortifiber Building Systems Group; Moistop Ultra.
 - c. Grace Construction Products, W. R. Grace & Co.; Florprufe 120.
 - d. Insulation Solutions, Inc.; Viper VaporCheck.
 - e. Meadows, W. R., Inc.; Perminator.
 - f. Raven Industries Inc.; Vapor Block.
 - g. Reef Industries, Inc.; Griffolyn.
 - h. Stego Industries, LLC; Stego Wrap.

2.7 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
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. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

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 Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.
 - n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Envicure 100.

- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 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.
 - 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 18 Percent E.
 - p. TK Products, Division of Sierra Corporation; TK-2519 WB.
 - q. Vexcon Chemicals, Inc.; Starseal 309.

- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
 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. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
 - b. ChemMasters; Safe-Cure Clear.

- c. Conspec by Dayton Superior; High Seal.
 - d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
 - e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
 - f. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
 - g. Kaufman Products, Inc.; SureCure Emulsion.
 - h. Lambert Corporation; Glazecote Sealer-20.
 - i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - j. Meadows, W. R., Inc.; Vocomp-20.
 - k. Metalcrete Industries; Metcure 0800.
 - l. Nox-Crete Products Group; Cure & Seal 200E.
 - m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
 - n. Vexcon Chemicals, Inc.; Starseal 0800.
- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 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. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
 - b. ChemMasters; Spray-Cure & Seal Plus.
 - c. Conspec by Dayton Superior; Sealcure 1315.
 - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
 - e. Edoco by Dayton Superior; Cureseal 1315.
 - f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
 - g. Kaufman Products, Inc.; Sure Cure 25.
 - h. Lambert Corporation; UV Super Seal.
 - i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - j. Meadows, W. R., Inc.; CS-309/30.
 - k. Metalcrete Industries; Seal N Kure 30.
 - l. Right Pointe; Right Sheen 30.
 - m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.
 - 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
- 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. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
 - f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
 - g. Lambert Corporation; UV Safe Seal.
 - h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - i. Meadows, W. R., Inc.; Vocomp-30.
 - j. Metalcrete Industries; Metcure 30.
 - k. Right Pointe; Right Sheen WB30.

- l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
 - m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.
2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, 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 IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
 4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

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. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- C. 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, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
- D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
- B. Foundation Walls and Piers: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Slump Limit: 4 inches (100 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
 4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
- C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 5000 psi exterior and 4000 psi (27.6 MPa) interior at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd. (309 kg/cu. m).
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

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 C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) 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.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
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

3.1 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 (3.2 mm) for smooth-formed finished surfaces.
 2. Class B, 1/4 inch (6 mm) for rough-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. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- 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. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) 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.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- 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 Architect.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 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.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- 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.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.
- G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.7 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 Architect.
 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 (38 mm) into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use 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 (3.2 mm). 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- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. 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.

3.8 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 Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. 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 weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) 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.
- E. 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.
- F. 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 deg F (4.4 deg C) 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.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) 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.

3.9 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 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. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
 - 1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.
- C. 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 indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten 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.
 - 1. Apply a trowel finish to surfaces indicated and 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 surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
 - b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and to 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.
- F. 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 Architect before application.

3.11 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:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 6 inches ((150 mm) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
 - 6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.12 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. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. 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 (300-mm) 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 (300 mm), 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.
 - 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.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect'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 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. 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 (0.25 mm) 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 scheduled to receive floor coverings 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. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) 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 (19-mm) 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.
 7. Repair random cracks and single holes 1 inch (25 mm) 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.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) 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.
 3. Slump: ASTM C 143/C 143M; 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.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. 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.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

10. 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 (3.4 MPa).
 11. Test results shall be reported in writing to Architect, 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.
 12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Structural Clay Facing Tile
3. Face brick.
4. Mortar and grout.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Steel reinforcing bars.
8. Embedded flashing.
9. Miscellaneous masonry accessories.
10. Masonry cell insulation.
11. Miscellaneous cavity-wall insulation.

B. Related Sections:

1. Section 047200 "Cast Stone Masonry" for furnishing cast stone trim.
2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 055000 "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
4. Section 071113 "Bituminous Dampproofing" for dampproofing applied to masonry below grade.
5. Section 072100 "Thermal Insulation" for cavity wall insulation
6. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
7. Section 078413 "Penetration Fire Stopping" for fire stopping at opening in masonry walls.
8. Section 078446 "Fire Resistive Joint Systems" for joints in fire rated masonry walls.
9. Section 079200 "Joint Sealants" for joints in masonry walls.
10. Section 079500 "Expansion Control" for expansion joints in masonry walls.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 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.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
 1. Colored mortar.
- D. Samples for Verification: For each type and color of the following:
 1. Structural Clay Facing Tile
 2. Face brick, in the form of straps of five or more bricks.
 3. Special brick shapes.
 4. Accessories embedded in masonry.
- E. Qualification Data: For testing agency.
- F. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
 - c. For exposed brick, include test report for efflorescence according to ASTM C 67.
 - d. For masonry units, 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.
- G. 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 C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

- H. **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, 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.
- I. **Cold-Weather and Hot-Weather Procedures:** Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

- A. **Testing Agency Qualifications:** Qualified according to ASTM C 1093 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 of each supplier's product to demonstrate aesthetic effects. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.
 - 1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high.
 - a. For exterior face brick, build the following sample panels of each supplier's brick, including those listed as alternates.
 - 1) One panel made of Type BK-1 and BK-2 per brick patterning details on drawings.
 - 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. Erection of sample panels is for final product selection based on color, texture, and blending of masonry units; relationship of mortar to masonry unit colors and other material and construction qualities specifically approved by Architect 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 Architect in writing.
- F. **Mockup:** Prior to installing unit masonry, construct mockup wall panels to verify selections made under sample submittals and to demonstrate aesthetic effects of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
 - 1. Locate mockups on site in the locations indicated or, if not indicated, as directed by Architect.
 - 2. Build mockup of wall areas as shown on Drawings.
 - a. Include sealant-filled joint complying with requirements of Division 7 Section "Joint Sealants."

3. Build mockups for each of the following types of masonry in height and width shown on drawings by full thickness, including face and back-up wythes as well as accessories. Coordinate panel make-up with Architect.
 - a. Exterior masonry wall as designated on exterior elevations.
4. Clean exposed faces of mockups with masonry cleaner indicated.
5. Notify Architect one week in advance of the dates and times when mockups will be constructed.
6. Protect accepted mockups from the elements with weather-resistant membrane.
7. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Acceptance of mockups 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 Architect in writing.
 - 1) Acceptance of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.

1.7 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.

1.8 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.
 1. Extend cover a minimum of **24 inches (600 mm)** down both sides of walls and hold cover securely in place.
 2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of **24 inches (600 mm)** 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 deg F (4 deg C) 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

2.1 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 E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

- A. 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 bullnose units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 - 1. Density Classification: Normal weight unless otherwise indicated.
 - 2. Size (Width): Manufactured to the following dimensions:
 - a. 4" nominal; 3 5/8" actual.

- b. 6" nominal; 5 5/8" actual.
 - c. 8" nominal; 7 5/8" actual.
 - d. 12" nominal; 11 5/8" actual.
3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C 216
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Face Brick Type (**BK-1**) Size (w x h x l): Ambassador (3-5/8" x 2-1/4" x 15-5/8") with Norman (3-5/8" x 2-1/4" x 11-5/8") and Modular (3-5/8" x 2 1/4" x 7-5/8") as detailed. See drawings for special shape bricks (SSB-1)
 - 1) Include one of the following selections:
 - a) Belden: Mayo Clear Range A
 - b) Glen-Gery: Smokey Quartz
 - c) Belden: Graystone Smooth
 - b. Face Brick Type (**BK-2**) Size (w x h x l): Ambassador (3-5/8" x 2-1/4" x 15-5/8") with Norman (3-5/8" x 2-1/4" x 11-5/8") and Modular (3-5/8" x 2 1/4" x 7-5/8") as detailed. See drawings for special shape bricks (SSB-1)
 - 1) Include one of the following selections:
 - a) Belden: Graystone Velour A
 - b) Glen-Gery: W72 Smoky Quartz

2.4 STRUCTURAL-CLAY FACING TILE

- A. General:
1. Provide solid, multicored, or hollow units, with shape and direction of cores optional unless otherwise indicated.

2. Where reinforced masonry is indicated, provide multicored units designed for use in reinforced, grouted masonry; either with vertical cores and with webs notched to receive horizontal reinforcement, or with horizontal cores and with holes in bed shells for placement of grout and to receive vertical reinforcement.
3. Provide special shapes where required for corners, jambs, coved bases, sills, and other special conditions indicated, including applications that cannot be produced by sawing standard units.
 - a. Provide bullnose units for outside corners unless otherwise indicated.
4. Where direct application of plaster is indicated, or where bonded to backup masonry, provide units with rough, combed, or scored faces.

B. Glazed Structural-Clay Facing Tile: ASTM C 126, Grade S (select).

1. Products: Subject to compliance with requirements.
 - a. Substitutions: Requests for substitutions shall be made in writing at least ten days prior to the date of the Bid Opening and must meet the requirements set forth in Instructions to Bidders.
 - b. Basis of Design Product: Elgin Butler
 - 1) Sizes: 8W Series with actual face dimensions of **7-3/4 inches (196.9 mm)** high by **15-3/4 inches (400.1 mm)** long by widths indicated.
2. Width: Manufactured to dimensions **1/4 inch (6.4 mm)** less than nominal dimensions.
3. Provide Type I (single-faced units).
4. Provide special units glazed on ends and tops, as well as faces for corners, jambs, sills, pilasters, columns, and other applications indicated, where glazed units are exposed on other surfaces and faces.
5. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, 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.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 1. Colored Portland Cement-Lime Mix:
 - a. **Products:** Subject to compliance with requirements, provide one of the following
 - 1) **Capital Materials Corporation**; Riverton Portland Cement Lime Custom Color.
 - 2) **Holcim (US) Inc.**; Rainbow Mortamix Custom Color Cement/Lime.
 - 3) **Lafarge North America Inc.**; Eaglebond Portland & Lime.
 - 4) **Lehigh Cement Company**; Lehigh Custom Color Portland/Lime Cement.
 2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 3. Pigments shall not exceed 10 percent of portland cement by weight.

- E. Aggregate for Mortar: ASTM C 144.
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 (6 mm)** thick, use aggregate graded with 100 percent passing the **No. 16 (1.18-mm)** sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C 404.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, 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
 - a. **Euclid Chemical Company (The);** Accelguard 80.
 - b. **Grace Construction Products, W. R. Grace & Co. - Conn.;** Morset.
 - c. **Sonneborn Products, BASF Aktiengesellschaft;** Trimix-NCA.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, **Grade 60 (Grade 420)**.
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
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 (3.77-mm)** diameter.
 4. Wire Size for Cross Rods: **0.148-inch (3.77-mm)** diameter.
 5. Wire Size for Veneer Ties: **0.148-inch (3.77-mm)** diameter.
 6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than **16 inches (407 mm)** o.c.
 7. Provide in lengths of not less than **10 feet (3 m)**, 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 (100 mm)** wide, plus 1 side rod at each wythe of masonry **4 inches (100 mm)** wide or less.
 2. 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 (32 mm)**. Size ties to extend at least halfway through facing wythe but with at least **5/8-inch (16-mm)** cover on outside face.

2.7 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. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
 3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least **5/8-inch (16-mm)** cover on outside face. Outer ends of wires are bent 90 degrees and extend **2 inches (50 mm)** parallel to face of veneer.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped **1/4-inch- (6.35-mm-)** diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie, sized to extend within **1 inch (25 mm)** of masonry face, made from **0.187-inch- (4.76-mm-)** diameter, hot-dip galvanized steel wire.
- D. 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 (445-N)** load in both tension and compression without deforming or developing play in excess of **0.05 inch (1.3 mm)**.
 2. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from **0.187-inch-(4.76-mm-)** diameter, hot-dip galvanized-steel wire unless otherwise indicated.
 3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) [Heckmann Building Products Inc.](#); Pos-i-tie
 - 2) [Hohmann & Barnard, Inc.](#); X-SEAL Anchor.
- 2.8 MISCELLANEOUS ANCHORS
- A. Anchor Bolts: Headed or L-shaped steel bolts complying with **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**; with **ASTM A 563 (ASTM A 563M)** hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
- 2.9 EMBEDDED FLASHING MATERIALS
- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual", Section 076200 "Sheet Metal Flashing and Trim", and as follows:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, **0.016 inch (0.40 mm)** thick.
 2. Fabricate continuous flashings in sections **96 inches (2400 mm)** long minimum, but not exceeding **12 feet (3.7 m)**. Provide splice plates at joints of formed, smooth metal flashing.

3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at **3-inch (76-mm)** intervals along length of flashing to provide an integral mortar bond.
 - a. **Products:** Subject to compliance with requirements, provide one of the following:
 - 1) **Cheney Flashing Company;** Cheney 3-Way Flashing (Sawtooth).
 - 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 metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least **3 inches (76 mm)** into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
6. Metal Drip Edge: Fabricate from stainless steel. Extend at least **3 inches (76 mm)** into wall and **1/2 inch (13 mm)** out from wall, with outer edge bent down 30 degrees and hemmed.
7. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Asphalt-Coated Copper Flashing: **7-oz. /sq. ft. (2-kg/sq. m)** 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. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

D. 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.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Weep/Vent Products: Use the following unless otherwise indicated:

1. Wicking Material: Absorbent rope, made from cotton or UV-resistant synthetic fiber, **1/4 to 3/8 inch (6 to 10 mm)** in diameter, in length required to produce **2-inch (50-mm)** exposure on exterior and **18 inches (450 mm)** in cavity. Use only for weeps.
2. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, **3/8-inch (9-mm)** OD by **4 inches (100 mm)** long.

B. 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:
 - a. [Advanced Building Products Inc.](#); Mortar Maze
 - b. [Archovations, Inc.](#); CavClear Masonry Mat.
2. Provide the following configurations:
 - a. Sheets or strips full depth of cavity and installed to full height of cavity.
- C. 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 (3.77-mm)** steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars 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. [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.

2.11 MASONRY-CELL INSULATION

- A. Loose-Granular Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

2.12 MISCELLANEOUS CAVITY-WALL INSULATION

- A. Extruded-Polystyrene Board Insulation with Increased R-Value: ASTM C 578, Type IV, but with an aged thermal resistance (R-value) for **1-inch (25-mm)** thickness of **5.6 deg F x h x sq. ft. /Btu at 75 deg F (1.0 K x sq. m/W at 24 deg C)** at 5 years; closed-cell product with a carbon-black filler and extruded with an integral skin.
- B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.13 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:
 - a. [Diedrich Technologies, Inc.](#)
 - b. [EaCo Chem, Inc.](#)
 - c. [ProSoCo, Inc.](#)

2.14 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 mortar.
 - 3. 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 C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.
 - 1. For masonry below grade or in contact with earth, use Type S.
 - 2. For reinforced masonry, use Type N.
 - 3. For mortar parge coats, use Type S.
 - 4. 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.
 - 5. For interior non-load-bearing partitions, Type O may be used instead of Type N.
- D. Grout for Unit Masonry: Comply with ASTM C 476.
 - 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 C 476, Table 1.
 - 3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 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.

3.2 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.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. 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 (3 mm in 3 m).
 - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m) maximum.
 - 3. 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 (3 mm in 3 m) maximum.
 - 4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm). Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
 - 5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
 - 6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.
 - 7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.3 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 (100-mm) 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 (50 mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) 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 (600 mm)** 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. 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 provide **1/2-inch (13-mm)** clearance between end of anchor rod and end of tube. Space anchors **48 inches** o.c. unless otherwise indicated.
 - 2. 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. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.4 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 cast-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 (19 mm)** 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.

3.5 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 1.77 sq. ft. (0.16 sq. m) of wall area spaced not to exceed 16 inches (406 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
 - 2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
 - a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement to allow for differential movement regardless of whether bed joints align.
 - 3. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. 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.
- D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.
- E. Coat below grade masonry to comply with Section 071113 "Bituminous Dampproofing."
- F. Apply Insulating Air Barrier to face of backup wythe to comply with Section 072100 "Insulating Air Barriers."
- G. Installing Miscellaneous Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) 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.

3.6 MASONRY-CELL INSULATION

- A. Pour granular insulation into cavities to fill void spaces. Maintain inspection ports to show presence of insulation at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of insulation to 1 story high, but not more than 20 feet (6 m).

3.7 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of **5/8 inch (16 mm)** on exterior side of walls, **1/2 inch (13 mm)** elsewhere. Lap reinforcement a minimum of **6 inches (150 mm)**.
1. Space reinforcement not more than **16 inches (406 mm)** o.c.
 2. Space reinforcement not more than **8 inches (203 mm)** o.c. in foundation walls and parapet walls.
 3. Provide reinforcement not more than **8 inches (203 mm)** above and below wall openings and extending **12 inches (305 mm)** beyond openings.
- 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 returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL

- A. Anchor masonry to structural steel where masonry abuts or faces structural steel to comply with the following:
1. Provide an open space not less than **1/2 inch** wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 3. Space anchors as indicated, but not more than **24 inches (610 mm)** o.c. vertically and **36 inches (915 mm)** o.c. horizontally.

3.9 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
1. Fasten screw-attached anchors through sheathing to wall framing metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
 2. Embed tie sections in masonry joints. Provide not less than **2 inches (50 mm)** of air space between back of masonry veneer and face of sheathing.
 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
 4. 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 **2.67 sq. ft. (0.25 sq. m)** of wall area. Install additional anchors within **12 inches (305 mm)** of openings and at intervals, not exceeding **36 inches (914 mm)**, around perimeter.

3.10 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.

B. Form control joints in concrete masonry as follows:

1. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint **4 inches (100 mm)** 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. Form open joint full depth of brick wythe and of width indicated, but not less than **3/8 inch (10 mm)** for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of **8 inches (200 mm)** at each jamb unless otherwise indicated.

3.12 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 **8 inches**, and through inner wythe to within **1/2 inch (13 mm)** of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately **2 inches (50 mm)** on interior face.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least **8 inches (200 mm)**; with upper edge tucked under building paper or building wrap, lapping at least **4 inches (100 mm)**.
4. At lintels and shelf angles, extend flashing a minimum of **6 inches (150 mm)** into masonry at each end. At heads and sills, extend flashing **6 inches (150 mm)** at ends and turn up not less than **2 inches (50 mm)** to form end dams.
5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than **1-1/2 inches (38 mm)** or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam.
7. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing **1/2 inch (13 mm)** back from outside face of wall and adhere flexible flashing to top of metal drip edge.
8. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

- D. 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. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
 - 3. Space weep holes formed from wicking material **16 inches** o.c.
 - 4. Trim wicking material flush with outside face of wall after mortar has set.
- E. 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 (50 mm)**, to maintain drainage.
- F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- G. 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.

3.13 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**.

3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner 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.

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 (19 mm)**. 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 (3 mm per 300 mm)**. Form a wash at top of parging and a cove at bottom.
- 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 Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and 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 brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 7. 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 (100 mm)** 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 Section 312000 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within **18 inches (450 mm)** 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 Owner's property.

END OF SECTION 042000

SECTION 047000

ARCHITECTURAL STONE VENEER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Architectural simulated stone veneer and trim.

1.2 RELATED SECTIONS

- A. Section 05400 - Cold Formed Metal Framing.
- B. Section 06160 - Sheathing.
- C. Section 07600 - Flashing and Sheet Metal.
- D. Section 07920 - Joint Sealants.

1.3 REFERENCES

- A. American National Standards Institute (ANSI): ANSI A118.4 Specifications for Latex-Portland Cement Mortar.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 2. ASTM C 67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
 - 3. ASTM C 144 - Standard Specification for Aggregate for Masonry Mortar.
 - 4. ASTM C 177 - Standard Test Method for Steady-State Head Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - 5. ASTM C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 6. ASTM C 270 - Standard Specification for Mortar for Unit Masonry.
 - 7. ASTM C 482 - Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement.
 - 8. ASTM C 567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
 - 9. ASTM C 847 - Standard Specification for Metal Lath.
 - 10. ASTM C 932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering.
 - 11. ASTM C 979 - Standard Specification for Pigments for Integrally Colored Concrete.
 - 12. ASTM C 1032 - Standard Specification for Woven Wire Plaster Base.
 - 13. ASTM C 1059 - Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
 - 14. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- C. International Code Council (ICC):
 - 1. ICC Evaluation Service - Evaluation Report AC51- Acceptance Criteria for Precast Stone Veneers.
- D. Underwriter's Laboratory (UL): Building Materials Directory.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Masonry Veneer Manufacturers Association (MVMA) see masonryveneer.org:
 - 1. Preparation instructions.
 - 2. Storage and handling requirements.
 - 3. Installation methods.
- C. Selection Samples: Standard sample board consisting of small-scale pieces of veneer units showing full range of textures and colors.
- D. Verification Samples: Following initial sample selection submit "laid-up" sample board using the selected stone and mortar materials and showing the full range of colors expected in the finished Work; minimum sample size: 3 feet by 3 feet (1 m by 1 m).
- E. Quality Assurance/Control Submittals:
 - 1. Qualifications:
 - a. Proof of manufacturer qualifications.
 - b. Proof of installer qualifications.
 - 2. Regulatory Requirements: Evaluation reports.
 - 3. Installation instructions for related materials.
- F. Closeout Submittals: Reference Section 01780 - Closeout Submittals; submit following items:
 - 1. Maintenance Instructions.
 - 2. Special Warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced mason familiar with installation procedures for manufactured veneer.
- B. Product Certifications:
 - 1. ICC Evaluation Service - Evaluation Report ESR-1215.
 - 2. UL - Classification listing in Building Materials Directory: UL 546T (F8002).
- C. Mock-Up: Provide a mock-up for evaluation of final appearance.
 - 1. Prepare 4 foot by 4 foot (1220 mm by 1220 mm) sample at a location on the structure as selected by the Architect. Use approved selection sample materials and colors.
 - 2. Obtain Architect's approval.
 - 3. Protect and retain sample as a basis for approval of completed manufactured stone work. Approved sample may be incorporated into completed work.
 - 4. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 5. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction..

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

- A. Manufacturer warranty: Period of fifty years against manufacturing defects when used on structures conforming to local building codes and when installed in accordance with manufacturer's written instructions.
1. Warranty coverage specifically excludes damage resulting from wall movement, settlement of the building, contact with chemicals or paint, discoloration due to contaminates, staining or oxidation.
 2. Warranty coverage is limited to replacement or repair of defective materials only and does not cover labor to remove or replace materials. Warranty coverage is limited to the original purchaser.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- a. Substitutions: Requests for substitutions shall be made in writing at least ten days prior to the date of the Bid Opening and must meet the requirements set forth in Instructions to Bidders.
- b. Basis of Design Manufacturers:
1. El Dorado Stone – Mountain Ledge
 - a. Series Accent Color: As selected from Manufacturer's full range
 - b. Include matching corner pieces
 2. Mountain Stone – Ledgestone
 - a. Series Accent Color: As selected from Manufacturer's full range
 - b. Include matching corner pieces

2.2 STONE VENEER:

- A. Veneer Unit Properties: Precast stone veneer units and accent pieces consisting of Portland cement, lightweight aggregates, and mineral oxide pigments.
1. Compressive Strength: ASTM C 192 and ASTM C 39, 5 sample average: greater than 1,800 psi (12.4MPa).
 2. Shear Bond: ASTM C 482: 50 psi (345kPa).
 3. Water Absorption: ICC Evaluation Service AC 51 (Section 4.6 and Table 2): Less than 22 percent when density is less than 85 PCF; less than 18 percent when density is less than 105 PCF.
 4. Freeze-Thaw Test: ASTM C 67: Less than 3 percent weight loss and no disintegration.
 5. Thermal Resistance: ASTM C 177: 0.473 at 1.387 inches (35 mm) thick.

2.3 RELATED MATERIALS

- A. Weather Resistive Barrier: ASTM D 226, Type 1, No. 15, non-perforated asphalt-saturated felt paper.
- B. Reinforcing: Complying with code agency requirements for the type of substrate over which stone veneer is installed.
1. ASTM C 847, 2.5lb/yd² (1.4kg/m²) galvanized expanded metal lath.
 2. ASTM C 847, 3.4lb (1.8 kg/m²) galvanized 3/8 inch (9.5 mm) rib lath.
 3. ASTM C 1032, 18 gauge (1.3 mm) woven wire mesh.
- C. Mortar:
1. Cement: Cement complying with ASTM C 270.
 2. Lime: ASTM C 207.

3. Sand: ASTM C 144, natural or manufactured sand.
4. Color Pigment: ASTM C 979, mineral oxide pigments.
5. Water: Potable.
6. Pre-Packaged Latex-Portland Cement Mortar: ANSI A118.4.

- D. Bonding Agent:
1. Exterior integral bonding agent meeting ASTM C 932.

- E. Sealer:
1. Water based silane or siloxane masonry sealer, clear.

2.4 MORTAR

- A. Standard Installation (Grouted Joints):
1. Mix mortar in accordance with ASTM C 270, Type N or S.
 - a. Add color pigment in grout joint mortar in accordance with pigment manufacturer's instructions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Examine substrates upon which work will be installed.
- C. Commencement of work by installer is acceptance of substrate.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Protection: Protect adjacent work from contact with mortar.
- B. Clean surfaces thoroughly prior to installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install and clean stone in accordance with Standard Installation Grouted Joint.
- C. Apply sealer in accordance with sealer manufacturer's installation instructions.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Manufacturer's Field Service Representative shall make periodic site visits for installation consultation and inspection as requested by Owner.

3.6 CLEANING

- A. Remove protective coverings from adjacent work.
- B. Cleaning Veneer Units:
 - 1. Wash with soft bristle brush and water/granulated detergent solution.
 - 2. Rinse immediately with clean water.
- C. Removing Efflorescence:
 - 1. Allow veneer to dry thoroughly.
 - 2. Scrub with soft bristle brush and clean water.
 - 3. Rinse immediately with clean water; allow to dry.
 - 4. If efflorescence is still visible, repeat above procedure using a solution of 1 part household vinegar and 5 parts water.
 - 5. Rinse immediately with clean water.

END OF SECTION

SECTION 047200 - CAST STONE MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Cast stone trim including but not limited to the following:
 - a. Window sills.
 - b. Lintels.
 - c. Wall caps.
 - d. Date stone (with incised date)

B. Related Sections:

- 1. Section 042000 "Unit Masonry" for installing cast stone units in unit masonry.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

- 1. For cast stone units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

- 1. Include building elevations showing layout of units and locations of joints and anchors.
- 2. Submit calculations sealed by a Delaware Professional Engineer for all cast stone units and anchorages.

C. Samples for Initial Selection: For colored mortar.

D. Samples for Verification:

- 1. For each color and texture of cast stone required, 10 inches (250 mm) square in size.
- 2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicated types and amounts of pigments used.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For each mix required to produce cast stone, based on testing according to ASTM C 1364, including test for resistance to freezing and thawing.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this project that has sufficient production capacity to manufacture required units, and is a plant certified by the Cast Stone Institute.
- B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- C. Source Limitations for Cast Stone: Obtain cast stone units through single source from single manufacturer.
- D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- E. Mockups: Furnish cast stone for installation in mockups specified in Section 042000 "Unit Masonry."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Coordinate delivery of cast stone with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
- B. Pack, handle, and ship cast stone units in suitable packs or pallets.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move cast stone units, if required, using dollies with wood supports.
 - 2. Store cast stone units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.7 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until cast stone has dried, but no fewer than seven days after completing cleaning.

- B. Hot-Weather Requirements: Comply with hot-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
1. Advanced Cast Stone, Inc.
 2. Cast Stone Systems, Inc.
 3. Reading Rock, Inc.
- B. Substitutions: Requests for substitutions shall be made in writing at least ten days prior to the date of the Bid Opening and must meet the requirements set forth in Instructions to Bidders.

2.2 CAST STONE MATERIALS

- A. General: Comply with ASTM C 1364 and the following:
- B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce cast stone color indicated.
- C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required cast stone textures and colors.
- D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required cast stone textures and colors.
- E. Admixtures: Use only admixtures specified or approved in writing by Architect.
1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.
 2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.
 3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.
- F. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60 (Grade 420). Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches (38 mm) of cast stone material.
1. Epoxy Coating: ASTM A 775/A 775M.
 2. Galvanized Coating: ASTM A 767/A 767M.
- G. Embedded Anchors and Other Inserts: Fabricated from stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666, Type 304.

2.3 CAST STONE UNITS

- A. Provide cast stone units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.
 - 1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.
- B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.
 - 1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.
 - 2. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
 - 3. Provide drips on projecting elements unless otherwise indicated.
- C. Fabrication Tolerances:
 - 1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch (3 mm).
 - 2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater, but in no case by more than 1/4 inch (6 mm).
 - 3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch (3 mm), whichever is greater.
 - 4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch (3 mm) on formed surfaces of units and 3/8 inch (10 mm) on unformed surfaces.
- D. Cure units as follows:
 - 1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F (38 deg C) for 12 hours or 70 deg F (21 deg C) for 16 hours.
 - 2. Keep units damp and continue curing to comply with one of the following:
 - a. No fewer than five days at mean daily temperature of 70 deg F (21 deg C) or above.
 - b. No fewer than six days at mean daily temperature of 60 deg F (16 deg C) or above.
 - c. No fewer than seven days at mean daily temperature of 50 deg F (10 deg C) or above.
 - d. No fewer than eight days at mean daily temperature of 45 deg F (7 deg C) or above.
- E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- F. Colors and Textures: As selected by Architect from manufacturer's full range.

2.4 MORTAR MATERIALS

- A. Provide mortar materials that comply with Section 042000 "Unit Masonry."
- B. Water: Potable.

2.5 ACCESSORIES

- A. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

- B. Dowels: 1/2-inch- (12-mm-) diameter, round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.
- C. 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 cast stone manufacturer and expressly approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Diedrich Technologies, Inc.
 - b. EaCo Chem, Inc.
 - c. ProSoCo, Inc.

2.6 MORTAR MIXES

- A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

2.7 SOURCE QUALITY CONTROL

- A. Engage a qualified independent testing agency to sample and test cast stone units according to ASTM C 1364.
 - 1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 SETTING CAST STONE IN MORTAR

- A. Install cast stone units to comply with requirements in Section 042000 "Unit Masonry."
- B. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
 - 1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 - 2. Coordinate installation of cast stone with installation of flashing specified in other Sections.
- C. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
- D. Set units in full bed of mortar with full head joints unless otherwise indicated.

1. Set units with joints 3/8" wide unless otherwise indicated.
 2. Build anchors and ties into mortar joints as units are set.
 3. Fill dowel holes and anchor slots with mortar.
 4. Fill collar joints solid as units are set.
 5. Build concealed flashing into mortar joints as units are set.
 6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
 7. Keep joints at shelf angles open to receive sealant.
- E. Rake out joints for pointing with mortar to depths of not less than 3/4 inch (19 mm). Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- F. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch (10 mm). Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- G. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- H. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated.
1. Keep joints free of mortar and other rigid materials.
 2. Build in compressible foam-plastic joint fillers where indicated.
 3. Form joint of width indicated, but not less than 3/8 inch (10 mm).
 4. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
 5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
 2. Shim and adjust anchors, supports, and accessories to set cast stone in locations indicated with uniform joints.
- B. Keep cavities open where unfilled space is indicated between back of cast stone units and backup wall; do not fill cavities with mortar or grout.
- C. Fill anchor holes with sealant.
1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- D. Set cast stone supported on clip or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths. Hold shims back from face of cast stone a distance at least equal to width of joint.

- E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and cast stone units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
 - 1. Form open joint of width indicated, but not less than 3/8 inch (10 mm).
- F. Prime cast stone surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
- G. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- B. Variation from Level: Do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches (3 mm in 900 mm) or one-fourth of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch (1.5 mm), except where variation is due to warpage of units within tolerances specified.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
- B. Replace units in a manner that results in cast stone matching approved Samples, complying with other requirements, and showing no evidence of replacement.
- C. In-Progress Cleaning: Clean cast stone as work progresses.
 - 1. Remove mortar fins and smears before tooling joints.
 - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of cast stone.
 - 3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
 - 5. Clean cast stone by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION 047200

SECTION 047300 - CAST STONE CONCRETE MASONRY VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Cast stone concrete masonry veneer (Architectural Masonry Veneer).
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry" for mortar and grout.
 - 2. Division 7 Section "Joint Sealants."
 - 3. Division 4 Section "Cast Stone"

1.3 DEFINITIONS

- A. Cast Stone Concrete Masonry Veneer: An architectural stone unit manufactured to copy fine grain texture and color of natural cut stone. Meets ASTM C 90 requirements.
- B. Dry Cast Concrete Products: Manufactured from zero-slump concrete.
- C. Machine Casting Method: Vibratory compaction by machine of earth-moist, zero-slump concrete against rigid mold until it is densely compacted.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for cast stone units.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions; details for reinforcement and anchorages, if any; and indication of finished faces.
 - 1. Include building elevations showing layout of units and locations of joints and anchors.
- C. Samples for Verification:
 - 1. For each color and texture of cast stone required, 12 inches (305 mm) square in size.

2. For each mortar color required, showing the full range expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. Label samples to indicate type and amount of colorant used. Provide sample for masonry mock-up panel.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of cast stone with requirements indicated.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
1. Sufficient plant facilities to provide quality, shapes, quantities, and sizes of architectural stone units required without delaying progress of the Work.
 2. Minimum of 10 years experience in producing masonry units.
 3. Custom Cast Stone Series and Architectural Masonry Veneer Series are to be manufactured from a similar mix design to match color and texture.
 4. Manufacturer shall have an internal Quality Assurance Testing Program with certified laboratory technician(s).
- B. Mockup: Prior to installing cast stone concrete masonry, construct mockup wall panels to verify selections made under sample submittals and from sample panels to demonstrate aesthetic effects of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final unit of Work.
1. Locate mockups on site in the locations indicated or, if not indicated, as directed by Architect.
 2. Build mockup of typical wall area as shown on drawings.
 - a. Include sealant-filled joint complying with requirements of Division 7 Section "Joint Sealants."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
1. Deliver architectural stone units secured to shipping pallets and protected from damage and discoloration.
 2. Provide itemized shipping list.
 3. Number each piece individually, as required, to match shop drawings and schedules.
- B. Storage:
1. Store architectural stone units and installation materials in accordance with manufacturer's instructions.
 2. Store architectural stone units on pallets with nonstaining, waterproof covers.
 3. Do not double stack pallets.
 4. Ventilate units under covers to prevent condensation.

5. Prevent contact with dirt and splashing.

C. Handling:

1. Protect architectural stone units, including corners and edges, during storage, handling, and installation to prevent chipping, cracking, staining, or other damage.
2. Handle long units at center and both ends simultaneously to prevent cracking.
3. Do not use pry bars or other equipment in a manner that could damage units.

1.7 COORDINATION

- A. Coordinate production and delivery of cast stone with unit masonry work to minimize the need for on-site storage and to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Reading Rock, Inc. (Basis of Design)
2. Advanced Cast Stone, Inc.

- B. Substitutions: Requests for substitutions shall be made in writing at least ten days prior to the date of the Bid Opening and must meet the requirements set forth in Instructions to Bidders.

2.2 CAST STONE CONCRETE MASONRY VENEER (Architectural Masonry Veneer)

- A. Compliance: ASTM C 90.

- B. Casting Method: Machine.

C. Finish:

1. Type (AMV-1): Size: 3-5/8 x 15-5/8 x 23-5/8 (WxHxL)

- a. Include one of the following selections:

- 1) Reading Rock's Rockcast Architectural Masonry Veneer, Sandstone Smooth
- 2) Advanced Cast Stone equivalent product.

2. Type (AMV-2): Size: 3-5/8 x 7-5/8 x 23-5/8 (WxHxL)

- a. Include one of the following selections:

- 1) Reading Rock's Rockcast Architectural Masonry Veneer, Sandstone Smooth
- 2) Advanced Cast Stone equivalent product

3. Type (AMV-3): Size: 3-5/8 x 3/8 x 23-5/8 (WxHxL)

a. Include one of the following selections:

- 1) Reading Rock's Rockcast Architectural Masonry Veneer, Sandstone Smooth.
- 2) Advanced Cast Stone equivalent product.

D. Test Results:

1. Compressive Strength, ASTM C 140: 4,000 - 6,000 psi at 28 days.
2. Absorption, ASTM C 140: Less than 6 percent at 28 days.
3. Linear Shrinkage, ASTM C 426: Maximum .065 percent.
4. Density, ASTM C 140: Greater than 120 pounds per cubic foot.
5. Freeze-Thaw, ASTM C 666: Less than 5 percent cumulative mass loss after 300 cycles.

E. Curing: Cure in enclosed chamber at 95 percent relative humidity and 95 to 120 degrees F for 12 to 18 hours and yard cure for 350 degree-days.

2.3 ARCHITECTURAL MASONRY VENEER MATERIALS

- A. Portland Cement: ASTM C 150, Type I or III. White and/or gray as required to match specified color.
- B. Coarse Aggregates: ASTM C 33, except for gradation. Granite, quartz, or limestone.
- C. Fine Aggregates: ASTM C 33, except for gradation. Manufactured or natural sands.
- D. Pigments: ASTM C 979, except do not use carbon black pigments. Inorganic iron oxide pigments.
- E. Water Reducing, Retarding, and Accelerating Admixtures: ASTM C 494.
- F. Other admixtures: integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
- G. Water: Potable.

2.4 TEXTURE AND COLOR

- A. General: Match texture and color of full-size sample on file with Architect.
- B. Texture of Surfaces Exposed to View:
 1. Fine-grained texture similar to natural stone and architectural stone units.
 2. Approximately equal to approved sample when viewed in direct daylight at 10 feet.
- C. Surface Air Voids:
 1. Size: Maximum 1/32 inch.
 2. Density: Less than 3 occurrences per any 1 square inch.
 3. Viewing Conditions: Not obvious under direct daylight at 10 feet.

D. Finish:

2. Minor chips shall not be obvious under direct daylight at 20 feet, as determined by Architect.
3. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.

E. Color Variation:

1. Viewing Conditions: Compare in direct daylight at 10 feet, between units of similar age, subjected to similar weathering conditions.

2.5 MORTAR

- A. Mortar: As specified in Section 042000.
- B. Mortar Materials: As specified in Section 042000.

2.6 ACCESSORIES

- A. Anchors: Non-corrosive type, sized for conditions. Type 304 stainless steel.
- B. Sealant: As specified in Section 079200.
- C. Cleaner: Prosoco Sure Klean Custom Masonry Cleaner, Prosoco Sure Klean 600 Detergent, or Prosoco Sure Klean Vana Trol.

2.7 FABRICATION

- A. Shapes: As indicated on drawings.

2.8 TOLERANCES

- A. General: Manufacture architectural stone units within tolerances in accordance with ASTM C 90, unless otherwise specified.
- B. Length, height, width: Do not deviate by more than plus or minus 1/8 inch from approved dimensions. These requirements do not apply to split faced units.

2.9 PRODUCTION QUALITY CONTROL

- A. Mix Designs: Test new and existing mix designs for applicable compressive strength and absorption compliance before manufacturing architectural stone units.
- B. Plant Production Testing: Tests to be conducted by certified laboratory testing technicians. Test from specimens selected at random from plant production in accordance with ASTM C 140.

PART 3 EXECUTION

3.1 EXAMINATION

CAST STONE CONCRETE MASONRY VENEER

- A. Examine construction to receive architectural stone units. Notify Architect if construction is not acceptable. Do not begin installation until unacceptable conditions have been corrected.
- B. Examine architectural stone units before installation. Do not install unacceptable units.

3.2 INSTALLATION

- A. Install units in conjunction with masonry, as specified in Section 042000.
- B. Pull units from multiple cubes during installation to minimize variation in color and help with natural blending.
- C. Cut units using motor-driven masonry saws. Finished ends should be turned to the visible side and the saw cut turned to the inside of the mortar joint to hide exposed aggregates and saw marks.
- D. Do not use pry bars or other equipment in a manner that could damage units.
- E. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
- F. Use Type N mortar (ASTM C 270), unless specified otherwise.
- G. Per ACI 530.1, it is not necessary, nor recommended, to wet the units prior to installation.
- H. Set units in full bed of mortar, unless otherwise indicated on the drawings.
- I. Fill vertical joints with mortar.
- J. Make joints 3/8 inch, unless otherwise indicated on the drawings.
- K. Tuck point mortar joints to slight concave profile (unless specified otherwise).
- L. Remove excess mortar immediately.
- M. Remove mortar fins and smears before tooling joints.
- N. Cover wainscot for protection and bond separation with plastic, felt paper or other approved products.
- O. Cover freshly installed masonry products as required to assist with the curing process.
- P. Sealant Joints:
 - 1. As specified in Section 079200.
 - 2. Prime ends of units, insert properly sized backing rod, and install sealant.
 - 3. Provide sealant joints at following locations:
 - a. Joints at relieving angles.
 - b. Control and expansion joints.
 - c. As indicated on the drawings.

3.3 TOLERANCES

A. Installation Tolerances:

1. Variation from Plumb: Do not exceed 1/8 inch in 5 feet or 1/4 inch in 20 feet or more.
2. Variation from Level: Do not exceed 1/8 inch in 5 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
3. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch or 1/4 of nominal joint width, whichever is greater.
4. Variation in Plane Between Adjacent Surfaces: Do not exceed 1/8-inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4 CLEANING

- A. Clean exposed units after mortar is thoroughly set and cured.
- B. Perform test of cleaner on small area of 4' x 4' on each type and color and receive approval by Architect before full cleaning. Let test area dry 4 to 5 days before inspection. Keep test area for future comparison.
- C. Clean units by wetting down the surface first, before using the specified cleaner (as specified in Section 2.7.C). Brush on cleaner, let dwell for 2 to 3 minutes. Reapply cleaner, scrub surface with masonry brush and rinse off thoroughly. Areas with heavy soiling use a wood block or non-metallic scraper.
- D. Apply cleaner to units in accordance with cleaner manufacturer's instructions.
- E. Do not use the following to clean units:
 1. Muriatic acid.
 2. Power washing.
 3. Sandblasting.
 4. Harsh cleaning materials or methods that would damage or discolor surfaces.

3.5 REPAIR

- A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.
- B. Repair with touchup materials provided by manufacturer in accordance with manufacturer's instructions.
- C. Repair methods and results to be approved by Architect.

3.6 INSPECTION AND ACCEPTANCE

- A. Inspect completed installation in accordance with ACI 530 requirements.

3.7 PROTECTION

- A. Protect installed units from splashing, stains, mortar, and other damage.

END OF SECTION 047300

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
3. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
 2. Welded built-up members with plates thicker than 2 inches (50 mm).
 3. Column base plates thicker than 2 inches (50 mm).
- D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 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 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.

1.5 PREINSTALLATION MEETINGS

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

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. 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. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members and connections of the Seismic-Load-Resisting System.
 - 6. Indicate locations and dimensions of protected zones.
 - 7. Identify demand critical welds.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand critical welds.
- D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

- E. Survey of existing conditions.
- F. Source quality-control reports.
- G. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- B. Comply with applicable provisions of the following specifications and documents:
1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 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. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use Allowable Stress Design; data are given at service-load level.
- B. Moment Connections: Type PR, partially restrained.
- C. Construction: Combined system of moment frame and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992/A 992M, Grade 50 (345).
- C. Channels, Angles: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).
- F. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- G. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.
- H. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
 - 1. Weight Class: See drawings.
 - 2. Finish: See drawings.
- I. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.
 - C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.
 1. Finish: Hot-dip zinc coating.
 - D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 1. Finish: Plain.
 - E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
 - F. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
 1. Configuration: Hooked.
 2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 5. Finish: Plain.
 - G. Headed Anchor Rods: ASTM F 1554, Grade 36 straight.
 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
 4. Finish: Plain or Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
 - H. Threaded Rods: ASTM A 36/A 36M.
 1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
 2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened.
 3. Finish: Plain or Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
 - I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
 - J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
 - K. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- 2.4 PRIMER
- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - B. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

- C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 unless indicated to be finish painted.
- D. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to 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 A 6/A 6M 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/D1.1M.
- 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. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning.", SSPC-SP 2, "Hand Tool Cleaning." Or SSPC-SP 3, "Power Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated.

- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel 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.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless noted otherwise on drawing.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 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 (50 mm).
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. 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 the following specifications and standards:
 - 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."
 - 5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
 - 6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 - 8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
 - 9. SSPC-SP 8, "Pickling."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). 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.

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.

- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

- B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified 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 existing conditions. Include 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.

3.2 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.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates 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 303, "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 are 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.
- E. Splice members only where indicated.

- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless otherwise noted on drawing.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M 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 where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect[and test] bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.

- E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes architecturally exposed structural-steel (AESS).
 - 1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for additional requirements applicable to AESS.
 - 2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
 - 3. Section 099123 "Interior Painting" for surface preparation and priming requirements.

1.3 DEFINITIONS

- A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.

1.4 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.

1.5 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
 - 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. Indicate grinding, finish, and profile of welds.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Indicate exposed surfaces and edges and surface preparation being used.
6. Indicate special tolerances and erection requirements.

B. Samples: Submit Samples of AESS to set quality standards for exposed welds.

1.6 INFORMATIONAL SUBMITTALS

A. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.

1. Build mockup of typical portion of AESS as shown on Drawings.
2. Coordinate painting requirements with Section 099123 "Interior Painting."
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling to prevent twisting, warping, nicking, and other damage. 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.

1.9 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 FILLER

A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.2 FABRICATION

- A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
- B. In addition to special care used to handle and fabricate AESS, comply with the following:
1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 2. Grind sheared, punched, and flame-cut edges of AESS to remove burrs and provide smooth surfaces and edges.
 3. Fabricate AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 4. Fabricate AESS with exposed surfaces free of seams to maximum extent possible.
 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 7. Fabricate AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Fabricate AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
 9. Seal-weld open ends of hollow structural sections with **3/8-inch (9.5-mm)** closure plates for AESS.
- C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of **20 feet (6 m)** under any lighting conditions.
 2. Tolerances for walls of hollow steel sections after rolling shall be approximately **1/2 inch (13 mm)**.
- D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of **1/8 inch (3.2 mm)** with a tolerance of **1/32 inch (0.8 mm)** for AESS.
- E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel 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.

2.3 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 - 2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 - 3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AESS is exposed to weather.
 - 4. Provide continuous welds of uniform size and profile where AESS is welded.
 - 5. Grind butt and groove welds flush to adjacent surfaces within tolerance of **plus 1/16 inch, minus zero inch (plus 1.5 mm, minus zero mm)** for AESS.
 - 6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
 - 7. At locations where welding on the far side of an exposed connection of AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
 - 8. Make fillet welds for AESS oversize and grind to uniform profile with smooth face and transition.

PART 3 - EXECUTION

3.1 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. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS 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.

1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.

3.3 ERECTION

- A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 1. Erect to the tolerances specified in AISC 303 for steel that is designated AESS.
 2. Erect AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
- B. Do not use thermal cutting during erection.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
 2. Remove erection bolts in AESS, fill holes, and grind smooth.
 3. Fill weld access holes in AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Touchup Painting: Cleaning and touchup painting are specified in Section 099123 "Interior Painting."

END OF SECTION 051213

SECTION 052100 - STEEL JOIST FRAMING

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH- and DLH-series long-span steel joists.
5. Joist accessories.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.
3. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

- B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.7 SEQUENCING

- A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/360 of the span.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Camber joists according to SJI's "Specifications."

- G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.3 LONG-SPAN STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows and as indicated on drawings:
 - 1. Joist Type: LH-series steel joists.
 - 2. End Arrangement: Underslung.
 - 3. Top-Chord Arrangement: See drawings.
- B. Provide holes in chord members for connecting and securing other construction to joists.
- C. Camber long-span steel joists according to SJI's "Specifications" unless noted on drawings.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.4 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15 unless indicated to be finish painted.
- C. Primer: Provide shop primer that complies with Section 099113 "Exterior Painting", and Section 099123 "Interior Painting."

2.5 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- D. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated.
- E. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

- F. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated.
- G. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated or Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- H. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
 - 1. Finish: Plain.
- I. Welding Electrodes: Comply with AWS standards.
- J. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A 780.
- K. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thickness indicated to be finish painted.
- D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting", and Section 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.

- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts (as indicated or required).
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements (as indicated or required).
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709.
 - c. Ultrasonic Testing: ASTM E 164.
 - d. Radiographic Testing: ASTM E 94.
- C. Visually inspect bolted connections.
- D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting", and Section 099123 "Interior Painting."
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof deck.
2. Acoustical cellular roof deck.
3. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 035216 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
5. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
6. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.

B. 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of steel deck.

- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- 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 fire rating and Class 1-90 windstorm ratings.

1.6 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.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 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. Fire-Resistance Ratings: Comply with ASTM E 119; 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.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 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:
 - 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. 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:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40 (275), G60 (Z180) zinc coating.
2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: Triple span or more.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACOUSTICAL 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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

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. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

C. Acoustical 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:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40 (275), G60 (Z180) zinc coating.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40 (275) G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Per Architect.
3. Deck Profile: As indicated.
4. Cellular Deck Profile: As indicated.
5. Profile Depth: As indicated.

6. Design Uncoated-Steel Thickness: As indicated.
7. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
8. Span Condition: Triple span or more.
9. Side Laps: Overlapped or interlocking seam at Contractor's option.
10. Acoustical Perforations: Cellular deck units with manufacturer's standard perforated flat-bottom plate welded to ribbed deck.
11. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber.
 - a. Factory install sound-absorbing insulation into cells of cellular deck.
12. Acoustical Performance: NRC as indicated, tested according to ASTM C 423.

2.4 COMPOSITE FLOOR 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:
 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. Verco Manufacturing Co.
 13. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.
- B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40 (275), G60 (Z180) zinc coating.
 2. Profile Depth: As indicated.
 3. Design Uncoated-Steel Thickness: As indicated on drawings.
 4. Span Condition: Triple span or more unless noted otherwise.

2.5 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) 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 (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile indicated and if not indicated recommended by SDI Publication No. 31 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and sloped recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A 780, SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 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.

3.2 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.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- 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.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:
 1. Weld Diameter: 5/8 inch (16 mm) nominal.
 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches (305 mm) apart in the field of roof and 6 inches (150 mm) apart in roof corners and perimeter, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28.
 3. Weld Washers: Install weld washers at each weld location as required.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (457 mm) and as follows:
 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 1. End Joint: Lapped 2 inches (51 mm) minimum or butted at Contractor's option.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.
 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or 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.

- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 5/8 inch (16 mm) nominal.
 - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
 - 3. Weld Spacing: Space and locate welds as indicated.
 - 4. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (914 mm), and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:
 - 1. End Joints: Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Install piercing hanger tabs at 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides unless otherwise indicated.

3.5 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 Architect.
- 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.

3.6 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. 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

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Exterior non-load-bearing wall framing.
2. Ceiling joist framing.
3. Soffit framing.
4. All members indicated on drawings as "Cold-Formed" and/or 20 gauge or heavier.

- B. Related Requirements:

1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.

- B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

- C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

1. Expansion anchors.
2. Power-actuated anchors.
3. Mechanical fasteners.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. 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.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AllSteel & Gypsum Products, Inc.
 2. California Expanded Metal Products Company.
 3. ClarkWestern Building Systems, Inc.
 4. Consolidated Fabricators Corp.; Building Products Division.
 5. Craco Mfg., Inc.
 6. Custom Stud Inc.
 7. Design Shapes in Steel.
 8. Dietrich Metal Framing; a Worthington Industries Company.
 9. Formetal Co. Inc. (The).
 10. MarinoWARE.
 11. Nuconsteel; a Nucor Company.
 12. Olmar Supply, Inc.
 13. Quail Run Building Materials, Inc.
 14. SCAFCO Corporation.
 15. Southeastern Stud & Components, Inc.
 16. State Building Products, Inc.
 17. Steel Construction Systems.
 18. Steel Network, Inc. (The).
 19. Steel Structural Systems.
 20. Steeler, Inc.
 21. Super Stud Building Products, Inc.

22. Telling Industries, LLC.
23. United Metal Products, Inc.
24. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel 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.
 - b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope 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 deg F (67 deg C).
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch (25 mm).
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
 1. Wall Studs: AISI S211.
 2. Headers: AISI S212.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- E. Fire-Resistance Ratings: Comply with ASTM E 119; 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.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: As required by structural performance.
 - 2. Coating: G60 (Z180).

- C. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 33 (230) or 50 (340), Class 1.
 - 2. Coating: G60 (Z180).

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: See drawings.
 - 2. Minimum Flange Width: See drawings.
 - 3. Minimum Section Properties: See drawings.

- 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 (32 mm).

- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AllSteel & Gypsum Products, Inc.
 - b. ClarkWestern Building Systems, Inc.
 - c. Dietrich Metal Framing; a Worthington Industries company.
 - d. MarinoWARE.
 - e. SCAFCO Corporation.
 - f. Steel Network, Inc. (The).
 - g. Steeler, Inc.

- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: As required by design (18 gauge minimum), or as indicated.
 - 2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: As required by design (18 gauge minimum).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: As required by design (18 gauge minimum).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
- F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As required or indicated.
 2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: As required or indicated.
 2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, 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.
 2. Bracing, bridging, and solid blocking.
 3. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- 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 C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

- A. Fabricate cold-formed steel 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 steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M 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 no fewer than three exposed screw threads.
 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, 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 plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel 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 steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M 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.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. 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.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: Install cold-formed steel 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 plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 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 top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches (406 mm) unless noted otherwise.
- 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.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at centers indicated on Shop Drawings.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 CEILING JOIST AND SOFFIT INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Joist spacing: 16 inches (406 mm) or as indicated.
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
- E. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Joist –track solid blocking of width and thickness indicated, secured to joist webs.

2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

- F. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- G. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 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.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- 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.

3.7 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 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 steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Elevator hoist beams.
7. Steel shapes for supporting elevator door sills.
8. Shelf angles.
9. Metal ladders.
10. Alternating tread devices.
11. Metal floor plate and supports.
12. Elevator pit sump covers.
13. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

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 Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing."
4. Section 129300 "Site Furnishings" for bicycle racks.

1.3 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 metal fabrications that are anchored to or that receive other work. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Metal nosings and treads.
 - 3. Paint products.
 - 4. Grout.
- B. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.
- C. Samples representative of materials and finished products as requested by Architect.
- D. Delegated-Design Submittal: For ladders and alternating tread devices, including analysis data signed and sealed by a professional engineer licensed in the state of Delaware responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer licensed in the state of Delaware, to design ladders and alternating tread devices.
- B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

- C. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 3. Uniform and concentrated loads need not be assumed to act concurrently.
 4. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- D. 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 deg F ambient; 180 deg F, material surfaces.

2.2 METALS

- 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.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless-steel fasteners for fastening aluminum.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- D. 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 E 488/E 488M, conducted by a qualified independent testing agency.

- E. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- F. Post-Installed Anchors: Torque-controlled expansion anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [**Group 1 (A1)**] [**Group 2 (A4)**] stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- 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 D 1187/D 1187M.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 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 (1 mm) 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 are 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.
- J. 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 (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 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 indicated and as recommended by partition manufacturer with attached bearing plates, anchors, and braces as indicated and 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.
- D. Galvanize miscellaneous framing and supports at exterior locations and interior locations where indicated.
- E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 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 (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) 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 (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.

2.8 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space side rails 18 inches apart unless otherwise indicated.
2. Side rails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
8. Galvanize and prime ladders, including brackets.

2.9 ALTERNATING TREAD DEVICES

- A. Landings, Treads, and Mounting Base: shall be stamped and formed from single piece material. Stock shapes, hand forming, or welded remnants shall not be permitted. All stamped parts shall have integrally formed rigidizing bends and shall be spot welded to stringers of like material.
- B. Welds: shall be a minimum of 8 welds per tread, and 12 welds each on the landing and mounting base. Each weld shall be quality controlled and be capable of withstanding a minimum of 2800 lbs. in shear.
- C. Pedestrian Surfaces: shall be punched through with upset non-skid openings.
- D. Riser Spacing: shall be equally spaced to within 3/16" for adjacent risers and to widths 3/8" for any two non-adjacent risers on a stair.
- E. Handrails: shall be contoured for body guidance and underarm support and shall be attached to the outside stringers and landings by bolting.
- F. Landing Reinforcement: shall be with 1/4" steel angle notched and punched and factory welded to the landing at the points of a handrail attachment.
- G. Rubber Foot Divider: shall be affixed to the central portion of the landing. A rubber bumper strip shall be attached or will be provided for field gluing to the central stringer.

- H. Acceptable Manufacturers: As manufactured by Lapeyre Stair, Inc. or approved equivalent.
- I. Finish: Manufacturer's standard safety yellow powder coat finish.

2.10 ELEVATOR PIT SUMP COVERS

- A. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 3/4 inch (19 mm) in least dimension.
- B. Provide steel angle supports as indicated.

2.11 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 and prime exterior miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

2.12 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.13 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 (200 mm) unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.

2.14 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.

2.15 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. 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 universal shop primer unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. 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.

2.17 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.
- B. Clear Anodic Finish: AAMA 611, Class I, AA-M12C22A41.

PART 3 - EXECUTION

3.1 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.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.
 - 2. Extruded Aluminum: Two coats of clear lacquer.

3.2 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, overhead doors, overhead grilles securely to, and rigidly brace from, building structure.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 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 (0.05-mm) dry film thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055113 – METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Preambled steel stairs with concrete-filled treads.
2. Steel tube railings and guardrail infill attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 055213 "Pipe and Tube Railings" for pipe and tube railings.

1.3 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 for metal stairs. 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.
- C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

1.4 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Prefilled metal-pan-stair treads.
2. Precast concrete treads.
3. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For stairs, guards, and railings, including analysis data signed and sealed by the professional engineer licensed in Delaware responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a professional engineer licensed in Delaware to design stairs, guards, and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
 - 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
 - 3. Uniform and concentrated loads need not be assumed to act concurrently.
 - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
 - 5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch (6.4 mm), whichever is less.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Steel Tubing: ASTM A 500 (cold formed).
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, **Grade 25 (Grade 170)**, unless another grade is required by design loads; exposed.
- F. Woven-Wire Mesh: Lockcrimp weave, square pattern, 2-inch (50-mm) woven-wire mesh, made from minimum 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ATSM A 510M).
 - 1. Basis-of-design: McNichols Company; square weave wire mesh #3693160041.

2.3 FASTENERS

- A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or **ASTM F 1941 (ASTM F 1941M)**, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, **ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6)**; with hex nuts, **ASTM A 563 (ASTM A 563M)**; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, **ASTM A 563 (ASTM A 563M)**; and, where indicated, flat washers.
- D. Post-Installed Anchors: Torque-controlled expansion 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 E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or **ASTM F 1941 (ASTM F 1941M)**, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

- D. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.
- E. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, guards, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
 - 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections 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. Weld exposed corners and seams continuously unless otherwise indicated.
 - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.6 STEEL-FRAMED STAIRS

- A. Manufacturers:
 - 1. Alfab, Inc.
 - 2. American Stair, Inc.
 - 3. Sharon Companies Ltd. (The).
- B. Stair Framing:

1. Fabricate stringers of steel plates or channels.
 - a. Provide closures for exposed ends of channel stringers.
 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
 3. Weld stringers to headers; weld framing members to stringers and headers.
 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than **0.0677 inch (1.7 mm)**.
1. Steel Sheet: Uncoated cold-rolled steel sheet, unless otherwise indicated.
 2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
 3. Shape metal pans to include nosing integral with riser.
 4. Attach abrasive nosings to risers.
 5. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
 6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
 - a. Smooth Soffit Construction: Construct subplatforms with smooth soffits.
- D. Perforated Stainless Steel Riser: At Stair C110A.
1. Configuration: As shown on drawings.

2.7 STAIR RAILINGS

- A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
1. Configuration: As shown on drawings
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint as shown in NAAMM AMP 521.
- C. Form changes in direction of railings as follows:
1. As detailed.
- D. Close exposed ends of railing members with prefabricated end fittings.

- E. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is **1/4 inch (6 mm)** or less.
- F. Connect posts to stair framing by direct welding unless otherwise indicated.
- G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
 - 1. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
 - 2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
 - 3. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides **1-1/2-inch (38-mm)** clearance from inside face of handrail to finished wall surface.
- H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

- E. 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.
- F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."
 - 1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.
- H. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
 - 1. Anchor posts to steel by welding to steel supporting members.
 - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 055113

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.
- B. Related Requirements:
 - 1. Section 055112 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.

1.3 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 for railings. 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.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For guards and railings, including analysis data signed and sealed by the professional engineer licensed in Delaware responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Pipe and Tube Railings:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Wagner, R & B, Inc.](#)
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a professional engineer licensed in Delaware to design guards and railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of **50 lbf/ ft. (0.73 kN/m)** applied in any direction.
 - b. Concentrated load of **200 lbf (0.89 kN)** applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of **50 lbf (0.22 kN)** applied horizontally on an area of **1 sq. ft. (0.093 sq. m)**.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 1. Temperature Change: **120 deg F**, ambient; **180 deg F material surfaces**.

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides **1-1/2-inch (38-mm)** clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed).
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Woven-Wire Mesh: Lockcrimp weave, square pattern, 2-inch (50-mm) woven-wire mesh, made from minimum 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).
 - 1. Basis-of-design: McNichols Company; square weave wire mesh #3693160041.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or **ASTM F 1941 (ASTM F 1941M)**, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or **ASTM F 1941 (ASTM F 1941M)**, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately $1/32$ inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

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 flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:

1. As detailed.

J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is **1/4 inch (6 mm)** or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide stainless-steel sleeves not less than **6 inches (150 mm)** long with inside dimensions not less than **1/2 inch (13 mm)** greater than outside dimensions of post, with metal plate forming bottom closure.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Shop prime uncoated railings with primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" unless primers specified in Section 099600 "High-Performance Coatings" are indicated.
 - 2. Do not apply primer to galvanized surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of **1/16 inch in 3 feet (2 mm in 1 m)**.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet (6 mm in 3.5 m)**.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending **2 inches (50 mm)** beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within **6 inches (150 mm)** of post.

3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than **5 inches (125 mm)** deep and **3/4 inch (20 mm)** larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and connected to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - 4. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum **2.0-mil (0.05-mm)** dry film thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking, cants, and nailers.
 - 3. Plywood backing panels.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing."

1.3 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.
- D. 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. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.5 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.

1.6 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

2.1 WOOD PRODUCTS, GENERAL

- A. 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.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA 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.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. 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.
- D. Application: Treat items indicated on Drawings, and the following:
 - 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, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
 - 1. Plywood backing panels.

2.4 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. Rooftop equipment bases and support curbs.
 - 4. Cants.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Mixed southern pine; SPIB.
 - 3. Spruce-pine-fir; NLGA.
 - 4. Hem-fir; WCLIB or WWPA.
 - 5. Northern species; NLGA.
 - 6. Eastern softwoods; NeLMA.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and the following species and grades:
 - 1. Mixed southern pine; No. 2 grade; SPIB.
 - 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - 4. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 5. Northern species; No. 2 Common grade; NLGA.

- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 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 of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- 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 E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

PART 3 - EXECUTION

3.1 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 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. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

- C. 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 (406 mm) o.c.
- D. 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.
- E. Comply with AWPAC 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.
- F. 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.
- G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072110 "Insulating Air Barriers" for water-resistive insulating air barrier applied over wall sheathing.

1.3 ACTION 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 plywood complies 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 plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 WOOD PANEL PRODUCTS

- A. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
- C. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWWA 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.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than **10.5 feet (3.2 m)** beyond the centerline of the burners at any time during the test.
 - 1. Use treatment that does not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified.
- C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.
- E. Application: Treat all plywood.

2.5 WALL SHEATHING

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
1. Span Rating: Not less than 16/0.
 2. Nominal Thickness: Not less than **1/2 inch (13 mm)**.
- B. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corporation; GlasRoc.
 - b. G-P Gypsum Corporation; Dens-Glass Gold.
 - c. National Gypsum Company; Gold Bond e (2) XP.
 - d. Temple-Inland Inc.; GreenGlass
 - e. United States Gypsum Co.; Securock.
 2. Type and Thickness: Regular, **1/2 inch (13 mm)** thick.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
1. of more than 800 hours according to ASTM B 117.
- D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer

or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.7 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 1. NES NER-272 for power-driven fasteners.
 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall and Roof Sheathing:
 - a. Screw to cold-formed metal framing.
 - b. Space panels **1/8 inch (3 mm)** apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install boards with a **3/8-inch (9.5-mm)** gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards with a **1/4-inch (6.4-mm)** gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
 - 1. Space fasteners approximately **8 inches (200 mm)** o.c. and set back a minimum of **3/8 inch (9.5 mm)** from edges and ends of boards.
 - 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately **8 inches (200 mm)** o.c. and set back a minimum of **3/8 inch (9.5 mm)** from edges and ends of boards.
 - 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
 - 1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Interior standing and running trim.
2. Custom Plastic-laminate cabinets.
3. Custom Plastic-laminate countertops.
4. Custom Solid-surfacing-material countertops.
5. Custom Solid-surfacing at curtain wall and storefront sills.
6. Shop finishing of interior woodwork.

- B. Related Sections include the following:

1. 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.
2. Division 09 "Wood Veneer Wall Panels" for panels at front of stage.
3. Division 12 Section "Manufactured Wood Casework" for general casework of stock design and related countertops.

1.3 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.

1.4 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.
- C. 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.

D. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.
3. Plastic laminates.
4. PVC edge material.
5. Thermoset decorative panels.
6. Solid-surfacing materials.

E. Samples for Verification:

1. Lumber with or for transparent finish, not less than 5 inches (125 mm) wide by 24 inches (600 mm) long, for each species and cut, finished on 1 side and 1 edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
4. Lumber and panel products with shop-applied opaque finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels, for each finish system and color, with 1/2 of exposed surface finished.
5. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
6. Solid-surfacing materials, 6 inches (150 mm) square.
7. Corner pieces as follows:
 - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.
 - b. Miter joints for standing trim.
8. Exposed cabinet hardware and accessories, one unit for each type and finish.

F. Product Certificates: For each type of product, signed by product manufacturer.

G. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Certified participant in AWI's Quality Certification Program.
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.
- 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 indicating that woodwork, including installation, complies with requirements of grades specified.
 2. Reference QCP project number 12.0866.

1.6 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.

1.7 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 between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 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.

1.8 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

2.1 WOODWORK FABRICATORS

- A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:

2.2 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. Wood Species for Opaque Finish: Any closed-grain hardwood.
- C. Wood Products: Comply with the following:
 - 1. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD.
 - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
 - 5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

- D. 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 semiexposed edges.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
 - 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.
- F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 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. Type: Standard type, unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 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.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
- E. Catches: Magnetic catches, BHMA A156.9, B03141.

- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
 - G. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.
 - H. 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.
 - 2. Box Drawer Slides: Grade 1; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
 - 3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
 - 4. Pencil Drawer Slides: Grade 1; for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.
 - 5. Keyboard Slides: Grade 1; for computer keyboard shelves.
 - 6. Trash Bin Slides: Grade 1HD-100; for trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide.
 - I. Aluminum Slides for Sliding Glass Doors: BHMA A156.9, B07063.
 - J. Door Locks: BHMA A156.11, E07121.
 - K. Drawer Locks: BHMA A156.11, E07041.
 - L. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - 1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett & Company, Inc.
 - M. Paper Slots: 17 inches (432 mm) long by 1-3/4 inches (45 mm) wide by 1 inch (25 mm) deep; black, molded-plastic, paper-slot liner with 1/4-inch (6.4-mm) lip.
 - 1. Product: Subject to compliance with requirements, provide "Model CP-2" by Doug Mockett & Company, Inc.
 - N. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - O. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- 2.4 MISCELLANEOUS MATERIALS
- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
 - B. 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.
 - C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. 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 3/4 Inch (19 mm) Thick or Less: 1/16 inch (1.5 mm).
 2. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: 1/8 inch (3 mm).
 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).
- D. 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 Architect 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.
- E. 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.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

- A. Wood Species: Any closed-grain hardwood.
- B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
- C. Assemble casings in plant except where limitations of access to place of installation require field assembly.
- D. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

2.7 PLASTIC-LAMINATE CABINETS

- A. AWI Type of Cabinet Construction: As indicated.
- B. 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 VGS.
 4. Edges: Grade HGS PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
- C. Materials for Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
 - b. For semiexposed 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.
- D. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- E. 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 indicated by laminate manufacturer's designations.
 2. Match Architect's sample.
 3. As selected by Architect from laminate manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Wood grains, matte finish.
 - d. Patterns, matte finish.
- F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.
- 2.8 PLASTIC-LAMINATE COUNTERTOPS
- A. High-Pressure Decorative Laminate Grade: HGS.
- B. 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 indicated by manufacturer's designations.
 2. Match Architect's sample.
 3. As selected by Architect from manufacturer's full range in the following categories:
 - a. Solid colors, matte finish.
 - b. Solid colors with core same color as surface, matte finish.
 - c. Wood grains, matte finish.
 - d. Patterns, matte finish.
- C. Grain Direction: Parallel to cabinet fronts.

- D. Edge Treatment: Same material, with eased edges at all 90 degree corners, as laminate cladding on horizontal surfaces.
- E. Core Material: Particleboard or medium-density fiberboard.
- F. Core Material at Sinks: Particleboard made with exterior glue.
- G. Backer Sheet: Provide plastic-laminate backer sheet, Grade BKL, on underside of countertop substrate.
- H. Paper Backing: Provide paper backing on underside of countertop substrate.

2.9 SOLID-SURFACING-MATERIAL COUNTERTOPS AND SILLS

- A. Solid-Surfacing-Material Thickness: 3/4 inch (19 mm).
- B. 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 Architect from manufacturer's full range.
- C. 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 shop-applied edges of materials and configuration indicated.
 - 2. Fabricate tops with loose backsplashes for field application.
- D. Install integral sink bowls in countertops in shop.
- E. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

2.10 SHOP FINISHING

- A. Grade: Provide finishes of same grades as items to be finished.
- B. General: Shop finish interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing opaque-finished architectural woodwork.
- C. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.
- D. Transparent Finish:
 - 1. AWI Finish System: Conversion varnish.
 - 2. Staining: Match approved sample for color.
 - 3. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
 - 4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.

5. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - a. Apply wash-coat sealer after staining and before filling.
 6. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.
- E. Opaque Finish:
1. AWI Finish System: As designated in Section 099123-Interior Painting.
 2. Color: As selected by Architect from manufacturer's full range.
 3. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.
- H. 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.
 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
 4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- I. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust 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 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold-applied, cut-back-asphalt dampproofing.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders.
 - 2. Section 042000 "Unit Masonry" mortar parge coat on masonry surfaces.
 - 3. Section 071326 "Self-Adhering Sheet Waterproofing" for waterproofing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. APOC, Inc.; a division of Gardner-Gibson.
 - 2. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.

3. Brewer Company (The).
4. ChemMasters, Inc.
5. Euclid Chemical Company (The); an RPM company.
6. Henry Company.
7. Karnak Corporation.
8. Koppers Inc.
9. Malarkey Roofing Products.
10. Meadows, W. R., Inc.

- B. Brush and Spray Coats: ASTM D 4479, Type I, fibered.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Cut-Back-Asphalt Primer: ASTM D 41.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Patching Compound: Epoxy or latex-modified repair mortar, Asbestos-free fibered, mastic of type recommended in writing by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
1. Test for surface moisture according to ASTM D 4263.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
 - 1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, CUT-BACK-ASPHALT DAMPPROOFING

- A. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat.
- B. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal. /100 sq. ft. (0.5 L/sq. m).
- C. Masonry Backup for Brick Veneer Assemblies: Apply primer and one brush or spray coat at not less than 1 gal. /100 sq. ft. (0.4 L/sq. m).

3.5 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Modified bituminous sheet waterproofing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
 - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.6 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. **Warranty Period:** Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. **Source Limitations for Waterproofing System:** Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. **Modified Bituminous Sheet:** Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. **Products:** Subject to compliance with requirements, provide one of the following:

- a. American Hydrotech, Inc; VM75.
- b. Carlisle Coatings & Waterproofing Inc; CCW MiraDRI 860/861.
- c. Grace Construction Products; W.R. Grace & Co. -- Conn; Bituthene 4000.
- d. Meadows, W.R., Inc; SealTight Mel-Rol.
- e. Polyguard Products, Inc; Polyguard 650.

2. **Physical Properties:**

- a. **Tensile Strength, Membrane:** 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
- b. **Ultimate Elongation:** 300 percent minimum; ASTM D 412, Die C, modified.
- c. **Low-Temperature Flexibility:** Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
- d. **Crack Cycling:** Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
- e. **Puncture Resistance:** 40 lbf (180 N) minimum; ASTM E 154.
- f. **Water Absorption:** 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
- g. **Water Vapor Permeance:** 0.05 perms (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
- h. **Hydrostatic-Head Resistance:** 231 feet minimum; ASTM D 5385.

3. **Sheet Strips:** Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. **General:** Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch (229-mm) centers.
- G. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on both sides with plastic film, nominal thickness 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272.

2.4 INSULATION

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
 3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
 - 1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.
 - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
 - 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).
- D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.
- E. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- F. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- G. Seal edges of sheet-waterproofing terminations with mastic.
- H. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

- I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.
- J. Immediately install protection course with butted joints over waterproofing membrane.

3.4 INSULATION INSTALLATION

- A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.
- C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to Architect.
- B. Prepare test and inspection reports.

3.6 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Perimeter insulation under slabs-on-grade.
2. Cavity-wall insulation.
3. Concealed building insulation.
4. Exposed building insulation.
5. Foamed-in-place insulation.
6. Vapor retarders.

- B. Related Sections include the following:

1. Division 04 Section "Unit Masonry" for insulation installed in cavity walls and masonry cells.
2. Division 07 Section "Self-Adhering Sheet Waterproofing" for insulated drainage panels installed with waterproofing.
3. Division 07 Section "EPDM Roofing" for insulation specified as part of roofing construction.
4. Division 09 Section "Gypsum Board Assemblies" for installation in metal-framed assemblies of insulation specified by referencing this Section.
5. Division 22 Section "Plumbing Insulation."
6. Division 23 Section "HVAC Insulation."
7. Division 33 Section "Subdrainage" for insulated drainage panels.

1.3 DEFINITIONS

- A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

- A. Plenum Rating: Provide fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.

1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm (13-m/s) air velocity.
2. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with *Chaetomium globosum* on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E 84.
 - 2. Fire-Resistance Ratings: ASTM E 119.
 - 3. Combustion Characteristics: ASTM E 136.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by 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 plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
 - 1. Available Manufacturers:
 - a. DiversiFoam Products.
 - b. Dow Chemical Company.

- c. Owens Corning.
 - d. Pactiv Building Products Division.
- 2. Type IV, 1.60 lb/cu. ft. (26 kg/cu. m), unless otherwise indicated.
- B. Foil-Faced, Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1 or 2, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on tests performed on unfaced core on thicknesses up to 4 inches (101 mm).
 - 1. Available Manufacturers:
 - a. Dow Chemical Company.
 - b. Rmax, Inc.

2.3 GLASS-FIBER BLANKET INSULATION

- A. Available Manufacturers:
 - 1. CertainTeed Corporation.
 - 2. Guardian Fiberglass, Inc.
 - 3. Johns Manville.
 - 4. Knauf Fiber Glass.
 - 5. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- C. Where glass-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt or roll form with thermal resistances indicated:
 - 1. 3-1/2 inches (89 mm) thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F (1.9 K x sq. m/W at 24 deg C).
 - 2. 3-5/8 inches (92 mm) thick with a thermal resistance of 11 deg F x h x sq. ft./Btu at 75 deg F (1.9 K x sq. m/W at 24 deg C).
 - 3. 5-1/2 inches (140 mm) thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F (3.3 K x sq. m/W at 24 deg C).
 - 4. 6-1/2 inches (165 mm) thick with a thermal resistance of 21 deg F x h x sq. ft./Btu at 75 deg F (3.7 K x sq. m/W at 24 deg C).

2.4 FOAMED-IN-PLACE INSULATION

- A. Available Manufacturers:
 - 1. Icynene, Inc.
 - 2. Polymaster, Inc.
 - 3. UCSC.
- B. Foamed-in-place Insulation: Open-cell polyurethane or polyisocyanurate gas chemically treated for flame-resistance, processing, and handling characteristics.

2.5 VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils (0.15 mm) thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
- B. Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 25 lb/1000 sq. ft. (12 kg/100 sq. m), with maximum permeance rating of 0.0507 perm (2.9 ng/Pa x s x sq. m).
 - 1. Available Products:
 - a. Raven Industries Inc.; DURA-SKRIM 6WW.
 - b. Reef Industries, Inc.; Griffolyn T-65.
- C. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft. (10 kg/100 sq. m), with maximum permeance rating of 0.1317 perm (7.56 ng/Pa x s x sq. m) and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively.
 - 1. Available Products:
 - a. Raven Industries Inc.; DURA-SKRIM 2FR.
 - b. Reef Industries, Inc.; Griffolyn T-55 FR.
- D. Foil-Polyester-Film Vapor Retarders: 2 layers of 0.5-mil- (0.013-mm-) thick polyester film laminated to an inner layer of 1-mil- (0.025-mm-) thick aluminum foil, with maximum water-vapor transmission rate in flat condition of 0.0 g/h x sq. m and with maximum flame-spread and smoke-developed indexes of 5.
 - 1. Product: Subject to compliance with requirements, provide "Zero Perm" by Alumiseal Corporation.
- E. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- F. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- G. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-barrier-related substrates.
- H. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated.

2.6 AUXILIARY INSULATING MATERIALS

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by insulation manufacturers for sealing joints and penetrations in vapor-retarder facings.
- B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.
- C. 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.

2.7 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
1. Available Products:
 - a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
 - b. Eckel Industries of Canada; Stic-Klip Type N Fasteners.
 - c. Gemco; Spindle Type.
 2. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.
- B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
1. Available Products:
 - a. Gemco; 90-Degree Insulation Hangers.
 2. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
 3. Spindle: Copper-coated, low carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
1. Available Products:
 - a. AGM Industries, Inc.; RC150.
 - b. AGM Industries, Inc.; SC150.
 - c. Gemco; Dome-Cap.
 - d. Gemco; R-150.
 - e. Gemco; S-150.
 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
 - a. Ceiling plenums.
 - b. Attic spaces.
 - c. Where indicated.
- D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of 1 inch (25 mm) between face of insulation and substrate to which anchor is attached.

1. Available Products:
 - a. Gemco; Clutch Clip.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
 1. Available Products:
 - a. AGM Industries, Inc.; TACTOO Adhesive.
 - b. Eckel Industries of Canada; Stic-Klip Type S Adhesive.
 - c. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated 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. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. For preformed insulating units, 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.

3.4 INSTALLATION OF UNDER-SLAB INSULATION

- A. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
- B. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

- A. On units of foam-plastic board insulation, install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates indicated.
 - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Division 04 Section "Unit Masonry."

3.6 INSTALLATION OF GENERAL BUILDING INSULATION

- 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. Seal joints between foam-plastic insulation 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. Set vapor-retarder-faced units with vapor retarder in location indicated of construction, unless otherwise indicated.
 - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install mineral-fiber insulation 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 cavity, 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 (76-mm) clearance of insulation around recessed lighting fixtures.
 - 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 (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 - 6. For wood-framed construction, install mineral-fiber blankets according to ASTM C 1320 and as follows:
- E. 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.

- F. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
 - 1. Retain insulation in place by metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
 - 2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.
- G. Apply self-supported, spray-applied cellulosic insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make it flush with face of studs by using method recommended by insulation manufacturer.

3.7 INSTALLATION OF RADIANT BARRIERS

- A. Install interior radiation control coating system according to ASTM C 1321.
- B. Install sheet radiant barriers in locations indicated according to ASTM C 1158.

3.8 INSTALLATION OF VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Before installing vapor retarder, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
- C. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

3.9 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 072110 – INSULATING AIR BARRIER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
1. Materials and installation methods for a spray polyurethane foam building insulation and air/vapor barrier system located in the non-accessible part of the wall.
 2. SRAB (sheet rubberized-asphalt barrier) self-adhered air/vapor barrier membrane in roof assemblies.
 3. Materials and installation to bridge and seal the following air leakage pathways and gaps:
 - a. Connections of the walls to the roof air barrier.
 - b. Connections of the walls to the foundations.
 - c. Seismic and expansion joints.
 - d. Openings and penetrations of window frames, store front, curtain wall.
 - e. Barrier precast concrete and other envelope systems.
 - f. Door frames.
 - g. Piping, conduit, duct and similar penetrations
 - h. Masonry ties, screws, bolts and similar penetrations.
 - i. All other air leakage pathways in the building envelope.
 4. Materials to act as flashings and counterflashings.
- B. RELATED SECTIONS
1. Section 03300 - Cast-In-Place Concretes for Concrete back-up walls and underslab vapor retarder.
 2. Section 04200 - Unit Masonry for backup walls and Masonry veneer cavity walls.
 3. Section 07131 - Self-Adhering Sheet Waterproofing: Below grade waterproofing.
 4. Section 07160 - Bituminous Dampproofing: Below grade dampproofing.
 5. Section 07210 - Building Insulation: Insulation with integral vapor retarder facing.
 6. Section 07620 - Sheet Metal Flashing and Trim: Sheet metal flashings.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide air/vapor barrier system constructed to perform as a continuous air/vapor barrier system, as building thermal insulation, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. System shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.

1.3 SUBMITTALS

- A. Provide submittals in accordance with Section 01330.
1. At bid submission, provide evidence to the Architect of licensing and certification under the Air Barrier Association of America's (ABAA's) Quality Assurance Program.
 2. Submit shop drawings showing locations and extent of air/vapor barrier and details of all typical conditions, intersections with other envelope systems and materials, membrane

flashings and counter-flashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated and how miscellaneous penetrations such as conduits, pipes electric boxes and the like are sealed.

3. Submit manufacturer's product data sheets for each type of material, including manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
4. Submit manufacturer's installation instructions.
5. Provide evidence of testing by an accredited laboratory confirming material has been tested and conforms to the requirements of ASTM E2178, Standard for Air Barrier Materials.
6. Certification by air/vapor barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
7. Certification of compatibility by air/vapor barrier manufacturer, listing all materials on the project that it connects to or that come in contact with it.
8. Submit two samples, 12 by 12 inch (300 by 300 mm) minimum size, of each air/vapor barrier material required for Project.
9. Submit test results of air permeability testing of primary air barrier material (ASTM E 2178-01)
10. Submit test results of assembly in accordance with ABAA test protocol.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:

1. The air barrier contractor shall be, during the bidding period as well as for the duration of the installation, officially recognized as a Licensed Contractor by the Air Barrier Association of America (ABAA). The contractor shall carry liability insurance and bonding.
2. Each worker who is installing air barriers must be either a Certified Applicator or an installer who is registered with ABAA
3. Air/vapor barrier installers must be trained and certified by ABAA/NECA (National Energy Conservation Association) and PSDI (Professional Skills Development Institute for energy conservation) in accordance with the training requirements outlined in the ULC S705.2-02 Installation Standard. Installers shall have their photo-identification certification cards in their possession and available on the project site, for inspection upon request.

B. Single-Source Responsibility: Obtain air/vapor barrier materials from a single manufacturer regularly engaged in manufacturing the product.

C. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

D. Preconstruction Meeting: Convene week prior to commencing Work of this section, in accordance with Section - Project Meetings.

E. Field-Constructed Mock-Ups: Prior to installation of air/vapor barrier, apply air/vapor barrier as follows to verify details under shop drawing submittals and to demonstrate tie-ins with adjoining construction, and other termination conditions, as well as qualities of materials and execution:

1. Apply air/vapor barrier in field-constructed mock-ups of assemblies specified in Section 04200 and Section 09253.
2. Apply air/vapor barrier in field-constructed mock-ups of assemblies specified in Section 01452, "Mock-Ups".

3. Construct typical exterior wall panel, 8 feet long by 8 feet wide, incorporating back-up wall, partial cladding, window and doorframe and sill, insulation, flashing, building corner condition, junction with roof system foundation wall and typical penetrations and gaps; illustrating materials interface and seals. All transition membranes and seals shall be installed per the manufacturer's system requirements.
- F. Test mock-up for air and water infiltration to conform with Section 01400 - Quality Control, in accordance with ASTM E 783 and ASTM E1105.
 - G. Cooperate and coordinate with the Owner's inspection and testing agency. Do not cover any installed air and vapor barrier unless it has been inspected, tested and approved.
 - H. Protect people and materials from over-spray and contact with chemicals and gases.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, expiration date, and directions for storage.
 - B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Protect stored materials from direct sunlight.
 - C. Avoid spillage. Immediately notify Owner, [Architect] [Consultant] if spillage occurs and start clean up procedures.
 - D. Clean spills and leave area as it was prior to spill.
 - E. Separate and recycle waste materials in accordance with Section [01355 - Waste Management and Disposal], and with the Waste Reduction Workplan.
 - F. Place materials defined as hazardous or toxic waste in designated containers.
 - G. Ensure emptied containers are sealed and stored safely for disposal away from children.
- 1.6 PROJECT CONDITIONS
- A. Environmental Conditions: Apply air/vapor barrier within range of ambient and substrate temperatures recommended by air/vapor barrier manufacturer. Do not apply air/vapor barrier to a damp or wet substrate, unless the manufacturer specifically permits that for the product.
 1. Do not apply air/vapor barrier in snow, rain, fog, or mist.
 2. Do not apply air/vapor barrier when the temperature of substrate surfaces and surrounding air temperatures are below those recommended by the manufacturer.
 3. The product shall not be installed after the expiry date printed on the label of each container. The product has a shelf life of 6 months from the date of manufacture.
- 1.7 WARRANTY
- A. For sealant and membrane materials provide a 24 month warranty period.
 - B. Material Warranty: Provide the manufacturer's three year air/vapor barrier material warranty under provisions of Section.

- C. System Warranty: Provide the manufacturer's three year system warranty, including the primary air/vapor barrier and installed accessory sealant and membrane materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MATERIALS & MANUFACTURERS

- A. Sprayed polyurethane foam air barrier wall systems are manufactured on the jobsite by trained, certified contractor manufacturers. The Contractor, Manufacturer must be certified by the Air Barrier Association of America (ABAA) and provide trained certified mechanics with a demonstrated ability to manufacture air barrier system on project of similar size, scope and complexity.

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1. Sprayed polyurethane foam material, when tested, shall meet the requirements of ULC S705.1-01 Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density, Material- Specification.
2. A copy of an Evaluation Report (such as the CCMC Evaluation Report) or copies of the test reports from an accredited testing laboratory, for each physical property, indicating that the product meets the requirements of ULC S705.1-01 shall be made available upon request. A copy of either the evaluation report or the test reports shall be on file at the ABAA office.
3. Material containers shall be labeled with the Evaluation Report number of the evaluation agency.
4. Design R value as indicated in test report; minimum R6/inch.
5. Density as indicated in test report: 1.9 pounds per cubic foot.
6. Smoke development as indicated in test report ASTM E84-04; Flame spread index 25, Smoke Developed 400 or less tested at 3" thickness
7. Products that meet the preceding requirements:
 - a. BASF Walltite® performance properties are used as the design standard or equal

B. AUXILIARY MATERIALS

1. Furnish auxiliary materials recommended by air/vapor barrier manufacturer for intended use and compatible with the air/vapor barrier.
2. Self-adhering modified asphalt/polyethylene flashing to counterflash metal flashings:

- a. Bakor Blueskin® TWF.
3. Primer: Water based liquid primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates;
 - a. Aquatac® as manufactured by Bakor Inc.
4. Primer: Solvent based, VOC compliant primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates;
 - a. Blueskin® Primer by Bakor, Inc.
5. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes by SRAB air/vapor barrier manufacturer.
6. Stainless-Steel Sheet Flashing: ASTM A167, Type 304, soft annealed, with No. 2D finish; minimum, 0.0156 inch (0.4 mm) thick.
7. Transition Strip: Self-adhering, smooth surfaced SBS modified bitumen membrane, nominal 40 mil thickness, width as required.
 - a. Blueskin® SA as manufactured by Bakor Inc
8. Transition Strip Primer:
 - a. Blueskin® Primer as manufactured by Bakor Inc.
9. Sheet Membrane Transition Strip Termination Sealant:
 - a. Polybitume 570-05 by Bakor Inc.
10. Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors, Curtainwall and Storefront systems: Non-reinforced, cured chloroprene polymer sheet (neoprene) complying with ASTM D2000 Designation 2BC415 to 3BC620, 50 to 65 mils (1.3 to 1.6 mm) thick.
 - a. Adhesive: Typical contact-type adhesive used for fully-adhered membranes.
 - b. Lap Sealant: Typical urethane or silicone lap and termination sealant used for membrane edges recommended by manufacturer.
 - c. Termination bars and fasteners:
 - 1) Stainless steel, Aluminum bars, and stainless fasteners Galvanized steel.
11. Sheet Membrane Sheet Membrane Air Barrier Perimeter Seal to Windows, Doors, Curtainwall and Storefront systems: Low modulus silicone sheet; provide manufacturer's standard system consisting of precured low-modulus silicone extrusion, in sizes to fit widths indicated, combined with a neutral-curing low modulus silicone sealant for bonding extrusions to substrates.
 1. Pecora Sil-Span.
 2. Dow 1-2-3 or equal.
12. Provide sealants in accordance with Section 07900 - Joint Sealers. Comply with ASTM C920 and ASTM C920 classifications for type, grade, class, and uses

- a. Silicone Sealant Type A: natural cure, low modulus, to seal sheet membrane flashing to polyethylene face of sheet rubberized-asphalt barrier and to seal between and to non-bituminous sheet systems.
 - 1) Acceptable materials:
 - a) Dow 790
 - b) Pecora 864
 - 2) SPF (Sprayed Polyurethane Foam) Sealant: Provide one- or two-component, foamed-in-place, polyurethane foam sealant with the following characteristics:
 - a) Density: 1.5 to 2.0 PCF.
 - b) Flame Spread (ASTM E162): 25 or less.
 - c) Initial R-Value (at 1 inch): Not less than 7. Acceptable materials:
 - Zerodraft Foam Sealant.
 - Zerodraft Insulating Air Sealant
 Zerodraft (Division of Canam Building Envelope Specialists Inc.),
 125 Traders Blvd. E., Unit # 4, Mississauga, ON, L4Z 2H3 Tel. 1-877-272-2626
 3. Substrate Cleaner: Non-corrosive type recommended by sealant manufacturer compatible with adjacent materials.

C. EQUIPMENT

1. The equipment used to spray the polyurethane foam material shall be in accordance with ULC S705.2-02 and the equipment manufacturer's recommendations for specific type of application.
2. Equipment settings are to be recorded on the Daily Work Record as required by the ULC S705.2-02 Installation standard.
3. Each proportioner unit to supply only one spray gun.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions under which air/vapor barrier systems will be applied, with Installer present, for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.
 1. Do not proceed with installation until after minimum concrete curing period recommended by air/vapor barrier manufacturer.
 2. Ensure that:
 - a. surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants
 - b. concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
 - c. masonry joints are flush and completely filled with mortar, and all excess mortar sitting on masonry ties has been removed.

3. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
4. Notify Architect in writing of anticipated problems using air/vapor barrier over substrate.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air/vapor barrier application.
- B. Prime masonry, concrete substrates with conditioning primer when installing modified asphalt membrane transition membranes.
- C. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond to transition membranes, with adequate drying time between coats.
- D. Prime wood, metal, and painted substrates with primer recommended by membrane manufacturer.
- E. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air/vapor barrier and at protrusions according to air/vapor barrier manufacturer's written instructions and approved tested system in accordance with ABAA air barrier testing protocol.
 1. Verify that surfaces and conditions are suitable to accept work as outlined in this section.
 2. Prior to commencement of work report in writing to the architect [consultant] any defects in surfaces or conditions that may adversely affect the performance of products installed under this section.
 3. Commencement of work outlined in this section shall be deemed as acceptance of existing work and conditions.
 4. Examine joints before sealing to ensure configurations, surfaces and widths are suitable for spray polyurethane foam. Report in writing all defects stating the locations of joints deemed unacceptable for the application of the spray polyurethane foam.

3.3 PREPARATION

- A. Protection:
 1. Mask and cover adjacent areas to protect from over spray.
 2. Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
 3. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
 4. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.
- B. Surface Preparation
 1. Surfaces to receive foam insulation shall be clean, dry and properly fastened to ensure adhesion of the polyurethane foam to the substrate.
 2. Ensure that all work by other trades that may penetrate through the air barrier system is in place and complete.
 3. Ensure that surface preparation and any primers required conform to the manufacturer's instructions.
 4. Prepare surfaces by brushing, scrubbing, scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion

and integrity of the spray polyurethane foam. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam. Ensure surfaces are dry before proceeding.

5. Install transition membranes to all applicable surfaces and ensure proper adhesion of the transition membranes to the substrate, capable of having spray polyurethane foam insulation.
6. Install counter-flashings”
 - a. Metal: Mechanically fasten metal counter-flashings with screws at 8” (200 mm) o.c.
 - b. Membrane: Cut into and uncover only 3” of siliconized release paper along one edge of the counter-flashing membrane. Adhere membrane flashing to the pre-primed substrate a minimum of 3” and roll firmly in place.
7. Ensure veneer anchors are in place.

C. APPLICATION:

1. Spray-application of polyurethane foam shall be installed in accordance with ULC S705.2-02 and the manufacturer’s instructions.
2. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer and the ULC S705.2 Installation standard.
3. Apply in consecutive passes as recommended by manufacturer to thickness as indicated on drawings. Passes shall be not less than ½ inch and not greater than 2 inches.
4. Do not install spray polyurethane foam within 3 inches of heat emitting devices such as light fixtures and chimneys.
5. Finished surface of foam insulation to be free of voids and embedded foreign objects.
6. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
7. Trim, as required, any excess thickness that would interfere with the application of cladding/covering system by other trades.
8. Clean and restore surfaces soiled or damaged by work of the section. Consult with section of work soiled before cleaning to ensure methods used will not damage the work.
9. Do not permit adjacent work to be damaged by work of this section. Damage to work of this section caused by other sections shall be repaired by this section at the expense of the subcontractor causing the damage.
10. Complete connections to other components or repair any gaps, holes or other damage using material which conforms to ULC S710.1 Polyurethane Sealant Foam – One Component – Material or ULC S711.1 Polyurethane Sealant Foam – Two Components – Material and shall be installed in accordance with ULC S710.2 Polyurethane Sealant Foam – One component – Installation or ULC S711.2 Polyurethane Sealant Foam – Two Component – Installation, whichever is appropriate.

D. FIELD QUALITY CONTROL

1. Site Tests
 - a. The Licensed Installer shall conduct daily visual inspection, adhesion/cohesion testing and density measurements as outlined by the ULC S705.2-02 Installation standard.
 - b. The Licensed Installer shall complete the Daily Work Record and record all information required including the results of the testing. The Daily Work Record shall be kept on site for routine inspection. Copies of the Daily Work Record shall be forwarded to the owner or owner’s representative upon request. Copies of the

- Daily Work Record or monthly summaries shall be sent to the ABAA office on a monthly basis as required by the Quality Assurance Program.
- c. Transition membranes shall be pull tested in accordance with the ABAA Quality Assurance Program requirements before installing the spray polyurethane air barrier material.
 - d. The costs incurred for daily testing and inspection by the Licensed Installer and the completion of the Daily Work Record shall be borne by the Licensed Contractor.

2. Inspection

- a. Arrange for site inspections by ABAA. The cost of inspections shall be included in the bid provided by the Licensed Contractor.
- b. The ABAA site-inspections shall verify conformance with the manufacturer's instructions, the standard ULC S705.2-02 Installation standard, the ABAA Quality Assurance Program, and this section of the project specification.
- c. Inspections and testing shall be carried out at 5%, 50% and 95% of completion. A written inspection report shall be forwarded to the architect, the owner's representative, the Contractor, and the ABAA-licensed installer within 3 working days of the inspection and test being performed. In the case of any deficiencies, the ABAA-licensed inspector may verbally advise the licensed installer at the time of the inspection.
- d. If the inspection reveals any defects, the Licensed Contractor shall immediately rectify all such defects at his cost.

E. TOLERANCES

1. Maximum variation from indicated thickness: minus (-) ¼ inch; plus (+) ½ inch.

F. PROTECTION

1. Protect the spray polyurethane foam from ultraviolet radiation when installed on the exterior of a building.
2. Cover the spray polyurethane foam with a thermal barrier when installed on the interior of the building.

END OF SECTION 072110

SECTION 074113 – STANDING SEAM ROOF PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Formed and field-assembled standing-seam metal roof panels and appropriate underlayment material.
- B. Related Sections include the following:
 - 1. Division 5 Section “Steel Roof Decking” for steel roof deck supporting metal roof panels.
 - 2. Division 7 Section “Metal Wall Panels” for factory-formed metal soffit panels.
 - 3. Division 7 Section “Flashing and Sheet Metal” for fascia, copings, flashings and other sheet metal work not part of metal roof panel assemblies.
 - 4. Division 7 Section “Joint Sealants” for field-applied sealants not otherwise specified in this Section.

1.3 DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight roofing system.
- B. Solar Flux: Direct and diffuse radiation from the sun received at ground level over the solar spectrum, expressed in watts per square meter.
- C. Solar Reflectance: Fraction of solar flux reflected by a surface, expressed as a percent or within the range of 0.00 and 1.00.

1.4 PERFORMANCE REQUIREMENTS

- A. Performance standards in these documents are intended to provide the Owner with a standard of quality. Roofing systems supplied by the manufacturer chosen by the bidder must meet/exceed all of the stated materials and roof system performance characteristics, referenced code approval (FM, UL, and IBC) wind uplift and fire resistance criteria, on site quality control, and warranty and post-installation maintenance agreement requirements. The Architect and Owner shall provide sole and final determination as to the acceptance and approval of the Bidders roofing system.
- B. General: Provide metal roof panel assemblies that comply with performance requirements specified as determined by testing manufacturers’ standard assemblies similar to those indicated for this Project, by a qualified testing and inspecting agency.
- C. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift resistance Class 90.
- D. Air and Water Infiltration: Provide test results of ASTM test E1646 Standard test method for water penetration of exterior metal roof and siding systems by uniform static air pressure difference and ASTM test E1680 Standard test method or air leakage through exterior metal roof and siding systems.

- E. Provide test results showing specified panel assembly passing ASTM E2140-01 Standard Test Method for Water Penetration of Metal Roof Panel System by Static Water Pressure Head. (Hydrostatic Roof System Test)
- F. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to procedures listed in ASTM E 1592:
 - 1. Wind Loads: Determine loads based on the following minimum design wind pressures:
 - a. Uniform pressure as indicated on Drawings.
 - b. Wind Speed: 120 mph.
 - 2. Snow Loads: 30 lbf / sq. ft.
Live Loads: 30 lbf / sq. ft.
 - 3. Deflection Limits: Engineer metal roof panel assemblies to withstand design loads with calculated vertical deflections no greater than 1/180 of the span.
- G. Thermal Movements: Provide metal roof panel assemblies that allow for thermal movements resulting from the following maximum change (+ or - 100 degrees F) 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 calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- H. Metal panel assembly shall be listed with Underwriters' Laboratories as Class A roof systems with regards to their resistance to external flame sources.
- I. Metal panel shall be listed with Underwriters' Laboratories as Class 4 Hail resistant panels.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal roof panel and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, accessories, and special details and should be specific to this project. All drawings to be stamped and sealed by an engineer employed by the metal roof manufacturer and shall be registered in the state of Delaware. Distinguish between factory and field-assembled work.
 - 1. Accessories: Include details of the following items:
 - a. Flashing and trim.
 - b. Gutters.
 - c. Downspouts.
 - d. Roof curbs.
 - e. Pipe penetration flashings
 - f. Snow guards.
 - 2. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.

- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Roof Panels: 12 inches long by actual panel width. Include fasteners, clips, closures, and other metal roof panel accessories.
 - 2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
 - 3. Vapor Retarders: 6-inch- square Samples.
 - 4. Accessories: 12-inch long Samples for each type of accessory.
- E. Material Certificates: For thermal insulation signed by manufacturers.
- F. Qualification Data: Installer, Professional Engineer.
- G. Field quality-control inspection reports.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for the following:
 - 1. Metal Roof Panels: Include reports for air infiltration, water penetration, thermal performance, fire-test-response characteristics, solar reflectance and structural performance.
 - 2. Insulation and Vapor Retarders: Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- I. Maintenance Data: For metal roof panels to include in maintenance manuals.
- J. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer, having completed a documented, comprehensive manufacturer's installation training program, and having a minimum of three (3) years experience installing the manufacturer's product.
 - 1. Installer's responsibilities include installation of metal roof panel assemblies and providing professional engineering services by metal roof panel manufacturer.
 - 2. Engineering Responsibility: Preparation of data for metal roof panels, including Shop Drawings, based on testing and engineering analysis, by an independent engineer registered in the State of Delaware, of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Source Limitations: Obtain metal roof panels through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal roof panels and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Fire-Resistance Ratings: Where indicated, provide metal roof panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.

2. Metal roof panels shall be identified with appropriate markings of applicable testing and inspecting agency.
- E. Preliminary Roofing Conference: Before starting roof construction, conduct conference at Project site. Comply with requirements for preinstallation conferences in Division 1 Section "Project Management and Coordination." Review methods and procedures related to roof joist construction and metal roof panels including, but not limited to, the following:
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, joist Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
 4. Examine joist conditions for compliance with requirements, including flatness and attachment to structural members.
 5. Review structural loading limitations of joist during and after roofing.
 6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
 8. Review temporary protection requirements for metal roof panels during and after installation.
 9. Review roof observation and repair procedures after metal roof panel installation.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal roof panel Installer, metal roof panel manufacturer's representative, deck Installer, and installers whose work interfaces with or affects metal roof panels including installers of roof accessories and roof-mounted equipment.
 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 3. Review methods and procedures related to metal roof panel installation, including manufacturer's written instructions.
 4. Examine deck substrate, purlins and rafter conditions for compliance with requirements, including flatness and attachment to structural members.
 5. Review structural loading limitations of deck and joist during and after roofing.
 6. Review flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
 7. Review governing regulations and requirements for insurance, certificates, and testing and inspecting if applicable.
 8. Review temporary protection requirements for metal roof panel assembly during and after installation.
 9. Review roof observation and repair procedures after metal roof panel installation.
 10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements: Verify locations of roof framing and roof opening dimensions by field measurements before metal roof panel fabrication and indicate measurements on Shop Approval Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal roof panels without field measurements, or allow for field-trimming of panels. Coordinate roof construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations, which are specified in Division 7 Section "Roof Accessories." Provide roof system manufacturer's curbs.
- B. Roof installer must supply and install roof accessories that are approved, supplied, and warranted by the roofing manufacturer, and according to manufacturer's recommended details.
- C. Coordinate metal panel roof assemblies with rain drainage work, flashing, trim, and construction of decks, joist parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

- A. Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal roof panel assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including rupturing, cracking, or puncturing.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: One year from date of final Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. 20-year period is for fluoropolymer finish and is maximum included with manufacturers' published data; 10-year period is usually available for siliconized polyester.
 3. Finish Warranty Period: 20 years from date of Final Completion.
- C. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period. This warranty will include the roof panels, trims, transitions, pipe penetration flashings, curbs and gutters.
1. 1. Warranty Period: 20 years from date of Substantial Completion.
- D. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Furnish a single manufacturer, twenty (20) year full system warranty, including five (5) year contractor/installer warranty, covering all new components installed above the roof deck, including insulation, fasteners, metal roof, all metal roof trims and transitions, manufacturer supplied curbs, pipe penetration flashings, and all metal wall panels installed with the metal roof.
1. Warranty Period: 20 years from date of Substantial Completion.
 2. Warranty Limit of Liability: Installed cost of metal roof system including labor and materials.
 - a. Warranty must include paint adhesion for the full term of the warranty
 - b. Warranty must include detailed description of warranty extension options.
 - c. Manufacturer will at it's own expense, repair or cause to be repaired, any damage found in the above outlined new roof system, as a result of failure of any of the system components after the warranty is provided to the Owner.
 - d. Manufacturer will provide local on site Technical Field Inspectors (non-sales), to visit the project a minimum of two (2) times per week to monitor the installation. Manufacturer will provide field reports to the Owners representative after each visit.
 - e. Manufacturer shall provide the Owners representative with a written resume stating qualifications of this inspector.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design: Subject to compliance with requirements, provide products by The Garland Company, Inc. or comparable product by one of the following:
1. Tremco, Inc.
 2. Bemo USA, Inc.
 3. Centria; SRS3.
- B. Prequalified Substitutions: Bidders proposing an equivalent substitution shall submit all information required and in accordance with the standards set forth in this specification section to the Architect no later than ten (10) days prior to the bid date. If acceptance of the proposed substitute is given, it will be by addenda.
1. Roof Manufacturer Compliance Checklist: Bidders proposing an equivalent substitution shall submit a fully completed copy of the checklist found at the end of this specification section.
 2. Bidders proposing an equivalent substitution shall submit all technical (ASTM D-5147) verified testing information that meets or exceeds the minimum standards set forth in the specification. The responsive bidder must submit in triplicate all testing of materials submitted, notarized and

tested by an accredited third party testing facility. Manufacturer technical data sheets will not be accepted as a basis for comparison.

- C. The Architect shall be the sole judge as to whether or not an item submitted is an equivalent. Should the contractor choose to submit a request for acceptance of a substitution, he shall assume all risk involved, monetary or otherwise should the Architect find it unacceptable.
- D. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
- F. Available Product: Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Panels
 - a. R-Mer Span Roof System by The Garland Company, Inc. 3800 East 91st Street Cleveland, Ohio.
 - b. Metal Panel Tremlock VP Roof System by Tremco Incorporated, 3734 Green Road, Beachwood, Ohio.
 - c. Equivalent product by Bemo USA, Inc.
 - d. SRS3 by Centria.
 - 2. Underlayment Sheets
 - a. W.R. Grace & Co. –Conn. 62 Whittemore Avenue, Cambridge, Massachusetts 02140.
 - b. Carlisle Coatings & Waterproofing, Inc., 900 Hensley Lane, Wylie, Texas 75098.
 - 3. Roof Insulation Boards
 - a. Firestone Building Products Company, 525 Congressional Boulevard, Carmel, Indiana 46032.
 - b. Carlisle SynTec Systems, Inc., P.O. Box 7000, Carlisle, Pennsylvania 17013.

2.2 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
 - 2. Surface: Smooth finish.
 - 3. Exposed Finishes: Apply the following coil coating, as specified or indicated on Drawings.
 - a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- (1) Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing with a minimum total dry film thickness of 0.9 mil; not less than 70 percent polyvinylidene fluoride resin.
 4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
- B. Panel Sealants:
1. Sealant Tape: Pressure-sensitive, 99 percent solids, gray butyl rubber compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1 inch wide and 1/16 inch thick minimum containing nylon spacer beads.
 2. Joint Sealant: ASTM C 920; elastomeric polyurethane sealant; of type, grade, class, and use classifications required to seal joints in metal roof panels and remain weathertight; and as recommended in writing by metal roof panel manufacturer.
 3. Butyl-Rubber-Based, Solvent-Release Sealant containing nylon spacer beads.

2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, SBS Base Sheet: ASTM D1970-00, .080 in. thick minimum, consisting of specially blended SBS modified asphalt above the fiberglass mat, with an SIS modified self adhesive bitumen blend below the fiberglass reinforcement. The bottom is provided with release-paper backing; cold applied.
1. Products:
 - a. W. R. Grace Ultra Heat Resistant Roofing Underlayment Sheet.
 - b. Carlisle CCW WIP 403HR Heat Resistant Roofing Underlayment Sheet.
- B. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. if necessary.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of factory-applied coating.
1. Fasteners for Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
 2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
 3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2.5 STANDING-SEAM METAL ROOF PANELS

- A. Vertical-Rib, Seamed-Joint, Continuous-Run Standing-Seam Metal Roof Panels: Factory-formed and field-formed with vertical ribs at panel edges and flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels, and mechanically seaming panels together. Metal roof panel and trims are to utilize hydrostatic details at all trims, transitions, and penetrations.
1. Basis-of-Design Product: Garland R-MER Span
 2. Material: G-90 Zinc-coated galvanized steel sheet, .0276 (24 gauge) thick.

- a. Exterior Finish: "Kynar 500/Hylar 5000".
 - b. Color: Custom.
3. Clips: One-piece or two-piece Low Moveable Clip to accommodate thermal movement within the sheet. *Fixed clips are not permitted for use.*
- a. Material: .0336 thick, zinc-coated (galvanized) steel sheet.
 - b. Clip spacing to meet requirements of IBC.
4. Joint Type: Single folded.
5. Panel Coverage: 16 inches.
6. Panel Height 2.0 inches.
7. Uplift Rating: UL 90.
8. No end laps are permitted.
- B. Field-roll formed panels must be roll formed on factory owned and operated equipment, the roll former must have a minimum of 12 stands, and all performance and warranty requirements defined elsewhere in this specification must be met. Portable roll formers operated by the roofing contractor will not be permitted.

2.6 ACCESSORIES

- A. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
 2. Clips: Minimum 0.0336 thick, one-piece or two-piece galvanized steel panel clips designed to withstand negative-load requirements.
 3. Backing Plates: Provide metal backing plates at panel end splices, pre-fabricated from manufacturer with stainless steel studs.
- B. Flashing and Trim: Formed from 24 gauge thick, zinc-coated (galvanized) steel sheet, prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels. All details will be installed utilizing hydrostatic joinery.
- C. Exterior Metal Gutters: Formed from 24 gauge thick, zinc-coated (galvanized) steel sheet repainted with coil coating. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in maximum length possible to minimize joints. Furnish gutter supports per manufacturers' standard, installed without through-fastening of panel. Provide wire ball strainers at outlets. Finish gutters to match metal roof panels or roof fascia and rake trim.
- D. Downspouts: Formed from 26 gauge thick, zinc-coated (galvanized) steel sheet prepainted with coil coating; in 10-foot long sections, complete with formed elbows and offsets. Finish downspouts to match metal roof panels as per noted on drawings.
- E. Roof Curbs: Fabricated from aluminum sheet per manufacturer's standard, with integral internal flange for attachment minimizing through fastening. Roof curbs to be supplied by the metal roof manufacturer and to be included with weathertightness warranty.
1. Insulate roof curb with 1-inch- thick, rigid insulation.
- F. Snow Guards: Prefabricated, noncorrosive units designed to be installed without penetrating metal roof panels, and complete with predrilled holes, clamps, or hooks for anchoring.

1. Seam-Mounted, Bar-Type Snow Guards: Aluminum rods or bars held in place by stainless-steel clamps attached to vertical ribs of standing-seam metal roof panels.
 - a. Aluminum Finish: Kynar 500/ hylar 5000 color to match metal roof panels
 - b. Stainless-Steel Finish: Mill.
 - c. Products:
 - 1) LMCurbs; S-5! SnoFence.
 - 2) Snow Management Systems, a division of Contek, Inc.; Vermont Snowguard.
 - 3) Roofing Manufacturer's system that meets all performance requirements.
- G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base and stainless steel pipe clamp to secure collar to pipe. Pipe penetration flashings to be supplied by the metal roof manufacturer and to be included with weathertightness warranty.

2.7 THERMAL INSULATION

- A. Rigid Board Insulation: Insulation board shall be rigid polyisocyanurate foam plastic with a asphalt coated felt facer meeting the requirements of ASTM C 1289, Type II, Class 1.
- B. Long Term Thermal Resistance of Rigid Board Insulation shall be not less than value of 30.0. Long Term R-values shall be determined using a 15 year time-weighted average in accordance with CAN/ULC S770.
- C. Rigid Board Insulation shall have a compressive strength not less than 20 psi as per the requirements of ASTM D1621.
- D. Rigid Board Insulation shall be a standard product with the insulation manufacturer, factory marked or identified with insulation manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Insulation, including facings, shall have a flame spread rating and a smoke developed rating in accordance with ASTM E 84.
- E. Rigid Board Insulation Fastener Assemblies shall be a standard FM Global approved product supplied by the insulation manufacturer. Each fastener assembly shall consist of a self-drilling self-tapping fluorocarbon coated steel screw and 3 inch diameter Galvalume coated steel plate washer.

2.8 FABRICATION

- A. General: Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.
- D. Sheet Metal Accessories: Fabricate flashing and trim to comply with manufacturers' standard.
 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Conceal fasteners and expansion provisions where possible.
 3. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal roof panel manufacturer.

- a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal roof panel manufacturer for application but not less than thickness of metal being secured.

2.9 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 and painted 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.

2.10 COVERBOARD

- A. Provide ½" DensDeck Rood Board or equivalent product.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 3. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
- B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.
- B. Install flashings and other sheet metal to comply with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
- C. Install fascia and copings to comply with metal roof manufacturers standard details.
 1. Miscellaneous Framing: Install roof decking, subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written recommendations.

3.3 INSULATION BOARD INSTALLATION

- A. General: Provide and install insulation boards over roof decking covered with vapor barrier sheets and secure to the steel roof decking using FM Approved fluorocarbon coated steel screws and Galvalume plate washers.
1. Install full-sized boards and stagger end joints of insulation boards 12 inches. Only half boards or larger shall be used at perimeters and corners. Small filler boards shall be used in the field of the roof prior to roof boards placement at perimeters and corners.
 2. Butt roof boards tight to adjacent boards, leaving not more than ¼ inch gapping at junctures. Roof boards shall be cut to fit tightly around all penetrations and at all nailers and curbs.
 3. Secure each insulation board to the roof deck using six (6) fastener assemblies. Place each of four of the fastener assemblies 6 inches in from the edge of insulation board.
 4. Minimize construction traffic on the installed roof boards. Roof boards damaged by traffic shall be removed and replaced. Cost for removal and replacement shall be at the sole cost of the contractor.
 5. Roof boards shall not be exposed to weather resulting in moisture infiltration. Contractor shall not apply more roof boards in one day than can be completely covered with the required roof membrane on that day. Furring channels must be wire-tied to supports in most fire-resistance-rated assemblies. Verify requirements of assemblies and revise below to suit Project.

3.4 UNDERLAYMENT INSTALLATION.

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free, on each roof insulation board under metal roof panels. Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply as per manufacturers recommended instructions, to shed water. Overlap side edges not less than 3-1/2 inches. Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days or follow underlayment manufacturer's guidelines.
1. Extend underlayment sheets over rake edges and 4 inches downward over the top of the facade.
 2. Extend underlayment sheets over roof to wall intersections for a 4 inch vertical distance.
 3. Extend underlayment sheets around dormers, chimneys, skylights, and other penetrating elements for a distance of 4 inches vertically.
- B. Sheeting Paper: Install red-rosin sheet over self-adhering sheet before installing metal roof panels.

3.5 METAL ROOF PANEL INSTALLATION, GENERAL

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement. Utilize hydrostatic joinery throughout. No joinery to be dependent on exterior sealants to ensure weathertightness.
1. Field cutting of metal roof panels by torch or abrasive cut-saw is not permitted.
 2. Install panels perpendicular to purlins.
 3. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction.
 4. Provide pre-fabbed and pre-drilled metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.
 5. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
 6. Locate and space fastenings in uniform vertical and horizontal alignment per shop drawings.
 7. Install ridge and hip caps as metal roof panel work proceeds.
 8. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.

B. Fasteners:

1. Steel Roof Panels: Use manufacturer's standard corrosion resistant steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Joint Sealers: Install sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide sealants recommended by metal roof panel manufacturer.

1. Seal side joints where recommended by metal roof panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.6 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips placed on bearing plates at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Clips: Install clips to supports with self-tapping fasteners.
2. Bearing Plates: Install bearing plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Form standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.7 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

C. Exterior Metal Gutters: Join sections with riveted, lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 feet o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Tie downspouts to underground drainage system indicated.

- E. Roof Curbs: Install curbs supplied by metal roof manufacturer, at locations indicated on Drawings. Curbs to be of internal flange design.
- F. Bar-Type Snow Guards: Attach bar supports to vertical ribs of standing-seam metal roof panels with clamps or set screws. Do not use fasteners that will penetrate metal roof panels.
 - 1. Provide one snow guard at each roof panel. Space as recommended by manufacturer.
- G. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels with aluminum blind-type clamping fastener.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of ¼ 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.

3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage an authorized manufacturer's representative to inspect two(2) work days during each week of the installation of the metal roofing system and perform a pre-final and final inspect of the completed metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

SECTION 074213 - METAL WALL PANELS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Metal wall panels with concealed fasteners at walls.
2. Soffit panels as indicated.

- B. Related Sections include the following:

1. Division 5 Section "Structural Steel" for structural-steel framing.
2. Division 5 Section "Cold-Formed Metal Framing" for metal studs, bracing, anchorage, and framing accessories.
3. Division 6 Section "Rough Carpentry" for wood blocking.
4. Division 7 Section "Flashing and Sheet Metal" for metal flashing and trim not part of this Work.
5. Division 7 Section "Joint Sealants" for field-applied sealants.
6. Division 7 Section "Metal Wall Shingles" for wall shingles.
7. Division 8 Section "Louvers and Vents" for integral louvers.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide manufactured wall panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.
- B. Air Infiltration: Provide manufactured wall panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. (0.45 L/s/sq. m) of fixed wall area when tested according to ASTM E 283 at a static-air-pressure difference of 4.0 lbf/sq. ft. (192 Pa).
- C. Water Penetration: Provide manufactured wall panel assemblies with no water penetration as defined in the test method when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. (300 Pa) and not more than 12.0 lb/sq. ft. (575 Pa).
- D. Structural Performance: Provide manufactured wall panel assemblies capable of withstanding design wind loads indicated under in-service conditions with deflection no greater than the following, based on testing manufacturer's standard units according to ASTM E 330 by a qualified independent testing and inspecting agency.
 1. Maximum Deflection: 1/180 of the span.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.
- B. Shop Drawings: Show layouts of panels, details of corner conditions, joints, panel profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work.

- C. Samples for Initial Selection: Manufacturer's color charts or chips showing the full range of colors, textures, and patterns available for wall panels with factory-applied finishes.
- D. Samples for Verification: Provide sample panels 12 inches (300 mm) long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.
- E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Product Test Reports: Indicate compliance of manufactured wall panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed metal wall panel projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fire-Test-Response Characteristics: Where fire-resistance-rated wall panel assemblies are indicated, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: As indicated by design designations in UL's "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Mockups: Before installing wall panels, construct mockups for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using exposed and concealed materials indicated for the completed Work.
 - 1. Locate mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect 7 days in advance of the dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before proceeding with construction of wall panels.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.
- B. Handling: Exercise care in unloading, storing, and erecting wall panels to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with tarpaulins or other suitable weathertight and ventilated covering. Store panels to ensure dryness. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
- C. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products:

1. Metal Wall Panel – 1: **(MWP-1)**

a. Basis of Design: Centria CS-200, 22 Gauge metal

- b. Comparable Products: In order for the products listed below to be considered equal to the basis of design product, they must meet the performance and detail requirements contained within the project documents and manufacturer's details / product data of the basis of design product listed above.

- 1. Morin XC-12

2. Metal Wall Panel – 2: **(MWP-2)**

a. Basis of Design: Centria IW-10A, 20 Gauge metal

- b. Comparable Products: In order for the products listed below to be considered equal to the basis of design product, they must meet the performance and detail requirements contained within the project documents and manufacturer's details / product data of the basis of design product listed above.

- 1. Morin F-12-S

3. Insulated Metal Wall Panel: **(IMP-1)**

a. Basis of Design: Dimension Series – 2” Horizontal Flat, Face sheet 20 Gauge, Liner 22 Gauge

- b. Comparable Products: In order for the products listed below to be considered equal to the basis of design product, they must meet the performance and detail requirements contained within the project documents and manufacturer's details / product data of the basis of design product listed above.

- 1. Kingspan – Designwall 2000 – 2” Vertical Flat

2.2 METALS AND FINISHES

- A. Exposed Finish for Exterior Panels: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - 1. Metallic Fluoropolymer: AAMA 620. Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent 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.
 - a. Color : Custom color(s) – Final color selections to be made by Architect
 - 1) MWP-1 : Up to two different colors
 - 2) MWP-2 : Nine different colors (refer to drawings for locations)
 - 3) IMP-1 : Up to two different colors
 - b. Gloss: 20-35 typical.

2.3 WALL PANEL ASSEMBLIES

- A. Exterior Wall Panels: Fabricate panel face sheets to the profile or configuration indicated; and of the material, finish, and thickness indicated. Design joints between panels to form weathertight seals. Panel configuration equivalent to products noted:
 - 1. Provide shop assembled / mitered corner trim panels.
 - 2. Soffit Panels: .032" aluminum, alloy 3015-H14, flush panel, 11" o.c. with manufacturer's J channel trim.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.
 - 1. Use stainless-steel fasteners for exterior applications and galvanized steel fasteners for interior applications.
- B. Accessories: Unless otherwise specified, provide components required for a complete wall panel assembly including trim, copings, fasciae, soffits, mullions, sills, corner units, clips, seam covers, flashings, louvers, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of panels.
 - 1. Closure Strips: Closed-cell, self-extinguishing, expanded, cellular, rubber or cross-linked, polyolefin-foam flexible closure strips. Cut or premold to match configuration of panels. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 2. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
 - 3. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant as recommended by panel manufacturer.
 - 4. Outside Corners: Shop assembled and mitered.
- C. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat, unless otherwise indicated. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.5 FABRICATION

- A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

- B. Sound Control: Where sound-absorption requirement is indicated, fabricate interior liner panels with 1/8-inch- (3-mm-) diameter holes uniformly spaced approximately 1000 holes per square foot (10 750 holes per square meter). Cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.
- C. Apply bituminous coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials that are noncompatible or could result in corrosion or deterioration of either materials or finishes.
- D. Fabricate panel joints with captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

2.6 SECONDARY FRAMING

- A. Panel Supports and Anchorage: Provide girts, furring channels, angles, plates, bracing, and other secondary framing members.
 - 1. Girts: C- or Z-shaped sections fabricated from 0.0598-inch- (1.5-mm-) thick, shop-painted, roll-formed steel.
 - 2. Flange and Sag Bracing: 1-5/8-by-1-5/8-inch (41-by-41-mm) angles, fabricated from 0.0598-inch- (1.5-mm-) thick, shop-painted, roll-formed steel.
 - 3. Base or Sill Angles: Fabricate from 0.079-inch- (2.0-mm-) thick, cold-formed, galvanized steel sections.
 - 4. Secondary structural members, except columns and beams, shall be manufacturer's standard sections fabricated from 0.079-inch- (2.0-mm-) thick, cold-formed galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panel walls.
 - 1. Panel Supports and Anchorage: Examine wall framing to verify that girts, angles, and other secondary structural panel support members and anchorage have been installed to meet requirements of panel manufacturer.
 - 2. Do not proceed with wall panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate metal wall panels with rain drainage work; flashing; trim; and construction of soffits, roofing, parapets, walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.
- C. Secondary Structural Supports: Install girts, angles, and other secondary structural panel support members and anchorage according to the Light Gage Structural Institute's "Guide Specifications," Section 07410, "Manufactured Roof and Wall Panels."

3.3 PANEL INSTALLATION

- A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting exterior panels by torch is not permitted.
 2. Install panels with concealed fasteners.
 3. Install panels with exposed exterior and interior fasteners, prefinished to match panel finishes. Provide waterproof washers at all exposed fasteners.
 4. Locate and space exposed fasteners in true vertical and horizontal alignment. Use proper tools to obtain controlled, uniform compression for positive seal without rupture of neoprene washer.
 5. Install felt paper on substrate as required by manufacturer.
- B. Accessories: Install components required for a complete wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, seam covers, flashings, louvers, sealants, gaskets, fillers, closure strips, and similar items.
- C. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not otherwise indicated, types recommended by panel manufacturer.
1. Install weatherseal to prevent air and moisture penetration. Flash and seal panels at ends and intersections with other materials with rubber, neoprene, or other closures to exclude weather.
 2. Seal panel end laps with a bead of tape or sealant, full width of panel. Seal side joints where recommended by panel manufacturer.
 3. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."
- D. Wall Panels: Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as necessary for waterproofing. Handle and apply sealant and back-up according to sealant manufacturer's written instructions.
1. Align bottom of wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 2. Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
 3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- E. Separate dissimilar metals by painting each metal surface in area of contact with a bituminous coating or by other permanent separation as recommended by manufacturers of dissimilar metals.
- F. Coat back side of metal panels with bituminous coating where it will contact wood, ferrous metal, or cementitious construction.
- G. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on level, plumb, and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.4 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION 074213

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-monomer (EPDM) roofing system.
2. Vapor retarder.
3. Roof insulation.

- B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 053100 "Steel Decking" for furnishing acoustical deck rib insulation.
2. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing and fastening spacings and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

- C. Samples for Verification: For the following products:

1. Sheet roofing, of color required.

2. Walkway pads or rolls, of color required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For 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 complying with performance requirements.
- C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 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.

1.9 FIELD 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.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of 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 Work of this Section, including all components of 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: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain components including roof insulation fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed 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. Roofing and base flashings shall remain watertight.
 - 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 - 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

2.3 EPDM ROOFING

A. EPDM: ASTM D 4637, Type I, nonreinforced, uniform, flexible EPDM sheet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design Manufacturer: Carlisle SynTec Incorporated.
 - b. Firestone Building Products.
 - c. Johns Manville.
 - d. Versico Incorporated.
2. Thickness: 60 mils (1.5 mm), nominal.
3. Exposed Face Color: White on black.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55- to 60-mil- (1.4- to 1.5-mm-) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

F. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

I. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

2.5 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by EPDM roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlisle SynTec Incorporated.
 - b. Firestone Building Products.
 - c. Hunter Panels.
 - d. Johns Manville.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.6 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm) thick.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Corporation; Dens Deck Prime.
 - b. USG Corporation; Securock Glass Mat Roof Board.

2.7 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. 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.

3.4 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with 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 (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) 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 roof drains 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 (6 mm) with insulation.
 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
 3. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 4. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
 1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.5 ADHERED MEMBRANE ROOFING INSTALLATION

- A. Adhere roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.
- E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeters.
- F. Apply roofing with side laps shingled with slope of roof deck where possible.
- G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.
- H. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.

- J. Adhere protection sheet over membrane roofing at locations indicated.

3.6 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to 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 splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

3.9 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- 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.

3.10 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
 - 1. Owner: Red Clay Consolidated School District
 - 2. Address: 1502 Spruce Avenue, Wilmington, DE 19805
 - 3. Building Name/Type: William F. Cooke, Jr. Elementary School

4. Address: 2025 Graves Road, Hockessin, DE 19707
5. Area of Work: Roof
6. Acceptance Date: _____.
7. Warranty Period: 20 Years
8. Expiration 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 100 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; and
 - 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.
 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 _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075323

SECTION 076200 - FLASHING AND SHEET METAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide all labor, equipment, and materials fabricate and install the following.

1. Fascia, scuppers, and trim.
2. Counterflashings over bituminous base flashing.
3. Counterflashings for roof accessories.
4. Counterflashings at roof mounted equipment and vent stacks.
5. Base flashing coverings.
6. Coping cap at parapets.
7. Gutters, scuppers and down spouts.
8. Counterflashings at walls and penetrations.
9. Lead flashing for bituminous membranes.
10. Other components.

B. RELATED SECTIONS

1. Section 061000 - Rough Carpentry
2. Section 074113 – Metal Roof Panels
3. Section 074215 – Metal Roof Shingles
4. Section 077200 - Roof Accessories
5. Section 079200 - Joint Sealants

1.3 REFERENCES

ASTM A-446	Specification for steel sheet
ASTM B-209	Specification for aluminum sheet
ASTM B-221	Specification for aluminum extruded shape
FS QQ-L-201	Specification for Lead Sheet
ASTM A792	Steel Sheet, Aluminum-Zinc Alloy-Coated, by the Hot-Dip Process
ASTM B32	Solder Metal
ASTM B209	Aluminum and Alloy Sheet and Plate
ASTM B486	Paste Solder
ASTM D226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D486	Asphalt Roof Cement, Asbestos-free
FS O-F-506	Flux, Soldering, Paste and Liquid
WH	Warnock Hersey International, Inc. Middleton, WI.
FM	Loss Prevention Data Sheet
NRCA	National Roofing Contractors Association - Roofing Manual
SMACNA	Architectural Sheet Metal Manual

1.4 SUBMITTALS

- A. Submit under provisions of all technical performance criteria set forth in the specifications.
- B. Product Data: Provide manufacturer's specification data sheets for each product.
- C. Provide approval letters from metal manufacturer for use of their metal within this particular roofing system type.
- D. Submit two samples, 12 x 12 inch in size illustrating typical external corner, internal corner, valley, junction to vertical dissimilar surface, material and finish.
- E. Shop Drawings
 - 1. For manufactured and shop fabricated gravel stops, fascia, scuppers, and all other sheet metal fabrications.
 - 2. Shop drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashing, termination's, and installation details.
 - 3. Indicate type, gauge and finish of metal.
- F. Certification
 - 1. Submit roof manufacturer's certification that metal fasteners furnished are acceptable to roof manufacturer.
 - 2. Submit roof manufacturer's certification that metal furnished is acceptable to roofing manufacturer as a component of roofing system and is eligible for roof manufacturer's system warranty.
 - 3. Submit certification that metal and fastening system furnished is Tested and Approved by Factory Mutual for I-90 Wind Up-Lift Requirements.
- G. Manufacturer's Product Data
 - 1. Metal material characteristics and installation recommendations.
 - 2. Submit color chart prior to material ordering and/or fabrication so that equivalent colors to those specified can be approved.

1.5 QUALITY CONTROL

- A. Reference Standards
 - 1. Comply with details and recommendations of SMACNA for methods of joining, anchorage, provisions for expansion, etc.
 - 2. Factory Mutual Loss Prevention Data Sheet 1-49 windstorm resistance 1-90.
- B. Manufacturer's Warranty
 - 1. Pre-finished metal material shall require a written 30-year non-prorated warranty covering fade, chalking and film integrity. The material shall not show a color change greater than 5 NBS color units per ASTM D-2244 or chalking excess of 8 units per ASTM D-659. If either occurs material shall be replaced per warranty, at no cost to the Owner.
- C. Contractor's Warranty
 - 1. The Contractor shall provide the Owner with a notarized written warranty assuring that all sheet metal work including caulking and fasteners to be watertight and secure for a period

of two years from the date of final acceptance of the building. Warranty shall include all materials and workmanship required to repair any leaks that develop, and make good any damage to other work or equipment caused by such leaks or the repairs thereof.

1.6 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal flashing work with 5 years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened containers or packages with labels intact and legible.
- B. Stack pre-formed and pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials which may cause discoloration or staining.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Metal system is to be comprised of minimum Aluminum or Galvalume steel, coated on both sides with an epoxy primer and on the weathering surface with a polyvinylidene fluoride or siliconized polyester baked organic coated finish.

- 1. Materials

- a. Aluminum-Zinc alloy Coated Steel

Aluminum-zinc alloy (galvalume) coated steel, ASTM A792, coating designation AZ-50, in thickness of .0217 nom. /24 gauge or .040 Aluminum; 36" to 48" by coil length, chemically treated, commercial or lock-forming quality.

*Subject to minimum quantity requirements

*Standard Kynar 500 finish coating is only accepted.

- b. Colors shall be custom to match metal roof color.

- B. Miscellaneous Metals and Flashings:

- 1. Zinc-Coated Steel Sheet: ASTM A526, 0.20% copper, 26 gage (0.0179"); designation G90 hot-dip galvanized, mill phosphatized.
- 2. Stainless Steel Sheet: Type 302/304, ASTM A167, 28 gage, (0.015"), annealed except dead soft where fully concealed by other work, 2D (dull) finish.
- 3. Copper Sheet: ASTM B370, 16 oz. (0.0216), temper H00 (cold-rolled).
- 4. Lead-Coated Copper Sheet: ASTM B101. Type I, Class A (12-15 1 lb. of lead coating per 100 sq. ft.), 17.1 oz. (0.022").
- 5. Zinc Alloy Sheet: Zinc with 0.6% copper and 0.14% titanium; 0.27" thick (21 gauge); standard (soft) temper, mil finish.

2.2 RELATED MATERIALS

- A. Metal Primer: Zinc chromate type.
- B. Plastic Cement: ASTM D 4586
- C. Sealant: Specified in Section 07900 or on drawings.
- D. Lead: Meets Federal Specification QQ-L-201, Grade B, four pounds per square foot.
- E. Solder: ANSI/ASTM B32; 95/05 type.
- F. Flux: FS O-F-506.
- G. Underlayment: ASTM D2178, No15 asphalt saturated roofing felt.
- H. Slip Sheet: Rosin sized building paper.
- I. Fasteners:
 - 1. Corrosion resistant screw fastener as recommended by metal manufacturer. Finish exposed fasteners same as flashing metal.
 - 2. Fastening shall conform to Factory Mutual I-90 requirements or as stated on section details, whichever is more stringent.
- J. Termination Bars:
 - 1. Shall be aluminum unless otherwise recommended by membrane manufacturers.
 - 2. Material shall be .125" x 1" (minimum) aluminum conforming to ASTM B-221, mill finish. Bar shall have caulk cup as required.
- K. Gutter and Downspout Anchorage Devices: Type recommended by fabricator.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect contact areas of dissimilar metals with heavy asphalt or other approved coating, specifically made to stop electrolytic action.

3.2 GENERAL

- A. Install work watertight, without waves, warps, buckles, fastening stress, or distortion, allowing for expansion and contraction.
- B. Fastening of metal to walls and wood blocking shall comply with SMACNA Architectural Sheet Metal Manual, Factory Mutual I-90 wind uplift specifications and/or manufacturer's recommendations whichever is of the highest standard.
- C. All accessories or other items essential to the completeness of sheet metal installation, whether specifically indicated or not, shall be provided and of the same material as item to which applied.

- D. Metal fascia and copings shall be secured to wood nailers at the bottom edge with a continuous cleat. Cleats shall be at least one gauge heavier than the metal it secures.

3.3 INSPECTION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets are in place, and nailing strips located.
- B. Verify membrane termination and base flashings are in place, sealed, and secure.
- C. Beginning of installation means acceptance of existing conditions.
- D. Field measure site conditions prior to fabricating work.

3.4 MANUFACTURED SHEET METAL SYSTEMS

- A. Installing Contractor shall be responsible for determining if the sheet metal systems are in general conformance with roof manufacturer's recommendations.
- B. Furnish and install manufactured sheet metal systems in strict accordance with manufacturer's printed instructions.
- C. Provide all factory-fabricated accessories including, but not limited to, fascia extenders, miters, scuppers, joint covers, etc.

3.5 SHOP FABRICATED SHEET METAL

- A. Installing Contractor shall be responsible for determining if the sheet metal systems are in general conformance with roof manufacturer's recommendations.
- B. Metal work shall be shop fabricated to configurations and forms in accordance with recognized sheet metal practices.
- C. Hem exposed edges.
- D. Angle bottom edges of exposed vertical surfaces to form drip.
- E. All corners for sheet metal shall be lapped with adjoining pieces fastened and set in sealant.
- F. Joints for gravel stop fascia system, cap flashing, and surface-mount counterflashing shall be formed with a 1/4" opening between sections. The opening shall be covered by a cover plate or backed by an internal drainage plate formed to the profile of fascia piece. The cover plate shall be embedded in mastic, fastened through the opening between the sections and loose locked to the drip edges.
- G. Install sheet metal to comply with Architectural Sheet Metal manual, Sheet Metal and Air Conditioning Contractor's National Associations, Inc.

3.6 FLASHING MEMBRANE INSTALLATION

A. COPING CAP

1. Copings shall be provided with factory fabricated welded watertight coping accessories such as miters, transitions, end caps, etc. and finished to match coping system. No exposed fasteners will be accepted throughout the entire project.
2. Accessories: Joint covers, corners, supports, strip flashing at joinings, fastening, and other accessories shall be included.
3. Install continuous cleat fasten 6" O.C.
4. Install new coping cap hooked to continuous cleat.

B. SURFACE MOUNTED COUNTERFLASHING/COPING CAP

1. Copings shall be provided with factory fabricated welded watertight coping accessories such as miters, transitions, end caps, etc. and finished to match coping system. No exposed fasteners will be accepted throughout the entire project.
2. Accessories: Joint covers, corners, supports, strip flashing at joinings, fastening, and other accessories shall be included.
3. Install continuous cleat fasten 6" O.C.
4. Install new coping cap hooked to continuous cleat.

C. SURFACE MOUNTED COUNTERFLASHING

1. Counterflashing shall be provided with watertight accessories such as miters, transitions, end caps, etc. and finished to match counterflashing.
2. Accessories: Joint covers, corners, fasteners, strip flashing at joinings, fastening, and other accessories shall be included.
3. Apply butyl tape to wall behind flashing. Secure termination bar through flashing butyl tape and into wall.
4. Secure new counterflashing set on a butyl tape above flashing 8" O.C., caulk top of counterflashing.

D. REGLET MOUNTED COUNTERFLASHING

1. Reglet shall be provided with watertight accessories such as miters, transitions, end caps, etc. and finished to match.
2. Accessories: Joint covers, corners, fasteners, strip flashing at joinings, fastening, and other accessories shall be included.
3. Cut reglet in masonry one joint above flashing.
4. Apply butyl tape to wall behind flashing. Secure termination bar through flashing butyl tape and into wall.
5. Secure reglet counterflashing with expansion fasteners and caulk reglet opening.

E. ROOF DRAIN

1. Prime lead/copper at a rate of 100 square feet per gallon and allow to dry.
2. Set lead/copper flashing (30" square minimum) in a 1/4" bed of mastic.
3. Install clamping ring and strainer assure all plies are under the clamping ring.

F. PLUMBING STACK

1. Prime flange and sleeve at a rate of 100 square feet per gallon and allow to dry.
2. Install properly sized sleeves in a 1/4" bed of elastomeric sealant.
3. Turn sleeve a minimum of 1" down inside of stack.
4. Caulk intersection of the membrane and flange with elastomeric sealant.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Roof curbs.

- B. Related Sections include the following:

- 1. Division 5 Section "Metal Fabrications" for ladders and miscellaneous metal framing and supports.
- 2. Division 6 Section "Rough Carpentry" for roof sheathing, wood cants, and wood nailers.
- 3. Division 7 Section "Flashing and Sheet Metal" for shop- and field-fabricated metal flashing and counterflashing, scuppers, gutters and downspouts, fasciae, roof expansion-joint covers, valleys, and miscellaneous sheet metal trim and accessories.
- 4. Division 7 Sections for roofing accessories included as part of roofing Work.
- 5. Division 9 Sections for shop primers and field painting.
- 6. Division 23 Section "Power Ventilators" for power roof-mounted ventilators.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for roof accessories with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples in manufacturer's standard sizes, and of same thickness and material indicated for the Work. If finishes involve normal color or shade variations, include sample sets showing the full range of variations expected.

1.4 QUALITY ASSURANCE

- A. Standards: Comply with the following:

- 1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
- 2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Roof Curbs and Equipment Supports:
 - a. Custom Curb, Inc.
 - b. Roof Products & Systems Corp.
 - c. ThyCurb, Inc.

2.2 MATERIALS, GENERAL

- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M) for alclad alloy 3005H25 or alloy and temper required to suit forming operations, with mill finish, unless otherwise indicated.
- B. Extruded Aluminum: ASTM B 221 (ASTM B 221M) alloy 6063-T52 or alloy and temper required to suit structural and finish requirements, with mill finish, unless otherwise indicated.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M with G90 (Z275) coating designation; commercial quality, unless otherwise indicated.
1. Structural Quality: Grade 40 (Grade 275), where indicated or as required for strength.
- D. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M with Class AZ-50 (AZ-150) coating, structural quality, Grade 40 (Grade 275), or as required for strength.
- E. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.
- F. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWWA C2; not less than 1-1/2 inches (38 mm) thick.
- G. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.
1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.
- H. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- I. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.
- J. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- K. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.
- L. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 ROOF CURBS

- A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.
- B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 0.0747-inch- (1.9-mm-) thick, structural-quality, hot-dip galvanized or aluminum-zinc alloy-coated steel sheet; factory primed and prepared for painting with welded or sealed mechanical corner joints.

2.4 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.

2.5 GALVANIZED STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
 - 1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- B. High-Performance Organic Finish: Cleaned and primed with inhibitive primer and organic coating as specified below. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Fluoropolymer Three-Coat System: 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 percent polyvinylidene fluoride resin by weight; complying with AAMA 621 for coil-coated sheets.
 - a. Color and Gloss: As selected by Architect from manufacturer's standard of colors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof deck, roof insulation, flashing, roofing membranes, penetrations, equipment, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to

supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.

- B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated.
- C. Separation: Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
- D. Flange Seals: Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.
- E. Cap Flashing: Where required as component of accessory, install cap flashing to provide waterproof overlap with roofing or roof flashing (as counterflashing). Seal overlap with thick bead of mastic sealant.

3.2 CLEANING AND PROTECTION

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Penetrations in fire-resistance-rated walls.
- 2. Penetrations in horizontal assemblies.
- 3. Penetrations in smoke barriers.

B. Related Sections:

- 1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
 - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
 - b. Classification markings on penetration firestopping correspond to designations listed by the following:
 - 1) UL in its "Fire Resistance Directory."

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. A/D Fire Protection Systems Inc.
 2. Grace Construction Products.
 3. Hilti, Inc.
 4. Johns Manville.
 5. Nelson Firestop Products.
 6. NUCO Inc.
 7. Passive Fire Protection Partners.
 8. RectorSeal Corporation.
 9. Specified Technologies Inc.
 10. 3M Fire Protection Products.
 11. Tremco, Inc.; Tremco Fire Protection Systems Group.
 12. USG Corporation.

2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.
- E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-wool-fiber or rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board.
 - d. Fillers for sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

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

3.4 IDENTIFICATION

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

3.5 FIELD QUALITY CONTROL

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

3.6 CLEANING AND PROTECTION

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

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes sealants for the following locations:

- 1. Exterior joints in vertical surfaces and nontraffic horizontal surfaces as indicated below:

- a. Control and expansion joints in cast-in-place concrete.
- b. Control and expansion joints in unit masonry.
- c. Perimeter joints between materials listed above and frames of doors and windows.
- d. Joints between dissimilar materials.
- e. Joints in cast stone as indicated in Division 4 Section "Cast Stone."
- f. Other joints as indicated.
- g. Joints between curtain wall frame and dissimilar materials

- 2. Exterior joints in horizontal traffic surfaces as indicated below:

- a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
- b. Joints between dissimilar materials.
- c. Other joints as indicated.

- 3. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.
- b. Perimeter joints of exterior openings where indicated.
- c. Tile control and expansion joints.
- d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
- e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
- f. Perimeter joints of toilet fixtures.
- g. Joints between dissimilar materials.
- h. Joints where acoustical sealant is called for under Wall Type General Notes on drawings.
- i. Other joints as indicated.
- j. Joints between curtain wall frame and dissimilar materials.

- 4. Interior joints in horizontal traffic surfaces as indicated below:

- a. Control and expansion joints in cast-in-place concrete slabs.
- b. Control and expansion joints in tile and terrazzo flooring.
- c. Joints between dissimilar materials.
- d. Other joints as indicated.

- 5. Fire Resistant Sealers

- B. Related Sections include the following:

- 1. Division 7 Section "Flashing and Sheet Metal" for sealing joints related to flashing and sheet metal for

roofing.

2. Division 7 Section "Firestopping" for through-penetration firestopping systems.
3. Division 8 "Glazing" for sealants used in glazing.
4. Division 9 Section "Tile" for sealing tile joints.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that have been produced and installed to establish and to maintain watertight and airtight continuous seals without causing staining or deterioration of joint substrates.
- B. Provide joint sealants for interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data from manufacturers for each joint sealant product required.
- C. Samples for initial selection purposes in form of manufacturer's standard bead samples, consisting of strips of actual products showing standard range of colors available, for each product exposed to view.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.
- C. Field-Constructed Mock-Ups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution:
 1. Joints in field-constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants specified in this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: 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.
 2. When ambient and substrate temperature conditions are outside limits permitted by joint sealant

manufacturer or are below 40 deg F (4.4 deg C).
 3. When joint substrates are wet.

- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.8 SEQUENCING AND SCHEDULING

- A. Sequence installation of joint sealants to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors: Provide color of exposed joint sealants to comply with the following:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated. Color selection must provide equivalent to match adjacent materials.

2.2 ELASTOMERIC JOINT SEALANTS (Interior & Exterior Vertical & Horizontal Joints)

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C 920 and including those requirements referencing ASTM C920 classifications for Type, Grade, Class and Uses.
- B. Base polymer must be silicone.
- C. Available Products: Subject to compliance with requirements, chemically curing elastomeric sealants that may be incorporated in the Work include, but are not limited to, the following:

<u>Substrate/Detail</u>	<u>Dow Corning Product</u>
Brick to Window Frame	Solvent Wipe
	Dow Corning 1200 primer to brick substrates
Brick to Brick	Dow Corning 795
	Solvent Wipe (non-alcohol type)
	Dow Corning 790
OR	
Brick to Precast/Concrete	Dow Corning 1200 Primer
	Dow Corning 795
Brick to Precast/Concrete	Solvent Wipe (non-alcohol type)
	Dow Corning 790

OR

Solvent Wipe
Dow Corning 1200 Primer
Dow Corning 795

Metal to Metal As recommended by sealant manufacturer.

2.3 LATEX JOINT SEALANTS (Interior Joints in Vertical & Horizontal Surfaces)

- A. General: Provide manufacturer's standard one-part, nonsag, mildew-resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.
- B. Acrylic-Emulsion Sealant: Provide product complying with ASTM C 834 that accommodates joint movement of not more than 5 percent in both extension and compression for a total of 10 percent.
- C. Silicone Emulsion Sealant: Provide product complying with ASTM C 834 and, except for weight loss measured per ASTM C 792, with ASTM C 920 that accommodates joint movement of not more than 25 percent in both extension and compression for a total of 10 percent.
- D. Available Products: Subject to compliance with requirements, latex joint sealants that may be incorporated in the Work include, but are not limited to, the following:

- 1. Acrylic-Emulsion Sealant:

- a. "AC-20", Pecora Corp.
- b. "Sonolac", Sonneborn Building Products Div., ChemRex, Inc.
- c. "Tremco Acrylic Latex 834", Tremco, Inc.

- 2. Silicone-Emulsion Sealant:

- a. "Trade Mate Paintable Glazing Sealant", Dow Corning Corp.

2.4 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
 - 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
 - 2. Product has flame spread and smoke developed ratings of less than 25 per ASTM E 84.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- C. Available Products: Subject to compliance with requirements, acoustical joint sealants that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Acoustical Sealant:
 - a. "SHEETROCK Acoustical Sealant", United States Gypsum Co.

- b. "AC-20 FTR Acoustical and Insulation Sealant", Pecora Corp.
2. Acoustical Sealant for Concealed Joints:
 - a. "BA-98", Pecora Corp.
 - b. "Tremco Acoustical Sealant", Tremco, Inc.

2.5 TAPE SEALANTS

- A. Tape Sealant: Manufacturer's standard, solvent-free, butyl-based tape sealant with a solids content of 100 percent formulated to be nonstaining, paintable, and nonmigrating in contact with nonporous surfaces with or without reinforcement thread to prevent stretch and packaged on rolls with a release paper on one side.
- B. Available Products: Subject to compliance with requirements, tape sealants that may be incorporated in the Work include, but are not limited to, the following:
 1. "Extru-Seal Tape", Pecora Corp.
 2. "Shim-Seal Tape", Pecora Corp.
 3. "PTI 606", Protective Treatments, Inc.
 4. "Tremco 440 Tape", Tremco, Inc.
 5. "MBT-35", Tremco, Inc.

2.6 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type 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. Plastic Foam Joint Fillers: Preformed compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 1. Open-cell polyurethane foam.
 2. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, nonoutgassing in unruptured state.
 3. Proprietary, reticulated, closed-cell polymeric foam, nonoutgassing, with a density of 2.5 pcf and tensile strength of 35 psi per ASTM D 1623, and with water absorption less than 0.02 gms/cc per ASTM C 1083.
 4. Equivalent to Nomaco's "Sof Rod".
- C. Elastomeric Tubing Joint Fillers: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, capable of remaining resilient at temperatures down to -26 deg F (-32 deg C). Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 FIRE RESISTANT SEALERS

- A. General: Provide manufacturer's standard fire stopping sealant with accessory materials, having fire-resistant ratings indicated as established, by the testing agency acceptable to authorities having jurisdiction.

1. Fire safing insulation to be used as a sealant back-up is specified in another Division 7 section.
- B. Foamed in Place Fire Stopping Sealant: Two-part, foamed-in-place, silicone sealant formulated for use in a through penetration fire stop system for filling openings around cables, conduit, pipes, and similar penetrations through walls and floors.
- C. Products: Subject to compliance with the requirements, provide one of the following:
 1. Dow Corning Fire Stop Foam.
 2. Pensil 851, General Electric.

2.8 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 with joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
 3. Remove laitance and form-release agents from concrete.
 4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant

manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

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

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Latex Sealant Standard: Comply with recommendations of ASTM C90 for use of latex sealants.
- D. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.
- E. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - 1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 2. Do not leave gaps between ends of joint fillers.
 - 3. Do not stretch, twist, puncture, or tear joint fillers.
 - 4. Remove absorbent joint fillers that have become wet before sealant application and replace them with dry material.
 - 5. Install bond-breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- F. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - 2. Provide flush joint configuration, per Figure 5B in ASTM C 1193, where indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.
 - 3. Provide recessed joint configuration, per Figure 5C in ASTM C1193, of recess depth and at locations indicated.
- H. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, and to comply with sealant manufacturer's directions for installation methods, materials, and tools that produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal,

apply heat to sealant in conformance with sealant manufacturer's recommendations.

3.4 FOAMED IN PLACE FIRE STOPPING SEALANT

- A. Install continuously around piping, conduit, wiring, joists, columns, etc. at penetrations through corridor partitions and fire rated partitions, walls, floors, and ceilings.
- B. Provide fire rating required at penetrations through fire rated partitions, walls, and ceilings. Minimum fire rating shall be equal to the rating of the wall.
- C. Install around irregularly shaped component passing through partitions, walls and ceilings requiring sealants where other sealant types will not adequately fill area.

3.5 CLEANING

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

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 079200

SECTION 079500 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior expansion control systems.
2. Exterior wall expansion control systems.

B. Related Requirements:

1. Division 3 Section "Cast-In-Place Concrete" for cast-in anchorage and frames for expansion joints cover assemblies in concrete floors and walls.
2. Division 4 Section "Unit Masonry" for adjacent masonry wall systems.
3. Division 7 Section "Flashing and Sheet Metal" for sheet metal roof and wall expansion joint systems.
4. Division 7 Section "Roof Accessories" for curb-type expansion joints.
5. Division 7 Section "Joint Sealants" for elastomeric sealants and preformed foam sealants without metal frames.
6. Division 9 Sections for walls, partitions, ceilings, and floor finishes with expansion joints.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

B. Samples for Initial Selection: For each type of expansion control system indicated.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

C. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion control system.
2. Expansion control system location cross-referenced to Drawings.
3. Nominal joint width.
4. Movement capability.
5. Classification as thermal or seismic.
6. Materials, colors, and finishes.
7. Product options.

8. Fire-resistance ratings.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.
 1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
 2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.
- B. Coordination: Coordinate installation of exterior wall expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified elsewhere.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.

2.3 INTERIOR EXPANSION CONTROL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Basis of Design Manufacturer: MM Systems Corporation.
 2. Balco, Inc.
 3. Construction Specialties, Inc.
- B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.
- C. Floor-to-Floor:
 1. Basis-of-Design Product: MM Systems – Model HFX.
 2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 2 hours.
 - c. Metal: Aluminum.
 - 1) Finish: Clear anodic, Class I.

D. Wall-to-Wall & Ceiling-to-Ceiling:

1. Basis-of-Design Product: MM Systems – Model FX-K
2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 2 hours.
 - c. Metal: Aluminum.
 - 1) Finish: Clear anodic, Class I.

2.4 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

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

1. Basis of Design Manufacturer: MM Systems Corporation.
2. Balco, Inc.
3. Construction Specialties, Inc.

B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

C. Wall-to-Wall:

1. Basis-of-Design Product: MM Systems: ESS Series.
2. Design Criteria:
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 2 hours.
 - c. Silicone Joint – Color to be selected by architect from manufacturer's standard and custom colors.

2.5 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.

D. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.

- E. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- G. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.6 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 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.

2.7 ALUMINUM FINISHES

- A. Mill finish.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion control system manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.
- C. Cast-In Frames: Coordinate and furnish frames to be cast into concrete.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Repair or grout blockout as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 - 5. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
- C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both frame interfaces and/or sides of slabs before installing compression seals.
- E. Foam Seals: Install with adhesive recommended by manufacturer.
- F. Epoxy-Bonded Seals: Pressurize seal for time period and to pressure recommended by manufacturer. Do not overpressurize.
- G. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.
- H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079500

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

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

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, joints, field splices, and connections.
 - 7. Details of accessories.
 - 8. Details of moldings, removable stops, and glazing.
 - 9. Details of conduit and preparations for power, signal, and control systems.

- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
3. Frames:
 - a. Materials: Cold-rolled steel sheet, minimum thickness of 0.053 inch (1.3 mm).
4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core fabricated as thermal-assemblies with a minimum R-value 11 or better.
3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Full profile welded.
4. Exposed Finish: Prime.

2.5 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 (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.

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

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."
- H. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
 3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.

5. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.
 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 7. 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 (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - c. Compression Type: Not less than two anchors in each frame.
 5. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
 6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

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

2.9 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-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 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 plumb, square, 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 will be 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 power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 - 4. 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: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

- b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: [**3/4 inch (19.1 mm)**] [**5/8 inch (15.8 mm)**] plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
- 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "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 (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. 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 Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames"
2. Section 087100 "Door Hardware"
3. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

- C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), 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 finished Work.
2. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.

1.4 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.
- B. Obtain doors from a single manufacturer to ensure uniformity in quality of appearance and construction. All material supplied for this project to conform to the AWI Sections 200 and 1300 for premium grade wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Protect doors during transit, storage and handling to help prevent damage, soiling and deterioration.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.6 FIELD 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 remainder of construction period.

1.7 WARRANTY

- A. **A. Special Warranty:** 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 (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) 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

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries.
 - 3. Graham Wood Doors; an Assa Abloy Group company.
 - 4. Marshfield Door Systems, Inc.
 - 5. VT Industries, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards"
1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
 2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty
- C. 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 and UL 10C.
1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
 4. Pairs: Provide formed-steel edges and astragals with intumescent seals.
 - a. Finish steel edges and astragals to match door hardware (locksets or exit devices).
- D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- E. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
 2. Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers. Closers to be mounted with thru-bolts.
 - b. 5-inch (125-mm) bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
 - c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices. Exit devices to be mounted with thru-bolts.
 3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- F. Structural-Composite-Lumber-Core Doors:
1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).
- G. 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 follows:
 - a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers. Closers to be mounted with thru-bolts.
 - b. 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch (125-mm) midrail blocking, in doors indicated to have exit devices. Exit devices to be mounted with thru-bolts.
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.
 - a. Screw-Holding Capability: 550 lbf (2440 N) per WDMA T.M.-10.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors (SCWD)

1. Grade: Premium, with Grade A faces.
2. Species: Cherry
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Slip match.
5. Assembly of Veneer Leaves on Door Faces: 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 20 feet or more.
8. Exposed Vertical and Top Edges: Same species as faces - edge Type A
9. Core: As required to meet performance requirements listed above.
10. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
11. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.

1. Wood Species: Same species as door faces.

2.5 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 NFPA 80 requirements 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, BHMA-156.115-W, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
 - 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 Section 088000 "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.

2.6 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 bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Use only paints and coatings that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 5, conversion varnish.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Effect: Filled finish
 - 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed 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.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 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

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Access doors and frames for walls and ceilings.

- B. Related Requirements:

- 1. Division 04 Section "Unit Masonry" for anchoring and grouting access door frames set in masonry construction.
 - 2. Division 07 Section "Roof Accessories" for roof hatches.
 - 3. Division 08 Section "Door Hardware" for mortise or rim cylinder locks and master keying.
 - 4. Division 09 Section "Acoustical Tile Ceilings" for suspended acoustical tile ceilings.
 - 5. Division 23 Section "Common Work Results for HVAC" for heating and air-conditioning equipment access doors.

1.3 ACTION 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 (75 by 125 mm) 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.

- a. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
 2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
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).
- C. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- D. Flush Access Doors with Exposed Flanges.
1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 2. Locations: Wall and ceiling.
 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory prime.
 4. Frame Material: Same material, thickness, and finish as door.
 5. Hinges: Spring-loaded, concealed-pin type.
 6. Hardware: Lock – mortise cylinder.

- a. Lock Preparation: Prepare door panel to accept cylinder specified in Division 08 Section "Door Hardware."

E. Fire-Rated, Flush Access Doors with Exposed Flanges:

- 1. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
- 2. Locations: Wall and ceiling.
- 3. Fire-Resistance Rating: Not less than that of adjacent construction.
- 4. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage.

- a. Finish: Factory prime.

- 5. Frame Material: Same material, thickness, and finish as door.
- 6. Hinges: Concealed-pin type.
- 7. Automatic Closer: Spring type.
- 8. Lock: Self-latching device with mortise cylinder lock.

- a. Lock Preparation: Prepare door panel to accept cylinder specified in Division 08 Section "Door Hardware."

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2 (ANSI H35.2M).
- E. Frame Anchors: Same type as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 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 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. For cylinder locks, furnish two keys per lock and key all locks alike.

2.5 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.
 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

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

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Service doors.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory.
 - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. Include description of automatic closing device and testing and resetting instructions.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
 - 1. Include similar Samples of accessories involving color selection.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 DOOR ASSEMBLY (CD)

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design Manufacturer: McKeon Rolling Steel Door Company, Inc.
 - b. ACME Rolling Doors.
 - c. Cookson Company.
 - d. Cornell Iron Works, Inc.
 - e. Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.
- C. Door Curtain Material: Steel.
- D. Door Curtain Slats: Flat profile slats of 3" center-to-center height.
- E. Bottom Bar: Two angles, each not less than 2" by 2" by 1/8 inch fabricated from steel angles and finished to match door.
- F. Curtain Jamb Guides: Steel with exposed finish matching curtain slats.
- G. Hood: Match curtain material and finish.
 - 1. Shape: Square.
 - 2. Mounting: Face of wall.
- H. Electric Door Operator:
 - 1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.

2. Operator Location: Front of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
4. Motor Exposure: Interior.
5. Emergency Manual Operation: Crank type.
6. Obstruction-Detection Device: Automatic photoelectric sensor electric sensor edge on bottom bar.
 - a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
7. Control Station: All operators are to be furnished with one (1) flush mount key switch control station marked open, close, and stop, housed in NEMA 1 enclosure.

I. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 MATERIALS, GENERAL

- 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.

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
 2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.

2.6 LOCKING DEVICES

- A. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.7 CURTAIN ACCESSORIES

- A. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

2.8 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
 - 1. Comply with NFPA 70.
 - 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
 - 1. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.
 - 1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.
1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
- 2.10 GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" 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.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
 - 3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior doors and components to be weather-resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

- C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083326 - OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Open-curtain overhead coiling grilles.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, angle-framing of grille opening, corner guards, and bollards.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and size of overhead coiling grille and accessory.

- 1. Include construction details, material descriptions, dimensions of individual components, profiles for curtain components, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

- 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
 - 4. Show locations of controls, locking devices, and other accessories.
 - 5. Include diagrams for power, signal, and control wiring.

- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

- 1. Include similar Samples of accessories involving color selection.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For overhead coiling grilles to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain overhead coiling grilles from single source from single manufacturer.
 - 1. Obtain operators and controls from overhead coiling-grille manufacturer.

2.2 OPEN-CURTAIN GRILLE ASSEMBLY (CG)

- A. Open-Curtain Grille: Overhead coiling grille with a curtain having a network of horizontal rods that interconnect with vertical links.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design Manufacturer: McKeon Rolling Steel Door Company, Inc.
 - b. ACME Rolling Doors.
 - c. Cookson Company.
 - d. Cornell Iron Works, Inc.
 - e. Overhead Door Corporation.
- B. Operation Cycles: Grille components and operators capable of operating for not less than 50,000 cycles. One operation cycle is complete when a grille is opened from the closed position to the fully open position and returned to the closed position.
 - 1. Include tamperproof cycle counter.
- C. Grille Curtain Material: Aluminum
 - 1. Rod Spacing: Approximately 1-1/2 inches (38 mm) o.c.
 - 2. Link Spacing: Approximately 9 inches (228 mm) in a straight in-line pattern.
 - 3. Spacers: Metal tubes matching curtain material.
- D. Bottom Bar: Continuous tube, fabricated from aluminum extrusion and finished to match grille.
- E. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- F. Hood: Galvanized steel.
 - 1. Shape: Square.
 - 2. Mounting: Face of wall.
- G. Electric Grille Operator:

1. Usage Classification: Medium duty, up to 12 cycles per hour and up to 50 cycles per day.
2. Operator Location: As indicated on Drawings.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.4 m) or lower.
4. Motor Exposure: Interior.
5. Emergency Manual Operation: Push-up type.
6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar.
 - a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.
7. Control Station: Interior mounted where indicated on drawings.
8. Other Equipment: Emergency-egress release and self-opening mechanism.

H. Grille Finish:

1. Aluminum Finish: Mill.

2.3 MATERIALS, GENERAL

- 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.

2.4 GRILLE CURTAIN MATERIALS AND CONSTRUCTION

- A. Open-Curtain Grilles: Fabricate metal grille curtain as an open network of horizontal rods, spaced at regular intervals, that are interconnected with vertical links, which are formed and spaced as indicated and are free to rotate on the rods.
1. Aluminum Grille Curtain: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Bottom Bar: Manufacturer's standard continuous shape unless otherwise indicated, finished to match grille.
1. Astragal: Equip grille bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
 2. Provide motor-operated grilles with combination bottom astragal and sensor edge.
- C. Grille Curtain Jamb Guides: Manufacturer's standard shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.
1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.5 HOODS AND ACCESSORIES

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized-steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
- B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling, unless otherwise indicated.
- C. Mounting Frame: Manufacturer's standard mounting frame designed to support grille; factory fabricated from ASTM A 36/A 36M structural-steel tubes or shapes, hot-dip galvanized per ASTM A 123/A 123M; fastened to floor and structure above grille; to be built into wall construction; and complete with anchors, connections, and fasteners.

2.6 LOCKING DEVICES

- A. Safety Interlock Switch: Equip power-operated grilles with safety interlock switch to disengage power supply when grille is locked.

2.7 COUNTERBALANCING MECHANISM

- A. General: Counterbalance grilles by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of parts and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.
- C. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 ELECTRIC GRILLE OPERATORS

- A. General: Electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille and operation cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.
 1. Comply with NFPA 70.
 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each grille.
- C. Grille Operator Location(s): Operator location indicated for each grille.
 1. Front-of-Hood Mounted: Operator is mounted to the right or left grille head plate, with the operator on coil side of the grille-hood assembly and connected to the grille drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:
 - a. Phase: Single phase.
 - b. Volts: 115 V.
 - c. Hertz: 60.
 2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate grille in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip motorized grille with adjustable switches interlocked with motor controls and set to automatically stop grille at fully opened and fully closed positions.
- F. Obstruction-Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.
1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
 - a. Self-Monitoring Type: Four-wire configured device designed to interface with grille operator control circuit to detect damage to or disconnection of sensor edge.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip electrically powered grille with capability for emergency manual operation. Design manual mechanism so required force for grille operation does not exceed 25 lbf.
- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.
- L. Emergency-Egress Release: Flush, wall-mounted handle mechanism, for accessibility-code-compliant egress feature, not dependent on electric power. The release allows an unlocked grille to partially open without affecting limit switches to permit passage, and it automatically resets motor drive upon return of handle to original position.

2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" 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.

2.10 ALUMINUM FINISHES

- A. Mill Finish: Manufacturer's standard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports, according to manufacturer's written instructions and as specified.
- B. Install overhead coiling grilles, hoods, controls, and operators at the mounting locations indicated for each grille.
- C. Accessibility: Install overhead coiling grilles, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Grilles: Install according to UL 325.

3.3 STARTUP SERVICE

- A. Perform installation and startup checks according to manufacturer's written instructions.
- B. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Test grille opening when activated by detector, fire-alarm system, emergency-egress release, or self-opening mechanism as required. Reset grille-opening mechanism after successful test.

3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly, so that grilles operate easily, free of warp, twist, or distortion.
 - 1. Adjust exterior components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling grilles.

END OF SECTION 083326

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Exterior and interior storefront framing.
- 2. Storefront framing for punched openings.
- 3. Exterior and interior manual-swing entrance doors and door-frame units.

B. Related Requirements:

- 1. Section 042000 "Unit Masonry" for adjacent surfaces
- 2. Section 084413 "Glazed Aluminum Curtainwalls"
- 3. Section 087100 "Door Hardware"
- 4. Section 088000 "Glazing"

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

- 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
- 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
- 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Entrance Door Hardware Schedule: Prepared by or under 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. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. 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.
 - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts 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 created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a professional engineer licensed in Delaware to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 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 (19.1 mm)**, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than **1/8 inch (3.2 mm)**.
 - a. Operable Units: Provide a minimum **1/16-inch (1.6-mm)** clearance between framing members and operable units.
 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

- a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).
- E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
- F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- G. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Thermal Cycling: 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 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 - c. Interior Ambient-Air Temperature: 75 deg F.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. [YKK AP America Inc.](#)
 - a. Exterior: YES 45 TU
 - b. Interior: YES 45 FS
 2. [Kawneer North America.](#) –

- a. Exterior: Trifab VG 451-T
 - b. Interior: Trifab VG 450
3. Oldcastle Building Envelope-
- a. Exterior: Series 3000
 - b. Interior: FG-2000
4. EFCO
- a. Exterior: Series 403(T)
 - b. Interior: Series 401

- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including venting windows and accessories, from single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
- 1. Construction: Exterior - Thermally improved.
 - 2. Glazing System: Retained mechanically with gaskets on four sides.
 - 3. Glazing Plane: Front.
 - 4. Finish: Clear anodic finish.
 - 5. Fabrication Method: Field-fabricated stick system.
 - 6. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
- 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - 2. 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.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 VENTING WINDOWS

- A. Aluminum Windows: Manufacturer's standard units, complying with AAMA/WDMA/CSA 101/I.S.2/A440, with self-flashing mounting fins, and as follows:
1. Window Type: Awning
 2. Minimum Performance Class: AW.
 3. Minimum Performance Grade: 40.
 4. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **0.064-inch (1.63-mm)** thickness at any location for main frame and sash members.
 - a. Thermally Improved Construction: Fabricate window units 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.
 5. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
 6. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
 - a. Reinforcement: Where fasteners screw-anchor into aluminum less than **0.128 inch (3.26 mm)** thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
 7. Projected Window Hardware (Awning):
 - a. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
 - 1) Type and Style: As selected by Architect from manufacturer's full range of types and styles.
 - b. Hinges: Non-friction type, not less than two per sash.
 - c. Lock: Lever handle and cam-action lock with keeper.
 8. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:
 - a. Aluminum Wire Fabric: **18-by-18 (1.1-by-1.1-mm)**, **18-by-16 (1.1-by-1.3-mm)**, or **18-by-14 (1.1-by-1.5-mm)** mesh of **0.013-inch- (0.3-mm-)** diameter, coated aluminum wire.
- B. Glazing: Same as adjacent aluminum-framed entrances and storefront glazing.
- C. Finish: Match adjacent aluminum-framed entrances and storefront finish.

2.5 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: **2-inch** overall thickness, with minimum **0.188-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.
 2. Door Design: As indicated.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.

2.6 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- 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. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.
- D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- E. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.
- F. 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.
- G. Cylinders: As specified in Section 087100 "Door Hardware."
- H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- I. Operating Trim: BHMA A156.6.
- J. Removable Mullions: BHMA A156.3, extruded aluminum.
 1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.
- K. 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 comply with field conditions and requirements for opening force.
- L. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- M. Surface-Mounted Holders: BHMA A156.16, Grade 1.
- N. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- O. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

- P. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- Q. Silencers: BHMA A156.16, Grade 1.
- R. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of **1/2 inch (12.7 mm)**.
- S. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.7 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."

2.8 ACCESSORIES

- A. 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.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for **30-mil (0.762-mm)** thickness per coat.

2.9 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. 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. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 6. 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. Storefront Framing: Fabricate components for assembly using shear-block system.
- F. 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.
 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.
- G. 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.
- H. 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.
- I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.11 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, 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.

3.2 PREPARATION

- A. Prepare surfaces that are in contact with 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.

3.3 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 and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

- D. Install components plumb and true in alignment with established lines and grades.

- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weatherstripping contact and hardware movement to produce proper operation.

- F. Install glazing as specified in Section 088000 "Glazing."

- G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

- H. 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.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: **1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**

2. Level: **1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch (12.7 mm)** wide, limit offset from true alignment to **1/16 inch (1.6 mm)**.
 - b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch (12.7 to 25.4 mm)** wide, limit offset from true alignment to **1/8 inch (3.2 mm)**.
 - c. Where surfaces are separated by reveal or protruding element of **1 inch (25.4 mm)** wide or more, limit offset from true alignment to **1/4 inch (6 mm)**.
4. Location: Limit variation from plane to **1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm)** over total length.

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes glazed aluminum curtain walls.
- B. Related Requirements:
 - 1. Section 04200 "Unit Masonry" for adjacent surfaces.
 - 2. Section 084113 "Aluminum Framed Entrances and Storefronts"
 - 3. Section 087100 "Door Hardware"
 - 4. Section 088000 "Glazing"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds. – see drawings for location to be assembled
2. Glazing.

- F. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. 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.
1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- D. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of curtain wall assemblies.

1.7 WARRANTY

- A. Special Assembly Warranty: Manufacturer and Installer agree to repair or replace components of glazed aluminum curtain wall 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 created by wind and thermal and structural movements.
 - c. Deterioration of metals[, metal finishes,] and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.

- e. Failure of operating components.
 2. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a professional engineer licensed in Delaware to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

- a. Operable Units: Provide a minimum **1/16-inch (1.6-mm)** clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus **1/4-inch (6.35-mm)** for spans greater than **11 feet 8-1/4 inches (3.6 m)** or 1/175 times span, for spans less than **11 feet 8-1/4 inches (3.6 m)**.
- E. Structural: Test according to ASTM E 330 as follows:
 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
 1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of **0.06 cfm/sq. ft.** at a static-air-pressure differential of **1.57 lbf/sq. ft.**
- G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft.**
- H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
 1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft.**
 2. Maximum Water Leakage: According to AAMA 501.1 No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- I. Energy Performance: Certify and label energy performance according to NFRC as follows:
 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than **0.45 Btu/sq. ft. x h x deg F** as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.
- J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
 1. Temperature Change: **120 deg F (67 deg C)**, ambient; **180 deg F (100 deg C)**, material surfaces.
 2. Thermal Cycling: 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 deg F**.
- b. Low Exterior Ambient-Air Temperature: **0 deg F**.

K. Structural-Sealant Joints:

- 1. Designed to carry gravity loads of glazing.
- 2. Designed to produce tensile or shear stress of less than **20 psi (138 kPa)**.

L. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

- 1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
- 2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 MANUFACTURERS (CW-#)

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

- 1. YKK AP America Inc.
 - a. Curtainwall: YCW 750 OG Series – 2 ½” x 7 ½” System
 - b. Butt Glazed Curtainwall: YCW 750 SSG Series – 2 ½” x 7 ½” System
 - 1) Modify mullion at transition to curtainwall as required per manufacturers written instructions.
- 2. Kawneer North America. –
 - a. Curtainwall: 1600 Wall System 1 – 2 ½” x 7 ½” System
 - b. Butt Glazed Curtainwall: 1600 Wall System 2 – 2 ½” x 7 ½” System
 - 1) Modify mullion at transition to curtainwall as required per manufacturers written instructions.
- 3. Oldcastle Building Envelope–
 - a. Curtainwall: Reliance 1” System Captured – 2 ½” x 7½ ” System
 - b. Butt Glazed Curtainwall: Reliance 1” System SSG Verticals – 2 ½” x 7 ½” System
 - 1) Modify mullion at transition to curtainwall as required per manufacturers written instructions.
- 4. EFCO
 - a. Curtainwall: System 5600 – 2 ½” x 7 ½” System
 - b. Butt Glazed Curtainwall: System 5600” System SSG Verticals – 2 ½” x 7 ½” System
 - 1) Modify mullion at transition to curtainwall as required per manufacturers written instructions.

B. Source Limitations: Obtain all components of curtain wall system, including framing spandrel panels, venting windows, entrances, sun control, and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally improved.
 2. Glazing System:
 - Type 1: Retained mechanically with gaskets on four sides and
 - Type 2: Retained mechanically with gaskets on two sides and structural sealant on two sides.
 3. Glazing Plane: Front.
 4. Finish: Clear anodic finish.
 5. Fabrication Method: Field-fabricated stick system.
- B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
 - a. Provide vertical pressure caps, Basis of Design – EFCO-12G3 at CW-3 (Art Room)
 - b. Provide vertical pressure caps, Basis of Design – EFCO-4564 at CW-6, CW-6A, & CW-6B (Stair C100A)
 - c. Provide manufacturer's standard pressure caps at all horizontal and all other vertical locations not listed above.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
 - b. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 2. 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.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 VENTING WINDOWS

- A. Aluminum Windows: AAMA/WDMA/CSA 101/I.S.2/A440, manufacturer's standard, with self-flashing mounting fins, and as follows:
1. Window Type: Awning
 2. Minimum Performance Class: AW.
 3. Minimum Performance Grade: 40
 4. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than **0.064-inch (1.63-mm)** thickness at any location for main frame and sash members.
 - a. Thermally Improved Construction: Fabricate window units 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.

5. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
6. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.
 - a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch (3.26 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.
7. Projected Window Hardware (Awning):
 - a. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
 - 1) Type and Style: As selected by Architect from manufacturer's full range of types and styles.
 - b. Hinges: Non-friction type, not less than two per sash.
 - c. Lock: Lever handle and cam-action lock with keeper.
8. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:
 - a. Aluminum Wire Fabric: 18-by-18 (1.1-by-1.1-mm), 18-by-16 (1.1-by-1.3-mm), or 18-by-14 (1.1-by-1.5-mm) mesh of 0.013-inch- (0.3-mm-) diameter, coated aluminum wire.

B. Glazing: Same as adjacent glazed aluminum curtain-wall glazing.

C. Finish: Match adjacent glazed aluminum curtain-wall finish.

2.5 ENTRANCES

A. Entrances: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts."

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers. Comply with Section 088000 "Glazing."

C. Glazing Sealants: As recommended by manufacturer. Comply with Section 088000 "Glazing."

D. Structural Glazing Sealants: ASTM C 1184, chemically 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 structural-sealant manufacturer for use in curtain-wall assembly indicated.

1. Color: As selected by Architect from manufacturer's full range of colors.

E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: Match structural sealant.

2.7 ACCESSORIES

- A. 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.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for **30-mil (0.762-mm)** thickness per coat.

2.8 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. 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. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from exterior.
 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Fabricate components to resist water penetration as follows:
 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
 2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using shear-block system.

- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.10 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, 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.

3.2 PREPARATION

- 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.

3.3 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 and to prevent impeding movement of moving joints.
 - 6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
 - 7. Seal joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
 - 2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
 - 1. 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.
- G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:
 - 1. Plumb: **1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**
 - 2. Level: **1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**
 - 3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch (12.7 mm)** wide, limit offset from true alignment to **1/16 inch (1.6 mm).**
 - b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch (12.7 to 25.4 mm)** wide, limit offset from true alignment to **1/8 inch (3.2 mm).**
 - c. Where surfaces are separated by reveal or protruding element of **1 inch (25.4 mm)** wide or more, limit offset from true alignment to **1/4 inch (6 mm).**
 - 4. Location: Limit variation from plane to **1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm)** over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: See drawings for test area locations
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of one test at each of the following locations:
 - 1) CW-3 – located at Art C125
 - 2) CW-1 – located at Media Center A115
 - 3) CW-6 – located at Stair C100A

2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - a. Perform a minimum of test at each of the following locations:
 - 1) CW-3 – located at Art C125
 - 2) CW-1 – located at Media Center A115
 - 3) CW-6 – located at Stair C100A
 3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- C. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
1. Test a minimum of two areas on each building facade.
 2. Repair installation areas damaged by testing.
- D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 084510 – TRANSLUCENT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions in Division 1 Specification sections, applied to this section.

1.2 SUMMARY

- A. This section includes furnishing and installation of translucent assembly in gymnasiums.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Division 5, Section "Structural Steel Framing."

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide design, fabrication, and erection of the canopy roof structure as required to make a complete and watertight installation. System to be produced, fabricated, and installed to withstand normal thermal movement, when loading, and impact loading (where applicable) without failure including loss of, or glass breakage, or glazing breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; and deterioration of glazing materials; and other defects in construction.
- B. Translucent panels shall consist of 2-3/4" thick factory prefabricated sandwich panels and system, windows, louvers, etc., factory assembled into a single unit (including installation).

1.4 SUBMITTALS

- A. General: Submit the following according to conditions of contract and Division 1 Specification sections.
- B. Product Data for material.
- C. Shop drawings including:
 - 1. Layout and installation details, including relationship to adjacent work.
 - 2. Detailed elevations and sections.
 - 3. Anchors and reinforcement.
 - 4. Glazing details.
- D. Structural calculations by structural engineer licensed in the State of Maryland.
- E. Samples: The manufacturer shall submit samples of each type of glazing and finish as requested.
- F. Test reports to be furnished by sandwich panel system manufacturer in accordance with Division 1, Submittals. The manufacturer shall submit certified test reports made by an independent testing organization for each type and class of panel system. Reports shall verify that the material will meet all performance requirements of this specification. Previously completed test reports will be acceptable if current and indicative of products used on this project. Test reports required are:
 - 1. Flame Spread and Smoke Development (ASTM E-84).
 - 2. Burn Extent (ASTM D-635).
 - 3. Color Difference (ASTM D-2244).
 - 4. Impact Strength (Free Falling Ball Method).

5. Tensile Bond Strength (ASTM C-297) after aging by ASTM D1037.
6. Shear Bond Strength (ASTM D-1002) after 5 aging conditions.
7. Insulation "U" Factor (by NFRC-100); ASTM C-236, E-1432, and C-1199).
8. Daylight Autonomy.

1.5 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain glazing and panel structure from one source. Manufacturer shall have demonstrated knowledge in applications of exterior skylight systems over the last five (5) years.
- B. Manufacturer's and Erector's Qualifications:
 1. Quality control inspections and testing conducted at least once each year, shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with "Acceptable Criteria for Sandwich Panels" as regulated by the ICBO-BS or equivalent.
 2. Materials and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten (10) consecutive years and which can show evidence of these materials being satisfactorily used on at least six (6) projects of similar size, scope and type within such a period. At least three (3) of the projects shall have been in successful use for ten (10) years or longer.
 3. Erection shall be by an installer which has been in the business of erecting specified materials for at least five (5) consecutive years; and can show evidence of satisfactory completion of projects of similar size, scope and type.
- C. Performance Requirements: The manufacturer shall be responsible for the configuration and fabrication of the complete skylight panel system.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect all materials to comply with manufacturer's directions and as needed to prevent damage to glazing materials and skylight finishes from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with glazing when ambient substrate temperature conditions are outside the limits permitted by manufacturer.
- B. Field Measurements: Check layout by accurate field measurements before fabrication. Show recorded measurements on shop drawings. Complete fabrication schedule with construction progress to avoid delay of the work.
 1. Where necessary proceed with fabrication without field measurements and coordinate fabrication tolerances to ensure proper fit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering exterior translucent covers which may be incorporated in the work include the following:
 1. Kalwall Corporation
 2. Major Industries

2.2 TRANSLUCENT FACING

- A. Translucent faces shall be manufactured from glass fiber reinforced thermostat resins by insulated panel unit system fabricator especially for architectural use. Thermoplastic faces are not acceptable.
- B. Weatherability:
 - 1. The full thickness of the exterior face shall not change color more than 3.0 Hunter or CIE Units (DELTA E by ASTM D-2244) after five (5) years outdoor South Florida weathering at 7 degrees facing south, determined by the average of at least three (3) white samples without a protective film or coating to ensure maximum long term color stability.
 - 2. The exterior face shall have a permanent glass erosion barrier to provide maximum long term resistance to reinforcing fiber exposure and shall be warranted against same for 25 years. (Note: For white, crystal, and Kal-Tint). Plastic film overlays are not acceptable.
- C. Appearance:
 - 1. The faces shall be uniform in color to prevent splotchy appearance. Faces shall be completely free of ridges and wrinkles which prevent proper surface contact in bonding to the aluminum grid core. Clusters of air bubbles/pinholes which collect moisture and dirt are not acceptable.
 - 2. Exterior face sheets shall be (smooth) .045" thick and crystal in color. Interior face sheets shall be .045" thick and crystal in color. Faces shall not vary more than +/-10% in thickness.
- D. Strength: The exterior face sheet shall be uniform in strength and repel an impact equal to (60) ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 6.37 lb. free-falling ball, and be resistant to penetration by pencil point or other small, sharp objects.

2.3 (NON-COMBUSTIBLE) GRID CORE

- A. Thermally broken grid core to meet values listed in 2.5A.

2.4 ADHESIVE

- A. The laminate adhesive shall be heat and pressure type engineered for structural sandwich panel use. Adhesive shall pass testing requirements specified by the International conference of Building Officials "Acceptance Criteria for Sandwich Panel Adhesive". Minimum strength shall be:
 - 1. 750 PSI tensile strength by ASTM C-297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D-1037.
 - 2. Shear strength average of five (5) exposure by ASTM D-1002:
 - a. 50% Relative Humidity at 73 degrees F: 540 PSI
 - b. Accelerated Aging by ASTM D-1183: 700 PSI
 - c. 182 degrees F: 60 PSI
 - d. Full Cycle Soak: 715 PSI
 - e. 500 Hour Oxygen Bomb: 1400 PSI

2.5 PANEL CONSTRUCTION

- A. Panels shall have a thickness of 2-3/4" with a "U" factor of .023 thermally broken, light transmission of 30%, and shading coefficient of .33.
- B. Translucent panels shall be a true sandwich panel of flat fiberglass sheets bonded to a grid core of mechanically interlocking thermally broken I-beams and shall be laminated under a controlled process of heat and pressure.
- C. Translucent panel units shall be pre-assembled and sealed at the factory. Panel units should be shipped to the job site in rugged shipping units and shall be ready for erection as units (except for removable components) by Contractor. Field assembly of major components will not be allowed.
- D. Grid pattern shall be 24" x 12" nominal and be symmetrical about the horizontal center line of each panel.
- E. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge. In order to ensure bonding strength, white spots at intersections of muntins and mullions shall not exceed 4 for each 40 square feet of panel, nor shall they be more than 3/64" in width.

2.6 BATTENS AND PERIMETER CLOSURE SYSTEM

- A. Extruded 6063-T6 and 6063-T5 aluminum screw clamp-tite screw type closure system.
- B. All battens and perimeter closures to be supplied with 300 series stainless steel screws (excluding final fasteners to the building).
- C. All exposed aluminum to be architectural corrosion resistant finish class 1 clear anodized finish complying with AAMA 606.1 or AAMA 608.1.

2.7 FLEXIBLE SEALING TAPE

- A. Sealing tape shall be manufacturer's standard pre-applied to closure system at the factory under controlled conditions.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Comply with manufacturers instructions to prepare substrate to receive skylight system.

3.2 INSTALLATION

- A. The skylight shall be completely erected and glazed by the manufacturer authorized installer.
- B. All aluminum that comes in contact with dissimilar metal shall receive a protective coating or isolator to prevent electrolytic action.
- C. Coordinate with other work by furnishing shop drawings, inserts, and similar items at the appropriate times for proper sequence of construction without delays. Installer must verify dimensions of the supporting structure and other elements which proceed the skylight work before fabrication of the required components, if openings are not ready for measuring it is the responsibility of the General Contractor to hold architectural, structural, and shop drawings dimensions and verify same in writing to skylight contractor to avoid delay in fabrication and installation of panels.

3.3 CLEAN UP

- A. Glazing panels shall be cleaned as they are installed and left in scratch-free condition inside and out with all laboring removed.

3.4 FINAL CLEANING AND PROTECTION

- A. Subsequent to installation of skylights, clean glazing, framing members, and accessories. No abrasive material shall be used in cleaning of panel surfaces.

END OF SECTION 084510

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Gates.
2. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
3. Lead-lining door hardware items required for radiation protection at door openings.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
4. Division 13 Section "Radiation Protection" for requirements for lead-lining for door hardware at openings indicated to receive radiation protection.
5. Division 26 sections for connections to electrical power system and for low-voltage wiring.
6. Division 28 sections for coordination with other components of electronic access control system.

1.3 REFERENCES

A. Fire/Life Safety

1. NFPA - National Fire Protection Association
 - a. NFPA 70 – National Electric Code
 - b. NFPA 80 - Standard for Fire Doors and Fire Windows
 - c. NFPA 101 - Life Safety Code
 - d. NFPA 105 - Smoke and Draft Control Door Assemblies

2. State Fire Safety Code.
- B. UL - Underwriters Laboratories
1. UL 10B - Fire Test of Door Assemblies
 2. UL 10C - Positive Pressure Test of Fire Door Assemblies
 3. UL 1784 - Air Leakage Tests of Door Assemblies
 4. UL 305 - Panic Hardware
- C. Accessibility
1. ADA - Americans with Disabilities Act.
 2. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
- D. DHI - Door and Hardware Institute
1. Sequence and Format for the Hardware Schedule
 2. Recommended Locations for Builders Hardware
 3. Key Systems and Nomenclature
- E. ANSI - American National Standards Institute
1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

1.4 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

B. Action Submittals:

1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
 - a. Door Index; include door number, heading number, and Architects hardware set number.
 - b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
 - c. Type, style, function, size, and finish of each hardware item.
 - d. Name and manufacturer of each item.
 - e. Fastenings and other pertinent information.
 - f. Location of each hardware set cross-referenced to indications on Drawings.
 - g. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - h. Mounting locations for hardware.
 - i. Door and frame sizes and materials.
 - j. Name and phone number for local manufacturer's representative for each product.
 - k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include how door will operate on egress, ingress, and fire and smoke alarm connection.
 - 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.
 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
 - b. Use ANSI A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
 - 1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
 6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory prepared for door hardware installation.
- C. Informational Submittals:
1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
 2. Product Certificates for electrified door hardware, signed by manufacturer:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 3. Certificates of Compliance:

- a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
 - b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
 - c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door hardware on doors located in accessible routes.
 5. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 - e. Final approved hardware schedule, edited to reflect conditions as-installed.
 - f. Final keying schedule
 - g. Copies of floor plans with keying nomenclature
 - h. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
 - i. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.5 QUALITY ASSURANCE

- A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
1. Where specific manufacturer's product is named and accompanied by "No Substitute," including make or model number or other designation, provide product specified. (Note: Certain products have been selected for their unique characteristics and particular project suitability.)
 - a. Where no additional products or manufacturers are listed in product category, requirements for "No Substitute" govern product selection.
 2. Where products indicate "acceptable substitute" or "acceptable manufacturer", provide product from specified manufacturers, subject to compliance with specified requirements and "Single Source Responsibility" requirements stated herein.
- B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
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.

4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
 - a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.
- C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of successful in-service performance for installing door hardware similar in quantity, type, and quality to that indicated for this Project.
- D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
 2. Can provide installation and technical data to Architect and other related subcontractors.
 3. Can inspect and verify components are in working order upon completion of installation.
 4. Capable of producing wiring diagrams.
 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated.
 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use of key, tool, or special knowledge for operation.
- J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate with force of not more than 5 lbf (22.2 N).
 2. Maximum opening-force requirements:

- a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- K. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01.
1. Attendees: Owner, Contractor, Architect, Installer, Owner's security consultant, and Supplier's Architectural Hardware Consultant.
 2. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.
- L. Pre-installation Conference: Conduct conference at Project site
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Inspect and discuss preparatory work performed by other trades.
 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.
- M. Coordination Conferences:
1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
 - a. Attendees: Door hardware supplier, door hardware installer, Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who was in attendance.
 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.
 - a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware installer, electrical subcontractor, Owner, Owner's security consultant, Architect and Contractor.
 - b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was held and who was in attendance.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
 - 1. Deliver each article of hardware in manufacturer's original packaging.
- C. Project Conditions:
 - 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
 - 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- D. Protection and Damage:
 - 1. Promptly replace products damaged during shipping.
 - 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
 - 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.7 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 Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
- F. Direct shipments not permitted, unless approved by Contractor.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.

- a. Closers:
 - 1) Mechanical: 10 years.
 - 2) Electrified: 2 years.
 - b. Exit Devices:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - c. Locksets:
 - 1) Mechanical: 3 years.
 - 2) Electrified: 1 year.
 - d. Continuous Hinges: Lifetime warranty.
 - e. Key Blanks: Lifetime
2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.9 MAINTENANCE

A. Maintenance Tools:

- 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and particular project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”
 - 1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article, herein.
- C. Approval of products from manufacturers indicated as “Acceptable Manufacturer” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

Item	Scheduled Manufacturer	Acceptable Manufacturer
Hinges	Ives (IVE)	Hager, Stanley
Continuous Hinges	Ives (IVE)	Markar, Stanley
Electric Power Transfer	Von Duprin (VON)	ABH, Falcon
Flush Bolts & Coordinators	Ives (IVE)	Burns, Rockwood
Locksets & Deadlocks	Schlage (SCH)	No Substitute
Exit Devices & Mullions	Von Duprin (VON)	No Substitute
Electric Strikes	Von Duprin (VON)	No Substitute
Power Supplies	Schlage Electronics (SCE)	No Substitute

Roller Latches	Ives (IVE)	Burns, Rockwood
Cylinders & Keying	Schlage (SCH)	No Substitute
Door Closers	LCN (LCN)	No Substitute
Door Trim	Ives (IVE)	Burns, Rockwood
Protection Plates	Ives (IVE)	Burns, Rockwood
Overhead Stops	Glynn-Johnson (GLY)	Rixson,
Stops & Holders	Ives (IVE)	Burns, Rockwood
Thresholds & Weatherstrip	National Guard (NAT)	Pemko, Zero
Silencers	Ives (IVE)	Burns, Rockwood
Magnetic Holders	LCN (LCN)	Rixson, Sargent
Door Position Switches	Schlage Electronics (SCE)	GE, Sargent
Key Cabinets	Telkee (TEL)	HPC, Lund

- D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
- E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.2 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
 4. Install hardware with fasteners provided by hardware manufacturer.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.3 HINGES

A. Provide five-knuckle, ball bearing hinges.

1. Manufacturers and Products:
 - a. Scheduled Manufacturer and Product: Ives 5BB series.
 - b. Acceptable Manufacturers and Products: Hager BB series, McKinney TA/T4A series, Stanley FBB Series.

B. Requirements:

1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
2. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
3. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
5. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
8. Doors 36 inches (914 mm) wide or less furnish hinges 4 1/2 inches (114 mm) high; doors greater than 36 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
9. Provide hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component.
10. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame specification.
11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.

2.4 CONTINUOUS HINGES**A. Stainless Steel**

1. Manufacturers:
 - a. Scheduled Manufacturer: Ives
 - b. Acceptable Manufacturers: Markar, Stanley
2. Requirements:
 - a. Provide pin and barrel continuous hinges conforming to ANSI A156.26, Grade 2.

- b. Provide pin and barrel continuous hinges fabricated from 14 gauge, type 304 stainless steel.
- c. Provide twin self-lubricated nylon bearings at each hinge knuckle, with 0.25-inch (6 mm) diameter stainless steel pin.
- d. Provide hinges capable of supporting door weights up to 600 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide pin and barrel continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide pin and barrel continuous hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges with symmetrical hole pattern.

B. Aluminum Geared

1. Manufacturers:

- a. Scheduled Manufacturer: Ives.
- b. Acceptable Manufacturers: Markar, Stanley.

2. Requirements:

- a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.
- b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
- c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
- d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
- e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
- f. Provide aluminum geared continuous hinges with electrified option where specified. Provide with sufficient number and gage of concealed wires to accommodate electric function of specified hardware.
- g. Install hinges with fasteners supplied by manufacturer.
- h. Provide hinges with symmetrical hole pattern.

2.5 ELECTRIC POWER TRANSFER

A. Manufacturers:

- a. Scheduled Manufacturer: Von Duprin
- b. Acceptable Manufacturers: No Substitute

B. Provide power transfer with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.6 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.7 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives
2. Acceptable Manufacturers: Burns, Rockwood

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical rod devices if required.

2.8 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage L9000 series
2. Acceptable Manufacturers and Products: No Substitute

B. Requirements:

1. Provide mortise locks certified as ANSI A156.13, Grade 1 Operational, Grade 1 Security, and manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
2. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
3. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
4. Provide electrical options as scheduled. Provide electrified locksets with micro switch (RX) option that monitors retractor crank, and is actuated when rotation of inside or outside lever rotates retractor hub. Provide normally closed contacts or normally open contacts as required by security system.
5. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
 - a. Lever Design: Schlage 17A.

2.9 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage ND Series
2. Acceptable Manufacturers and Products: No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to “KEYING” article, herein.
2. Provide locksets able to withstand 1500 inch pounds of torque applied to locked outside lever without gaining access per ANSI A156.2 Abusive Locked Lever Torque Test and cycle tested to 3 million cycles per ANSI A156.2 Cycle Test.
3. Provide solid steel rotational stops to control excessive rotation of lever.
4. Provide completely refunctionable lockset that allows lock function to be changed to over twenty other common functions by swapping easily accessible parts.
5. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
6. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
7. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
8. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
9. Provide electrical options as scheduled.
10. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
 - a. Lever Design: Schlage Sparta.

2.10 AUXILIARY LOCKS

A. Deadlocks:

1. Manufacturers and Products:

- a. Scheduled Manufacturer and Product: Schlage L400 series
- b. Acceptable Manufacturers and Products: No Substitute.

2. Requirements:

- a. Provide mortise deadlock series conforming to ANSI A156 and function as specified. Cylinders: Refer to “KEYING” article, herein.
- b. Provide deadlocks with standard 2-3/4 inches (70 mm) backset. Provide deadbolt with full 1 inch (25 mm) throw, constructed of stainless steel.
- c. Provide manufacturer’s standard strike.

2.11 EXIT DEVICES

A. Manufacturer and Product:

1. Von Duprin 98/35 series,
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware. Cylinders: Refer to "KEYING" article, herein.
2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide end-cap with two-point attachment to door. Match exit device finish, stainless steel for US26, US26D, US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide compression springs in devices, latches, and outside trims or controls; tension springs prohibited.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrical requirements.
6. Concealed Vertical Cable Exit Devices: Cable-actuated concealed vertical latch system in two-point and less bottom latch (LBL) configurations. Vertical rods not permitted.
 - a. Cable: Stainless steel core wire in stainless steel with polytetrafluoroethylene (Teflon®) liner color-coded to latches and center slides. Conduit and core wire ends snap into latch and center slides without use of tools.
 - b. Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper-infiltrated steel, with molybdenum disulfide low friction coating.
 - c. Top Latchbolt: Minimum 0.382 inch (10 mm) and greater than 90 degree engagement with strike to prevent door and frame separation under high static load.
 - d. Bottom Latchbolt: Minimum of 0.44 inch (11 mm) engagement with strike.
 - e. Product Cycle Life: 1,000,000 cycles.
 - f. Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
 - g. Latch release does not require separate trigger mechanism.
 - h. Cable and latching system characteristics:
 - 1) Assembled prior to being installed in door.
 - 2) Installed in door as complete assembly.
 - 3) Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
 - 4) Connected to exit device at single attachment point.
 - 5) Bottom latch height adjusted from single point, after system is installed and connected to exit device, while door is hanging
 - 6) Latch position altered up and down 2 inches (51 mm) without additional adjustment.
 - 7) System may be removed while door is hanging.
 - 8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face mount for aluminum doors, eliminating requirement of tabs.
 - 9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting option for top latch, regardless of exit device centerline.
7. Provide exit devices with manufacturer's approved strikes.
8. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder dogging at non-fire-rated exit devices, unless specified less dogging.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.

12. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - a. Lever Style: Match lever style of locksets.
 - b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
13. Provide UL labeled fire exit hardware for fire rated openings.
14. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
15. Provide electrical options as scheduled.

2.12 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 6000 series.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary-resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide fail-secure type electric strikes, unless specified otherwise.
5. Coordinate voltage and provide transformers and rectifiers for each strike as required.

2.13 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage Electronics or Von Duprin PS900 series.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide power supplies, recommended and approved by manufacturer of electrified locking component, for operation of electrified locks, electrified exit devices, magnetic locks, electric strikes, and other components requiring power supply.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Options:
 - a. Provide power supply, where specified, with internal capability of charging sealed backup batteries 24 VDC, in addition to operating DC load.
 - b. Provide sealed batteries for battery back-up at each power supply where specified.
 - c. Provide keyed power supply cabinet.
5. Provide power supply in an enclosure, complete, and requiring 120VAC to fused input.

6. Provide power supply with emergency release terminals, where specified, that allow release of all devices upon activation of fire alarm system complete with fire alarm input for initiating "no delay" exiting mode.

2.14 CYLINDERS

- A. Manufacturer:
 1. Scheduled Manufacturer: Schlage
 2. Acceptable Manufacturers and Products: No Substitute.
- B. Requirements: Provide cylinders/cores complying with the following requirements.
 1. Furnished by same manufacturer as locks.
 2. Cylinders/cores compliant with ANSI/BHMA A156.5; latest revision, Section 12, Grade 1; permanent cylinders; cylinder face finished to match lockset, manufacturer's series as indicated.
- C. Full-sized cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 1. Keying:
- D. [Manufacturer-keyed permanent cylinders/cores, configured into existing keying system per "KEYING" article herein.
- E. Locksmith-keyed permanent cylinders/cores, configured into existing keying system per "KEYING" article herein.
 1. Provide contact information if the Owner or Owners representative are to provide the permanent cylinders and/or cores.
 2. Features: Cylinders/cores shall incorporate the following features.
- F. Nickel silver bottom pins.
 1. Identification:
- G. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Blind code marks shall not include actual key cuts.
- H. Identification stamping provisions must be approved by the Architect and Owner.
- I. Failure to comply with stamping requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 1. Forward cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- J. Construction Keying System.
- K. 3 construction control keys and extractor tool, if required.
- L. 12 construction change (day) keys.
- M. Replaceable Construction Cores.

1. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
- N. 12 construction change (day) keys.
- O. Contractor will replace temporary construction cores with permanent cores.

2.15 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
- B. Keying System: Existing Schlage system maintained by Owner or Owners representative, incorporating decisions made at keying conference.
- C. Keying Requirements – General
 1. Permanent cylinders/cores keyed by the manufacturer according to the following key system.
- D. Keying system tied into existing Schlage Primus system as directed by the Owner.
 1. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements shall be cause for replacement of cylinders/cores involved at no additional cost to Owner.
- E. Key Features: Provide keys with the following features.
 1. Patent Protection: Keys and blanks protected by one or more utility patent(s).
- F. Keys
 1. Material: Nickel silver; minimum thickness of .092-inch (2.3mm)
 2. Identification:
- G. Coordinate with cylinder/core and key identification requirements above.
- H. Stamp keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
- I. Failure to comply with stamping requirements shall be cause for replacement of keys involved at no additional cost to Owner.
 1. Quantity: Furnish in the following quantities.
- J. Change (Day) Keys: 3 per cylinder/core.
- K. Permanent Control Keys: 5.
- L. Master Keys: 6.
- M. Unused balance of key blanks shall be furnished to Owner with the cut keys.

2.16 KEY CONTROL SYSTEM

A. Key Control System Manufacturers:

1. Scheduled Manufacturer: Telkee
2. Acceptable Manufacturers: HPC, Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

C. Key Management Software Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage SITEMASTER 200
2. Acceptable Manufacturers and Products: Best Keystone 600N, Corbin-Russwin KeyWizard, Medeco KeyWizard, Sargent KeyWizard, Yale KeyWizard.

D. Key Management Software Requirements:

1. Software: Provide tracking, issuing, collecting and transferring information regarding keys. Provide customized query, reporting, searching capability, comprehensive location hardware listings, display key holder photos and signature for verification, and provide automatic reminders for maintenance, back-ups and overdue keys.
2. Provide training for Owner's personnel on proper operation and application of key management software.

2.17 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4040XP series
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter, with 11/16 inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general speed, and backcheck.

7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.18 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
4. Provide flush pulls as specified. Where required, provide back-to-back mounted model.
5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
7. Provide wire pulls of solid bar stock, diameter and length as scheduled.

2.19 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
 - a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
 - c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.20 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson
2. Acceptable Manufacturers: Rixson,

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.21 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.22 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: National Guard.
2. Acceptable Manufacturers: Pemko, Zero.

B. Requirements:

1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Size of thresholds:
 - a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.23 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.
2. Acceptable Manufacturers: Burns, Rockwood.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.24 MAGNETIC HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: LCN.
2. Acceptable Manufacturers: Rixson, Sargent.

B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordination projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Wire magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.25 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer: Schlage Electronics.
2. Acceptable Manufacturers: GE-Interlogix, Sargent.

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.26 FINSHES

A. Finish: BHMA 626/652 (US26D); except:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Continuous Hinges: BHMA 630 (US32D)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)

8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where on-site modification of doors and frames is required:
 1. Remove existing hardware being replaced, tag, and store according to contract documents.
 2. Field modify and prepare existing door and frame for new hardware being installed.
 3. When modifications are exposed to view, use concealed fasteners, when possible.
 4. Prepare hardware locations in accordance with:
 - 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: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.3 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. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- H. 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 (750 mm) of door height greater than 90 inches (2286 mm).
- I. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as indicated in keying section.
- J. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by Architect.
- M. Closer/holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- N. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- O. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- P. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- Q. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

- R. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- S. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. 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.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 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.

3.6 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 door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

- A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

- A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type and function. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

Hardware Set No. 100

For use on door #(s):

A100A/1 A100B/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-98-NL-OP-110	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-SD-98-EO	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
4	EA	PRIMUS CORE	20-740	626	SCH
2	EA	90 DEG OFFSET PULL	8190 18" O	630	IVE
2	EA	OH STOP & HOLDER	100H	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	MULLION SEAL	5100	BLK	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS KL900	LGR	VON

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 101

For use on door #(s):

A100A/2 A100B/2

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD EPT	628	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
2	EA	ELEC PANIC HARDWARE	RX-QEL+-SD-98-EO	626	VON
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
3	EA	PRIMUS CORE	20-740	626	SCH
2	EA	90 DEG OFFSET PULL	8190 18" O	630	IVE
2	EA	OH STOP & HOLDER	100H	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	MULLION SEAL	5100	BLK	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS KL900	LGR	VON

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 102

For use on door #(s):

A100A/3

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-98-NL-OP-110	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-SD-98-EO	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
2	EA	90 DEG OFFSET PULL	8190 18" O	630	IVE
2	EA	OH STOP & HOLDER	100H	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS KL900	LGR	VON

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 103

For use on door #(s):

A100A/4

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD EPT	628	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
2	EA	ELEC PANIC HARDWARE	RX-QEL+-SD-98-EO	626	VON
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
3	EA	PRIMUS CORE	20-740	626	SCH
2	EA	90 DEG OFFSET PULL	8190 18" O	630	IVE
2	EA	OH STOP & HOLDER	100H	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS KL900	LGR	VON

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 104

For use on door #(s):

A101/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
1	EA	BLADE STOP SPACER	4040-61	689	LCN

Hardware Set No. 105

For use on door #(s):

A100B/3 A100B/4 B100A/2 C100F/3 C100F/4 C100H/2

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
1	EA	DUMMY PUSH BAR	350-EO	626	VON
2	EA	90 DEG OFFSET PULL	8190 18" O	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN

Hardware Set No. 106

For use on door #(s):

A100E/1 A115/2 C100A/1 D114/2

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
2	EA	PANIC HARDWARE	CD-98-EO	626	VON
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
3	EA	PRIMUS CORE	20-740	626	SCH
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	MULLION SEAL	5100	BLK	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

DOOR OPERATION: Door position switch to be connected to access control system for monitoring.

Hardware Set No. 107

For use on door #(s):

C101/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	STOREROOM LOCK	LV9080T 17A	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	DRIP CAP	17	AL	NGP
1	SET	SEALS	5050B	BRN	NGP
1	EA	THRESHOLD	896S	AL	NGP
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

DOOR OPERATION: Door position switch to be connected to access control system for monitoring.

Hardware Set No. 108

For use on door #(s):

B100A/1 C100F/2 C100H/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
1	EA	ELEC PANIC HARDWARE	RX-CD-98-EO	626	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-SD-98-NL-OP-110	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
4	EA	PRIMUS CORE	20-740	626	SCH
2	EA	90 DEG OFFSET PULL	8190 18" O	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	CUSH SHOE SUPPORT	4040-30	689	LCN
2	EA	BLADE STOP SPACER	4040-61	689	LCN
1	EA	MULLION SEAL	5100	BLK	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS KL900	LGR	VON

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 109

For use on door #(s):

C110/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
1	EA	KEYED FIRE RATED REMOVABLE MULLION	KR9954-STAB	689	VON
1	EA	FIRE EXIT HARDWARE	98-EO-F	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
2	EA	PRIMUS CORE	20-740	626	SCH
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	SET	SEALS	5050B	BRN	NGP
1	SET	ASTRAGAL	140PA	CL	NGP
1	EA	MULLION SEAL	5100	BLK	NGP
2	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

DOOR OPERATION: Door position switch to be connected to access control system for monitoring.

Hardware Set No. 110

For use on door #(s):

C107/2 C120/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	STOREROOM LOCK	LV9080T 17A	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
2	EA	OH STOP & HOLDER	90H	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT x ST2731	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
1	SET	SEALS	5050B	BRN	NGP
1	SET	ASTRAGAL	140PA	CL	NGP
2	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

DOOR OPERATION: Door position switch to be connected to access control system for monitoring.

Hardware Set No. 111

For use on door #(s):

C128/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	112HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL+-98-EO	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	OH STOP & HOLDER	90H	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA TBSRT x ST2731 Template	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	DRIP CAP	17	AL	NGP
1	SET	SEALS	5050B	BRN	NGP
1	EA	THRESHOLD	896S	AL	NGP
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS KL900	LGR	VON
1			CARD READER BY OTHERS		

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 112

For use on door #(s):

C114/3 C116/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
2	EA	PANIC HARDWARE	CD-98-EO	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
4	EA	PRIMUS CORE	20-740	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	OH STOP & HOLDER	90H	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT x ST2731	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	DRIP CAP	17	AL	NGP
1	SET	SEALS	5050B	BRN	NGP
1	EA	MULLION SEAL	5100	BLK	NGP
2	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

DOOR OPERATION: Door position switch to be connected to access control system for monitoring.

Hardware Set No. 113

For use on door #(s):

C124/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	PRIVACY W/DB & IND	LV9496T 17A L583-363	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	DRIP CAP	17	AL	NGP
1	SET	SEALS	5050B	BRN	NGP
1	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896S	AL	NGP

Hardware Set No. 114

For use on door #(s):

C100F/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954-STAB	689	VON
2	EA	PANIC HARDWARE	CD-98-EO	626	VON
3	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
4	EA	PRIMUS CORE	20-740	626	SCH
2	EA	90 DEG OFFSET PULL	8190 18" O	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	MULLION SEAL	5100	BLK	NGP
1	EA	THRESHOLD	896S	AL	NGP
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

DOOR OPERATION: Door position switch to be connected to access control system for monitoring.

Hardware Set No. 115

For use on door #(s):

C122/2 C202/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	DBL CYL STORE W/DB	L9466T 17A	626	SCH
2	EA	PRIMUS CORE	20-740	626	SCH
1	EA	SURFACE CLOSER	4040XP SHCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	DRIP CAP	17	AL	NGP

1	EA	DOOR SWEEP	C627A	CL	NGP
1	EA	THRESHOLD	896S	AL	NGP

Hardware Set No. 200

For use on door #(s):

C100A/2 C200/1 D114/1 D114/3

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	705	630	IVE
2	EA	FIRE EXIT HARDWARE	9849-L-BE-F-996-17-LBL	626	VON
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM1980	689	LCN
1	SET	SEALS	5020B	BRN	NGP
1	SET	SEALS	5060B	BRN	NGP

Door held open by wall magnets connected to fire alarm system.

Hardware Set No. 201

For use on door #(s):

C100A/3

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	705	630	IVE
2	EA	FIRE EXIT HARDWARE	9849-L-F-996-17-LBL	626	VON
2	EA	RIM CYLINDER	20-057-ICX	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM1980	689	LCN
1	SET	SEALS	5020B	BRN	NGP
1	SET	SEALS	5060B	BRN	NGP

Door held open by wall magnets connected to fire alarm system.

Hardware Set No. 202

For use on door #(s):

C100C/3

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	705	630	IVE
1	EA	FIRE EXIT HARDWARE	9849-EO-F-LBL	626	VON
1	EA	FIRE EXIT HARDWARE	9849-L-F-996-17-LBL	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM1980	689	LCN
1	SET	SEALS	5020B	BRN	NGP

1	SET	SEALS	5060B	BRN	NGP
2	EA	SILENCER	SR64	GRY	IVE

Door held open by wall magnets connected to fire alarm system.

Hardware Set No. 300

For use on door #(s):

B101/1	B102/1	B103/1	B104/1	B105A/1	B105D/1
B105E/1	B106/1	B107/1	B108/1	B109/1	B110/1
B112/1	C125/1	D101/1	D102/1	D103/1	D104/1
D105/1	D107/1	D107A/2	D109/1	D110/1	D111/1
D112/1	D113/1	D200D/1	D201/1	D202/1	D203/1
D204/1	D205/1	D207E/1	D209/1	D210/1	D211/1
D212/1	D213/1				

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 301

For use on door #(s):

A101/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM X STORERM	ND70X80TD SPA	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

DOOR OPERATION: Door normally closed and secure from the waiting room. Entry from waiting room into corridor by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring. Corridor side of lock is equipped with a classroom function and can be unlocked during the day for entry into the waiting area.

Hardware Set No. 302

For use on door #(s):

A104/1 A105/1 A107/1 A109/1 C108/1

Provide each SGL door(s) with the following:

DOOR HARDWARE

087100-33

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 303

For use on door #(s):

A111/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP/HOLDER	FS495	626	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 304

For use on door #(s):

A100E/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 305

For use on door #(s):

A112/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	L9010 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 306

For use on door #(s):

A112/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 307

For use on door #(s):

A100D/1 B100/1 D100A/1 D200A/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	SET	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
2	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP
1	SET	SEALS	5060B	BRN	NGP

Hardware Set No. 308

For use on door #(s):

A113/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP/HOLDER	FS495	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 309

For use on door #(s):

A113C/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 17A	626	SCH
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 310

For use on door #(s):

A113A/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	OH STOP	90S J	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 311

For use on door #(s):

A106/1 A117/1 A120A/1 B105G/1 D107D/1 D207G/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/DB & IND	L9496T OCCUPIED/VACANT 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 312

For use on door #(s):

A113B/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 17A	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE

3 EA SILENCER SR64 GRY IVE

Hardware Set No. 313

For use on door #(s):

C110/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-NL-F-996-17	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 314

For use on door #(s):

C109/1 D107C/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 315

For use on door #(s):

B100C/1 C100E/1 C107/1 D100B/1 D200B/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 316

For use on door #(s):

C104/1 C106/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 317

For use on door #(s):

B105F/1 C100G/1 D207F/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE DS	630	VON
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 KL900	LGR	SCE

CARD READER BY OTHERS

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 318

For use on door #(s):

A118/1 A119/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	OH STOP	90S J	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 319

For use on door #(s):

A115/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	CD-9849-EO-LBL	626	VON
1	EA	PANIC HARDWARE	CD-9849-NL-OP-110-LBL	626	VON
1	EA	RIM CYLINDER	20-057-ICX	626	SCH
2	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
3	EA	FSIC CORE	23-030	626	SCH
2	EA	90 DEG OFFSET PULL	8190 10" O	630	IVE
2	EA	SURFACE CLOSER	4040XP HCUSH TBSRT	689	LCN

Hardware Set No. 320

For use on door #(s):

C114/1 C114/2 C121/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	KEYED FIRE RATED REMOVABLE MULLION	KR9954-STAB	689	VON
2	EA	FIRE EXIT HARDWARE	98L-F-2-SI-996-17	626	VON
4	EA	RIM CYLINDER	20-057-ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061-ICX	626	SCH
5	EA	FSIC CORE	23-030	626	SCH
2	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
2	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP
1	SET	SEALS	5060B	BRN	NGP
1	EA	MULLION SEAL	5100	BLK	NGP

Hardware Set No. 321

For use on door #(s):

C123/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	MOUNTING BRACKET	MB	689	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP/HOLDER	FS495	626	IVE
1	SET	SEALS	107NA	CL	NGP
1	EA	DOOR BOTTOM	522N	AL	NGP

INSTALLATION NOTE: Mount 107NA sound seal and MB mounting bracket prior to installing door closer. Note closer is lower on the door to accommodate sound seal.

Hardware Set No. 322

For use on door #(s):

C123A/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4041 DEL CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 323

For use on door #(s):

C125A/1 C125B/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 324

For use on door #(s):

C118/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 325

For use on door #(s):

C115/1 C117/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4041 DEL CUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 16" X 1" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP
1	SET	SEALS	5060B	BRN	NGP

Hardware Set No. 326

For use on door #(s):

C122/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	715	630	IVE
1	SET	AUTO FLUSH BOLT	FB31P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB	689	IVE
2	EA	SURFACE CLOSER	4041 DEL CUSH TBSRT	689	LCN
2	EA	KICK PLATE	8400 16" X 1" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP
1	SET	SEALS	5060B	BRN	NGP

Hardware Set No. 327

For use on door #(s):

C116A/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 16" X 1" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 328

For use on door #(s):

C126/1 C126/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM DEAD LOCK	L463T	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP/HOLDER	FS495	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 329

For use on door #(s):

C112/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP HCUSH TBSRT	689	LCN

Hardware Set No. 330

For use on door #(s):

C127/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	KICK PLATE	8400 4" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE

Hardware Set No. 331

For use on door #(s):

C132/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	KICK PLATE	8400 4" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 332

For use on door #(s):

C133/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/DB & IND	LV9496T 17A L583-363	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 333

For use on door #(s):

C131/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 334

For use on door #(s):

C114A/1 C201/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4041 DEL TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 335

For use on door #(s):

B105C/1 D207D/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 336

For use on door #(s):

B105B/1 D207B/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
2	EA	OH STOP	90S	630	GLY
2	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 337

For use on door #(s):

110A/2 B101A/1 B101A/2 B102A/1 B102A/2 B106A/1
 B106A/2 B107A/1 B107A/2 B110A/1

Provide each DD door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	DUTCH DOOR BOLT	054	626	IVE
1	EA	PASSAGE SET	L9010 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	WALL STOP	WS406CCV	630	IVE
4	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 338

For use on door #(s):

A120/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP/HOLDER	FS495	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 339

For use on door #(s):

A120/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP HCUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 340

For use on door #(s):

B101B/1 B102B/1 B106B/1 B107B/1 B110B/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 17A	626	SCH
1	EA	OH STOP	90S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 341

For use on door #(s):

C202/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 342

For use on door #(s):

C105/1

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	AUTO FLUSH BOLT	FB42	630	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	COORDINATOR	COR7G	626	IVE
2	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B4E	630	IVE
2	EA	WALL STOP	WS406CCV	630	IVE
1	SET	SEALS	5020B	BRN	NGP
1	SET	SEALS	5060B	BRN	NGP

Hardware Set No. 343

For use on door #(s):

C123A/2

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	DBL CYL STORE W/DB	L9466T 17A	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4041 DEL CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	SET	SEALS	5020B	BRN	NGP

Hardware Set No. 344

For use on door #(s):

A116/1 D107B/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PRIMUS CORE	20-740	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE DS	630	VON
1	EA	SURFACE CLOSER	4040XP CUSH TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 KL900	LGR	SCE
			CARD READER BY OTHERS		

DOOR OPERATION: Door normally closed and secure. Entry from secure side by valid credential or key override which will unlock electrified door. Free egress from inside at all times. Door position switch and request to exit connected to access control system for monitoring.

Hardware Set No. 345

For use on door #(s):

D207A/1 D207C/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HW HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	CLASSROOM SECURITY	L9071T 17A XL11-986	626	SCH
2	EA	FSIC CORE	23-030	626	SCH
1	EA	SURFACE CLOSER	4040XP TBSRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Set No. 346

For use on door #(s):

A108/1 A110/1

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 17A	626	SCH
1	EA	FSIC CORE	23-030	626	SCH
1	EA	KICK PLATE	8400 4" X 2" LDW B4E	630	IVE
1	EA	WALL STOP	WS406CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Interior vision lites.
 - 2. High performance architectural insulating glass
 - 3. Entrances and other door glazing.
 - 4. Fire Rated Glazing.
- B. Related Sections: The following sections contain requirements that relate to this Section.
 - 1. Division 8 Section "Aluminum Storefronts and Entrances" for aluminum framed entrance requirements.
 - 2. Division 8 Section "Hollow Metal Doors and Frames" for interior hollow metal frames for vision lites.
 - 3. Division 8 Section "Glazed Aluminum Curtain Walls" for curtain wall requirements.
 - 4. Division 8 Section "Decorative Glass Glazing" for decorative glass requirements.
 - 5. Division 10 Section "Display Cases" - pre-glazed as part of that section.

1.3 DEFINITIONS

- A. Manufacturer is used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.
- B. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's directions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- C. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's directions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated glass standard.
- D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use due to causes other than glass breakage and improper practices for maintaining, and cleaning insulating glass. Evidence of failure is the obstruction of vision by dust, moisture, or film on the interior surfaces of glass. Improper practices for maintaining and cleaning glass do not comply with the manufacturer's directions.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems that are produced, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading (where applicable), without failure including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; and other defects in construction.

- B. Glass Design: Glass thicknesses are not indicated on Drawings. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for the various size openings in the thicknesses and strengths to meet or exceed the following criteria:
1. Minimum glass thickness, nominally, of lites in exterior walls is 6.0 mm (0.23 inch).
 2. Tinted and heat-absorbing glass thicknesses for each tint indicated are the same throughout Project.
 3. Minimum glass thicknesses of lites, whether composed of annealed or heat-treated glass, are selected so the worst-case probability of failure does not exceed the following:
 - a. 8 lites per 1000 for lites set vertically or not over 15 degrees off vertical and under wind action.
Determine minimum thickness of monolithic annealed glass according to ASTM E 1300. For other than monolithic annealed glass, determine thickness per glass manufacturer's standard method of analysis including applying adjustment factors to ASTM E 1300 based on type of glass.
- C. Normal thermal movement results from the following maximum change (range) in ambient and surface temperatures acting on glass-framing members and glazing components. Base engineering calculation on materials' actual surface temperatures due, to both solar heat gain and nighttime sky heat loss.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 CODE COMPLIANCE

- A. Contractors (general contractors, subcontractors, suppliers, installers, et.al.) are responsible for complying with applicable codes and standards with regards to provision and installation of the proper glazing materials. Drawings and specifications may not identify all glass type locations.

1.6 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each glass product and glazing material indicated in conjunction with a glazing schedule listing glass types and thicknesses for each size opening and location.
- C. Samples for verification purposes of 12-inch-square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch-long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative in color of the adjoining framing system.
- D. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.
- E. Compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants. Include sealant manufacturer's interpretation of test results relative to sealant performance and recommendations for primers and substrate preparation needed for adhesion.
- F. Compatibility test report from manufacturer of insulating glass edge sealant indicating that glass edge sealants were tested for compatibility with other glazing materials including sealants, glazing tape, gaskets, setting blocks, and edge blocks.
- G. Product test reports for each type of glazing sealant and gasket indicated, evidencing compliance with requirements specified.
- H. Maintenance data for glass and other glazing materials to include in Operating and Maintenance Manual specified in Division 1.

1.7 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. FGMA Publications: "FGMA Glazing Manual."
 - 2. LSGA Publications: "LSGA Design Guide."
 - 3. SIGMA Publications: TM-3000 "Vertical Glazing Guidelines".
- B. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.
- C. Fire-Resistive Glazing Products for Door Assemblies: Products identical to those tested per ASTM E 152, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Fire-Resistive Glazing Products for Window Assemblies: Products identical to those tested per ASTM E 163, labeled and listed by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component lite of units with appropriate certification label of inspecting and testing agency indicated below:
 - 1. Insulating Glass Certification Council (IGCC).
 - 2. Associated Laboratories, Inc. (ALI).
 - 3. National Certified Testing Laboratories (NCTL).
- F. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.
- G. Single-Source Responsibility for Glass: Obtain glass from one source for each product indicated below:
 - 1. Primary glass of each (ASTM C 1036) type and class indicated.
 - 2. Heat-treated glass of each (ASTM C 1048) condition indicated.
 - 3. Laminated glass of each (ASTM C 1172) kind indicated.
 - 4. Insulating glass of each construction indicated.
- H. Single-Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
 - 1. Testing is not required when glazing sealant manufacturer can submit required preparation data that is acceptable to Architect and is based on previous testing of current sealant products for adhesion to and compatibility with submitted glazing materials.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 PROJECT CONDITIONS

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.10 WARRANTY

- A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.
 - 1. Warranty Period: Manufacturer's standard but not less than 5 years after date of Substantial Completion.
- B. Manufacturer's Warranty on Laminated Glass: Submit written warranty signed by insulating glass manufacturer agreeing to furnish replacements for those laminated glass units that deteriorate as defined in the "Definitions" article, f.o.b. point of manufacture, freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to glass manufacturer's published instructions.
 - 1. Warranty Period: Manufacturer's standard but not less than 5 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to the following (note additional manufacturers in specific product areas):
 - 1. Pilkington Group
 - 2. Guardian Industries Corp.
 - 3. PPG Industries, Inc.
 - 4. Oldcastle Building Envelope
 - 5. Viracon, Inc.

2.2 PRIMARY FLOAT GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class as indicated below, and Quality q3 (glazing select).
 - 3. Class 1 (clear) unless otherwise indicated, all interior windows and interior sheet of insulated exterior windows.
 - 4. Class 2 (tinted, heat-absorbing, and light-reducing) at exterior surface sheets as indicated.
- B. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient, and visible reflectance.

2.3 HEAT-TREATED FLOAT GLASS

- A. Uncoated, Tinted, Heat-Treated Float Glass: ASTM C 1048, Condition C (uncoated glass), Type I (transparent glass, flat), Class 2 (tinted heat-absorbing and light-reducing), Quality q3 (glazing select), with tint color and performance characteristics for 6.0-mm-thick (0.23-inch-thick) glass matching those indicated for annealed primary tinted float glass; kind as indicated below:
 - 4. Kind FT (fully tempered) where indicated or required.

2.4 CERAMIC-COATED GLASS

- A. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B (spandrel glass, one-surface ceramic coated), Type 1 (transparent glass, flat), Quality q3 (glazing select). Color to be chosen from manufacturer's full line of

standard colors (line must include black and gray).

2.5 FIRE-RATED GLAZING PRODUCTS

- A. Laminated Ceramic Glazing Material: Proprietary Category II safety glazing product in the form of 2 lites of clear ceramic glazing material laminated together to produce a laminated lite of 5/16-inch (8-mm) nominal thickness; polished on both surfaces; weighing 4 lb/sq.ft. (19.5 kg/sq.m); and as follows:
1. Fire-Protection Rating: As indicated for the assembly in which glazing material is installed, and permanently labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.
 2. Polished on both surfaces, transparent.
 3. Product: "FireLite Plus" by Nippon Electric Glass Co., Ltd., and distributed by Technical Glass Products.

2.6 INSULATING GLASS PRODUCTS

- A. Sealed Insulating Glass Units: Preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774 and with other requirements indicated, including those in Insulating Glass Product Data Sheet at the end of this Section.
1. For properties of individual glass lites making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lites of insulating glass units.
 2. Provide heat-treated, coated float glass of kind indicated or, if not otherwise indicated, Kind HS (heat strengthened) where recommended by manufacturer to comply with system performance requirements specified and Kind FT (fully tempered) where safety glass is designated or required.
 3. Performance characteristics designated for coated insulating glass are nominal values based on manufacturer's published test data for units with lites 6.0 mm (0.23 inch) thick and nominal 1/2-inch dehydrated space between lites, unless otherwise indicated.
 4. U-values are expressed as Btu/hour x sq.ft. x deg F.
- B. Construction Characteristics:
1. Air Space Width: Nominal 1/2 inch measured perpendicularly from surfaces of glass lites at unit's edge.
 2. Gas Filling: Fill air space with argon.
 3. Sealing System: Dual seal, primary and secondary sealants: manufacturer's standard sealants.
 4. Spacer Specifications: Manufacturer's standard.
 5. Desiccant: Either molecular sieve or silica gel or blend of both.
 6. Corner Construction: Manufacturer's standard corner construction.
 7. Color of Spacer: Color as selected by Architect from manufacturer's standard colors.
- C. Insulating Glass Types:
1. Type GL-1 Units: All units except as noted; Each Lite: 6.0 mm (0.23 inch).
 - A. Outdoor Lite: Class 2 (tinted, heat-absorbing and light-reducing) float glass with tint color: PPG Azuria is basis of design
 - B. Indoor Lite: Class 1 (clear) float glass with Low E coating on #3 surface; PPG Sungate 500
 - C. Performance Characteristics:
 - a. Visible Light Transmittance: 57%
 - b. U-Value Winter: 0.35; U Value: Summer: 0.35
 - c. Shading Coefficient: 0.40
 - d. Solar Heat Gain Coefficient: 0.34
 - e. Outdoor Visible Light Reflectance: 12%

2. Type GL-2 Units: At Curtainwall

- A. Outdoor Lite: Clear, low reflective equivalent to PPG Solarban 70XL (2)
- B. Indoor Lite: Class 1 (clear) float glass
- C. Performance Characteristics:
 - a. Visible Light Transmittance: 64%
 - b. U-Value Winter: 0.28; U Value: Summer: 0.26
 - c. Shading Coefficient: 0.32
 - d. Solar Heat Gain Coefficient: 0.27
 - e. Outdoor Visible Light Reflectance: 12%

3. Type GL-3 Units: At Curtainwall

- A. Outdoor Lite: Clear, low reflective equivalent to PPG Solarban 70XL (2)
- B. Indoor Lite: Equivalent to Walker Textures Acid Etched 1 Face Opaque
- C. Performance Characteristics:
 - a. Visible Light Transmittance: 64%
 - b. U-Value Winter: 0.28; U Value: Summer: 0.26
 - c. Shading Coefficient: 0.32
 - d. Solar Heat Gain Coefficient: 0.27
 - e. Outdoor Visible Light Reflectance: 12%

4. Performance of Insulated Glass: Performance Values listed are minimum acceptable values for insulated glass.

2.7 LAMINATED SAFETY GLASS

- A. Provide Category II safety glazing comprised of laminated Clear Float Glass, annealed and heat strengthened with minimum 0.030 inch thick individual layers.

2.8 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- C. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bit complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

2.9 GLAZING TAPES

- C. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent, nonstaining and nonmigrating in contact with nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with AAMA 800 for products indicated below.

1. AAMA 804.1.

- D. Available Products: Subject to compliance with requirements, glazing tape that may be incorporated in the Work include, but is not limited to, the following:

- E. Products: Subject to compliance with requirements, provide one of the following:

1. Back-Bedding Mastic Glazing Tape Without Spacer Rod:

- a. PTI 303 Glazing Tape (shimless), Protective Treatments, Inc.
- b. S-M 5700 Poly-Glaze Tape Sealant, Schnee-Morehead, Inc.
- c. Tremco 440 Tape, Tremco Inc.
- d. Extru-Seal, Pecora Corp.
- e. PTI 606 Architectural Sealant Tape, Protective Treatments, Inc.

2.10 ELASTOMERIC GLAZING SEALANTS AND PREFORMED GLAZING TAPES

- A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturer's recommendations for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
 3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
 4. Colors: Provide color of exposed sealants indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.

2.11 GLAZING GASKETS

- A. Dense Elastomeric Compression Seal Gaskets: Molded or extruded gaskets of material indicated below, complying with ASTM C 864, of profile and hardness required to maintain watertight seal:
1. Neoprene.
 2. EPDM.
 3. Thermoplastic polyolefin rubber.
 4. Any material indicated above.
- B. Cellular Elastomeric Preformed Gaskets: Extruded or molded closed cell, integral-skinned neoprene of profile and hardness required to maintain watertight seal; complying with ASTM C 509, Type II; black.
- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
1. Manufacturers of Preformed Gaskets:
 - a. D.S. Brown Co.
 - b. Maloney Precision Products co.
 - c. Tremco.

2.12 MISCELLANEOUS GLAZING MATERIALS

- A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
- D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.

- E. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
 - 2. Presence and functioning of weep system.
 - 3. Minimum required face or edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions as indicated on shop drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass from edge damage during handling and installation as follows:
 - 1. Stack individual lites on edge and lean them against sturdy uprights at a slope of 5° to 7° from vertical.
 - 2. Cushion the bottom edges with soft, firm pads free of dirt, grit, glass chips or other foreign material.
 - 3. Avoid rotating or “cartwheeling” insulating glass units over their corners. Instead, use a turning device such as a rolling block if units must be rotated.
 - 4. Schedule glass deliveries to coincide with glazing schedules.
 - 5. Unpack the glass from cases according to printed instructions. Never move partially unpacked cases or “end-pick” lites.
 - 6. Check glass surfaces and edges for damage before glazing. Do not install glass with large edge chips. never slide one lite over another.
 - 7. Prevent contact of the glass with markings - typically flags, festoons or tape to identify openings to be glazed; never mark the glass with an “X” or other identity symbol.
 - 8. Protect the glass with screens of plywood or plastic wherever there is welding, cutting, sandblasting, fireproofing, or other potentially damaging work in progress.
 - 9. Begin glazing in concrete openings only after any surface treatments such as sandblasting, grouting and waterproofing have been completed.
 - 10. Insist that workers handling glass wear gloves, safety shoes, hard hats and glazing gauntlets.

3.4 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

- B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- C. Install gaskets so they protrude past face of glazing stops.

3.5 PROTECTION AND CLEANING

- A. Protect exterior glass from breakage 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 including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended 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 build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.
- E. Wash glass on both faces in each area of Project prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

END OF SECTION 088000

SECTION 088113 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following decorative glass for interior applications:
 - 1. Pressed Glass
- B. Related Sections:
 - 1. Section 088000 "Glazing" for standard glass products.

1.3 DEFINITION

- A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass installed adjacent to walking surfaces, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Differential deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to 50 lbf/ft. (730 N/m) applied horizontally to one panel at any point up to 42 inches (1067 mm) above the adjacent walking surface.
 - 2. Base design on thickness at thinnest part of the glass.

1.5 ACTION SUBMITTALS

- A. Product Data: For each decorative-glass and glazing product indicated.
- B. Shop Drawings: For decorative glass. Show fabrication and installation details. Include the following:
 - 1. Size and location of penetrations.
 - 2. Glazing method.
 - 3. Mounting method.

- C. Glass Samples: For the following products, 12 inches (300 mm) square:
 - 1. Each type of decorative glass.
- D. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative of the glazed system.
- E. Product Schedule: For decorative glass. 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.

1.6 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of decorative glass to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.
- D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.
- E. Glazing Publications: Comply with published recommendations in GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- F. Safety Glazing: Where safety glazing is indicated, comply with testing requirements in 16 CFR 1201 for Category II materials.
 - 1. Labeling: Permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard that glass complies with.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect decorative glass and glazing materials according to manufacturer's written instructions and as needed to prevent damage to surfaces and edges.

- B. Retain packaging and sequencing numbers for decorative-glass units.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install decorative glass 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.
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

1.11 WARRANTY

- A. 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: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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.
- 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 requirements indicated. 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 requirements indicated. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 MONOLITHIC-GLASS PRODUCTS

- A. Heat-Treated Float Glass: ASTM C 1048; 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.

2.3 DECORATIVE GLASS TYPES

- A. Decorative Glass (**Type DGL-1**): Pressed glass

1. Basis-of-Design Product: Subject to compliance with requirements, provide 3-Form Pressed Glass Unit: Two-ply laminate, both plies heat treatment ASTM C 1172, King LD (Laminated with decorative interlayer)
2. Glass Thickness: Overall Thickness Not less than 7/16"
3. Patterns: As selected by Architect from manufacturer's full range.

2.4 GLAZING MATERIALS

- A. Glazing Gaskets, Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in Section 088000 "Glazing."
- B. Joint Sealants: As specified in Section 079200 "Joint Sealants."

2.5 DECORATIVE-GLASS FABRICATION

- A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written recommendations of product manufacturer and with referenced glazing standard.
- B. Edge Finishing: Fabricate finished edges to produce smooth, polished edges without chips, scratches, or warps.
 1. Finished Edge: Clean cut
 2. Edge-Finished Glass Adhesive: Clear, nonyellowing, as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine decorative-glass framing members, with Installer present, for compliance with the following:
 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 2. Minimum required face or edge clearances.
 3. Effective sealing between joints of decorative-glass framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 orientation of outer surfaces as indicated on Drawings. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

- A. Set decorative-glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.
- B. Set glass lites with proper orientation so that each outer surface faces the direction indicated on Drawings.
- C. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces.

3.4 GLAZING, GENERAL

- A. Decorative Glass: Install glazing as specified in Section 088000 "Glazing."
- B. Comply with combined written instructions of manufacturers of gaskets, glass, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- C. Adjust glazing channel dimensions during installation as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- D. 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.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- F. 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.
- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- H. Provide spacers for glass lites where length plus width is more than 50 inches (1270 mm).
 - 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 (3-mm) 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.
- I. 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.

3.5 CLEANING AND PROTECTION

- A. Protect decorative glass from damage immediately after installation by attaching crossed streamers to framing and 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. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. 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 088113

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvers.
- B. Related Requirements:
 - 1. Section 074213 "Metal Wall Panels" for louvers integral to the metal wall panel system.

1.3 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. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- 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 each type of metal finish required.

- D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. 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 pressures as indicated on Drawings.
- B. 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.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F ambient; 180 deg F material surfaces.
- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Wind-Driven-Rain-Resistant Louver (L-1 & L-2):
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Greenheck Fan Corporation. – Model: EHH-601

- b. Ruskin Company; Tomkins PLC. – Model: EME520DD
- 2. Louver Depth: 6 inches.
- 3. Frame and Blade Nominal Thickness: Not less than 0.081 inch.
- 4. Louver Performance Ratings:
 - a. Free Area: Not less than 7.0 sq. ft. (0.65 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.
 - b. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 700-fpm (3.6-m/s) free-area exhaust velocity.
 - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches (200 mm) per hour and a wind speed of 50 mph (22.4 m/s) at a core-area intake velocity of 676 fpm.
- 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 OPERABLE, FORMED-METAL LOUVERS

- A. Louver Operation: Provide operable louvers with operating mechanisms to suit louver sizes.
 - 1. Provide mechanical linkage, 24 VDC actuator and control interface for use with specified building automation system. Provide custom size to match width / height of opening within door frame
- B. Single-Blade, Operable Louver (**L-3**):
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck EAD-401 or comparable product by one of the following:
 - a. Ruskin Company; Tomkins PLC.
 - 2. Louver Depth: 4 inches (100 mm).
 - 3. Blade Type: Drainable.
 - 4. Frame and Blade Material and Nominal Thickness: 6063-T5 aluminum not less than 0.125 nominal wall thickness.
 - 5. See Mechanical drawings for performance requirements.
 - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. 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 according to ASTM E 488, conducted by a qualified independent testing agency.

- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. 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.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide subsills made of same material as louvers for recessed louvers.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent 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 Architect from manufacturer's full range of standard and custom colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, 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.

3.2 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.

3.3 INSTALLATION

- A. Locate and place louvers 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. Protect unpainted galvanized and nonferrous-metal surfaces that are 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.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, 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 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
- 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

- B. Related Requirements:

- 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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 E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

- 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
- 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

- B. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - b. Depth: 3-5/8 inches, unless otherwise indicated.

- C. Slip-Type Head Joints: Where indicated, provide the following:
 1. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

- 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:
 - a. Fire Trak Corp.; Fire Trak System.
 - b. Grace Construction Products; FlameSafe FlowTrak System.
 - c. Metal-Lite, Inc.; The System.

- 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 (0.84 mm).

- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 2. Depth: 7/8 inch (22.2 mm).

- G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- C. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. USG Corporation; Drywall Suspension System.

2.4 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 following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 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.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
 2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.

3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (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 (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
- E. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- F. Z-Furring Members:
1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches (1219 mm) o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Do not attach hangers to steel roof deck.
 - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. 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.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) 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

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Cement Board (Tile backing panels)
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
 - 2. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 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.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 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.

PART 2 - PRODUCTS

2.1 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 E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [CertainTeed Corp.](#)
 2. [Georgia-Pacific Gypsum LLC.](#)
 3. [Lafarge North America Inc.](#)
 4. [National Gypsum Company.](#)
 5. [USG Corporation.](#)
- B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 1. Thickness: **5/8 inch (15.9 mm)**.
 2. Long Edges: Tapered.
- C. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.
 1. Core: **5/8 inch (15.9 mm)**, Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 1. Core: **5/8 inch (15.9 mm)**, Type X.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [CertainTeed Corp.; ProRoc Type C.](#)
 - b. [Georgia-Pacific Gypsum LLC; Fireguard C.](#)
 - c. [Lafarge North America Inc.; Firecheck Type C.](#)
 - d. [National Gypsum Company; Gold Bond Fire-Shield C.](#)
 - e. [USG Corporation; Firecode C Core.](#)
 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 3. Long Edges: Tapered.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units (CB): ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [CertainTeed Corp.; FiberCement BackerBoard.](#)
 - b. [Custom Building Products; Wonderboard.](#)
 - c. [James Hardie Building Products, Inc.; Hardiebacker.](#)
 - d. [National Gypsum Company; Permabase Cement Board.](#)
 - e. [USG Corporation; DUROCK Cement Board.](#)
 2. Thickness: **1/4 inch**
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
 2. Shapes:
 - a. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 1) Basis of Design: CornerKey by Fry Reglet Corp.
 - b. LC-Bead
 - c. L-Bead
 - d. Expansion (Control) Joint
 - e. Curved-Edge Corner bead
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Fry Reglet Corp. (Basis of Design).
 - b. Gordon, Inc.
 - c. MM Systems Corporation.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), alloy 6063-T5.
 3. Finish: As scheduled by Architect from manufacturer's full range.
 4. Reveals: Equivalent to the following by Fry Reglet:
 - DM-1: DRMZ-50-50
 - DM-2: DRM-50-50
 - DM-3: DRM-50-50 2-PC
 - DM-4: DRMF-50-50

2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints 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.
 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. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant: As specified in Section 079200 "Joint Sealants."
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- G. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 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.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.7 sq. m)** in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch- (6.4- to 9.5-mm-)** wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide **1/4- to 1/2-inch- (6.4- to 12.7-mm-)** 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.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 1. Type X: Typical at all horizontal and vertical locations unless otherwise indicated.
 2. Abuse-Resistant Type: As indicated on Drawings.
 3. Moisture- and Mold-Resistant Type: As indicated on Drawings.
 4. Type C: Where required for specific fire-resistance-rated assembly indicated.
- B. Single-Layer Application:
 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, **16 inches (400 mm)** minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

- D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.
- E. Curved Surfaces:
 - 1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus **12-inch-** (300-mm-) long straight sections at ends of curves and tangent to them.
 - 2. For double-layer construction, fasten base layer to studs with screws **16 inches** (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches** (300 mm) o.c.

3.4 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: As indicated, or if not indicated and required, install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use where indicated.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 3. Level 5: At abuse resistant gypsum board
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 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.
 - 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 – TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Glazed Ceramic Tile in select Toilet Rooms.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors (minimum of 90), textures, and patterns (minimum of 50) available for each type and composition of tile indicated. Include samples of grout and accessories involving color selection. Quarry tile work will require dark custom color grout.
- D. Samples for verification purposes of each item listed below, prepared on samples of size and construction indicated, products involve color and texture variations, in sets showing full range of variations expected.
 - 1. Full-size units of each type of trim and accessory for each color required.
 - 2. Slate thresholds in 6-inch lengths.
- E. Master grade certificates for each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- F. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each cementitious and admixture component and from one source or producer for each aggregate.
- C. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.
- C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at 50 deg F (10 deg C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types, compositions, and grades of tile indicated.
 - 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Provide selections made by Architect from manufacturer's full range of standard colors, textures, and patterns for products of type indicated.
 - 2. Provide tile trim and accessories that match color and finish of adjoining flat tile.
- D. Mounting: Where factory-mounted tile is required, provide back- or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of uses and has been successfully used on other projects.

2.2 TILE PRODUCTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Dal-Tile Corp or comparable product by one of the following:
 - 1. American Olean Tile Co., Inc.

2. Buchtal Corp, USA
3. Interceramic

B. Glazed Interior Wall Tile: Provide flat tile complying with the following requirements:

1. Nominal Facial Dimensions: 4 1/4" x 4 1/4"
2. Nominal Thickness: 5/16"
3. Face: Plain with square edge, modified square edge, or cushion edge as selected by Architect, semi-gloss glazed finish, straight joint pattern.
4. Mounting: Factory back-mounted.
5. Colors: Refer to color schedule on drawings

2.3 SETTING MATERIALS

A. Thin-Set Portland Cement Mortar: Where thin-set portland cement mortar applications are indicated, use the following unless otherwise required.

1. Dry-set portland cement mortar, ANSI A118.1, factory sanded.

B. Latex-Portland Cement Mortar: ANSI A118.4, composition as follows:

1. Prepackaged dry mortar mix composed of portland cement, graded aggregate, and the following dry polymer additive in the form of a re-emulsifiable powder to which only water is added at job site.
 - a. Dry Polymer Additive: Manufacturer's standard.
2. Latex additive (water emulsion) of type described below, serving as replacement for part or all of gauging water, combined at job site with prepackaged dry mortar mix supplied or specified by latex additive manufacturer.
 - a. Latex Type: Manufacturer's standard.

2.4 GROUTING MATERIALS

A. Commercial Portland Cement Grout: ANSI A118.6, color as indicated.

B. Dry-Set Grout: ANSI A118.6, color as indicated.

2.5 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with requirements of Division 7 Section "Joint Sealers," including ASTM C 920 as referenced by Type, Grade, Class, and Uses.

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

C. Multipart Pourable Urethane Sealant for Use T: Type M; Grade P; Class 25; Use T.

2.6 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of

uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" that apply to type of setting and grouting materials and methods indicated.
- B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated, or if not otherwise indicated, as applicable to installation conditions shown.
- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.
- E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths unless otherwise shown.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
- F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw cut joints after installation of tiles.
 - 1. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants."
- G. Grout tile to comply with referenced installation standards, using grout materials indicated.
 - 1. Mix and install proprietary components to comply with grout manufacturer's directions.

3.3 WALL TILE AND INSTALLATION METHODS

- A. Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:
- B. Thin-Set Portland Cement Mortar: ANSI A108.5.
 - 1. Masonry, Interior: TCA W202 (with leveling grout).
 - 2. Wood or Metal Studs, Interior: TCA W243.
 - 3. Grout: Dry-set.
 - 4. Color as selected by Architect from manufacturer's standard.

3.4 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.
- C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.
 - 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
 - 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.4 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. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of initial access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 5. Perimeter moldings.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 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 Panels: Full-size panels equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, 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 panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel 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 panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.
- B. Fire-Resistance Ratings: Comply with ASTM E 119; 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.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations: Obtain each type of acoustical ceiling panel its applicable supporting suspension system from single source from single manufacturer.
- B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 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 (400 mm) away from test surface according to ASTM E 795.
- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. CertainTeed Corp.
 - 3. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Products:
 - 1. Acoustical Panel - Type **(ACT-1)**
 - a. Type, Form and Finish: ASTM E1264, Type IV, Form 2, Pattern E.
 - b. Size: 24"x24"x 3/4"
 - c. CAC 35, NRC 70.
 - d. Edge Detail: 9/16" Beveled Tegular
 - f. Basis of Design: Armstrong Ultima – 1912
 - 2. Acoustical Panel - Type **(ACT-2)**
 - a. Type, Form and Finish: ASTM E1264, Type IV, Form 2, Pattern E.
 - b. Size: 24"x 48"x 3/4"
 - c. CAC 35, NRC .70.
 - d. Edge Detail: 9/16" Beveled Tegular
 - e. Basis of Design: Armstrong Ultima - 1915

3. Acoustical Panel - Type **(ACT-3)**
 - a. Type, Form and Finish: ASTM E1264, Type IV, Form 2, Pattern E.
 - b. Size: 24"x 24" x 5/8".
 - c. CAC 40, NRC N/A.
 - d. Edge Detail: Square Lay-in.
 - e. Basis of Design: Armstrong Clean Room VL No. 868.
4. Acoustical Panel - Type **(ACT-4)**
 - a. Type, Form and Finish: ASTM E1264, Type IV, Form 2, Pattern E.
 - b. Size: 24"x 48" x 5/8".
 - c. CAC 40, NRC N/A.
 - d. Edge Detail: Square Lay-in.
 - e. Basis of Design: Armstrong Clean Room VL No. 870.
5. Acoustical Panel - Type **(ACT-5)**
 - a. Type, Form and Finish: ASTM E1264, Type XII, Form 2, Pattern E.
 - b. Size: 24"x 96"x 1"
 - c. CAC N/A, NRC .95.
 - d. Edge Detail: 9/16" Square Tegular.
 - e. Basis of Design: Armstrong Optima Plank No. 3262
6. Specialty Ceiling – Type **(AC-1)**
 - a. Type, Form and Finish: ASTM E1264, Type XII, Form 2, Pattern E.
 - b. Size: 48" x 48" x 7/8"
 - c. Basis of Design: Armstrong Soundscapes: Panel Square 5440__:
 1. Color as selected by Architect from manufacturer's full range
7. Specialty Ceiling – Type **(AWC-1)**
 - a. Type, Form and Finish: Composite
 - b. Size: 6" x 96" x 3/4" with 3/4" reval
 - c. CAC N/A, NRC .40
 - d. Basis of Design: Armstrong Woodworks Linear 666W1__
 1. Provide 6" Woodwork Trim with wood substrate
 2. Species / Finish as selected by Architect from manufacturer's full range
8. Specialty Ceiling – Type **(MC-1)**
 - a. Type, Form and Finish: Custom
 - b. Sizes: See Drawings_
 - c. Basis of Design: Armstrong Metalworks RH215 Flat
 1. Provide 50 mm side walls at all 4 edges
 2. Color: As selected by Architect from manufacturer's standard and custom RAL range.
 3. Perforations: As selected by Architect from manufacturer's standard, premium, and custom ranges.
 4. Provide 1/2" Acoustical Infill Panels above ceiling panels – Armstrong – 6093

9. Specialty Wall / Ceiling System – Type (WG-1)

- a. Type, Form and Finish: Custom
- b. Size: 2 ¼” 8 Blades with backer
- c. CAC N/A, NRC .90
- d. Basis of Design: Armstrong Woodworks Grille – 5666-BO-____
 1. Species / Finish as selected by Architect from manufacturer’s full range
 2. Attached system as recommended by manufacturer

2.4 METAL SUSPENSION SYSTEMS, EDGE MOLDING & TRIM, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- F. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
- G. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.5 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product listed or comparable product by one of the following:
 1. Armstrong World Industries, Inc.
 2. CertainTeed Corp.
 3. USG Interiors, Inc.: Subsidiary of USG Corporation.

B. Products

1. Direct-Hung Suspension Systems, Non-Fire-Resistance Rated:

a. Acoustical Panel Types (**ACT-1 & ACT-2**):

- 1) Basis for Design: Armstrong Suprafine XL
- 2) Type: Narrow face, capped double web, Hot-dipped galvanized grid, ASTM C 636.
- 3) Suspension System Accessories: Attachment devices and hangers, ASTM C 636.
- 4) Color: White.

- b. At Acoustical Panel Types (**ACT-3 & ACT-4**):
 - 1) Basis for Design: Armstrong Prelude XL
 - 2) Type: Wide-face, capped double-web steel, hot-dipped galvanized grid, ASTM C 636.
 - 3) Suspension System Accessories: Attachment devices and hangers, ASTM C 636.
 - 4) Color: White.
- c. At Acoustical Panel Type (**ACT-5**):
 - 1) Basis for Design: Armstrong 9/16" Interlude XL.
 - 2) Type: Dimensional Tee System, double-web hot galvanized steel, ASTM C 635.
 - 3) Suspension System Accessories: Attachment devices and hangers, ASTM C 635;
 - a. Provide Stabilizer Clips, spacing per manuf. Recommendation, No. 435
 - b. Provide Spring border clips, No. 7870
 - 4) Color: White.
 - 5) Perimeter Trim at ACT-5 in Media Center A115 – North Edge
 - a. Basis for Design: Armstrong's Axiom Classic Trim.
 - b. Height: 4".
 - c. Color: As selected by Architect from manufacturer's full line.
- d. At Specialty Ceiling Type (**AC-1**):
 - 1) Basis for Design: Armstrong Soundscapes – Group Suspension System
 - 2) Applicable Components:
 - a. Grouping Frames Kits – 5451
 - b. Frame Splice Kits – 5452
 - c. Frame Alignment Kits - 5453
 - d. Deck Hanging Kits – 5450
 - e. Panel Hook Kits – 5453
 - 3) Color: Black
- e. At Specialty Ceiling Type (**AWC-1**):
 - 1) Basis for Design: Armstrong HD Linear Carriers - 5371
 - 2) Applicable Components:
 - a. Linear Wood Splice - 5843
 - 3) Color: Black
- f. At Specialty Ceiling Type (**MC-1**):
 - 1) Basis for Design: Armstrong Metalworks RH215 Flat System –“H” Profile System
 - 2) Color: As selected by Architect from manufacturer's standard and custom RAL range.

2.6 ACOUSTICAL SEALANT

- A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
 - 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
 - 3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- 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 and, if permitted with fire-resistance-rated ceilings, 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.
 - 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 (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) 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 edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 6. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubber wall base.
 - 2. Resilient stair accessories.
 - 3. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 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 (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg 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. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RUBBER WALL BASE (RB)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
 2. Johnsonite; A Tarkett Company.
 3. Mondo Rubber International, Inc.
 4. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
1. Group: I (solid, homogeneous).
 2. Style and Location:
 - a. Style B, Cove: Refer to Finish Schedule for locations.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors: As selected by Architect from full range of industry colors.

2.2 RUBBER STAIR ACCESSORIES (RUB)

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
 2. Johnsonite; A Tarkett Company.
 3. Mondo Rubber International, Inc.
 4. Roppe Corporation, USA.
- C. Stair Treads: ASTM F 2169.

1. Type: TS (rubber, vulcanized thermoset).
 2. Class: 1 (smooth, flat).
 3. Group: 2 (with contrasting color for the visually impaired).
 4. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
 5. Nosing Height: 2 inches (51 mm).
 6. Thickness: 1/4 inch (6 mm) and tapered to back edge.
 7. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.
- D. Separate Risers: Smooth, flat; in height that fully covers substrate; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
1. Style: Coved toe, 7 inches (178 mm) high by length matching treads.
 2. Thickness: 0.125 inch (3.2 mm).
- E. Landing Tile: Matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
- F. Locations: Provide rubber stair accessories in areas indicated on drawings.
- G. Colors and Patterns: As selected by Architect from full range of industry colors.
- 2.3 RUBBER MOLDING ACCESSORY (T)
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Roppe Corporation, USA.
- B. Description: Rubber reducer strip for resilient flooring, joiner for tile and carpet, and transition strips.
- C. Profile and Dimensions: As appropriate for adjacent floor coverings
- D. Locations: At all dissimilar floor material transitions.
- E. Colors and Patterns: As selected by Architect from full range of industry colors.
- 2.4 INSTALLATION MATERIALS
- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
 - 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 substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 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 practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. 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.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- 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. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
 - 1. Apply one coat(s).
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Vinyl sheet flooring with rolled cove base.

Extent of resilient sheet flooring and accessories is shown on drawings, in schedules and specifications.

- B. Related Section: 079200 "Joint Sealants."

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual flooring showing full range of colors and patterns available for each type of resilient flooring indicated. Colors and patterns must be equivalent to those indicated on the color schedule.
- D. Samples for verification purposes in minimum 12" x 12" piece of each different color and pattern of resilient floor specified, showing full range of variations expected in these characteristics.
- E. Maintenance data for resilient sheet flooring, to include in Operating and Maintenance Manual specified in Division 1.
- F. Shop Drawings showing floor pattern cuts, pieces and joints.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Floor Tile: Obtain each type, color, and pattern of flooring from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Fire Performance Characteristics: Provide resilient sheet flooring with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.
 - 2. Smoke Density: Less than 450 per ASTM E 662.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet flooring and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

- B. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- C. Store flooring on flat surfaces. Move flooring and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.
- D. The entire quantity of like sheet flooring, including those required under 1.8 of this section, must be supplied with one delivery and from one “dye lot.”

1.6 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive sheet flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).
- B. Do not install flooring until it is at the same temperature as the space where it is to be installed.
- C. Close spaces to traffic during tile installation.

1.7 SEQUENCING AND SCHEDULING

- A. Install sheet flooring and accessories after other finishing operations, including painting, have been completed.
- B. Do not install flooring over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

1.8 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents. Coordinate turn-in to School Maintenance Facility.
 - 1. Furnish quantity of full-width units equal to 5.0% of each class, wearing surface, color, pattern and size of resilient flooring installed.
 - 2. All extra materials must be from same “dye lot” as installed sheet flooring.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, resilient sheet flooring that may be incorporated in the Work include, and are limited to, the following without prior approval by Architect:
 - 1. Vinyl Sheet Flooring:
 - a. Mannington (Basis of Design)
 - b. Armstrong World Industries, Inc.
 - c. Tarkett, Inc.
 - d. Azrock
 - e. Mohawk Congolium.

2.2 ACCEPTABLE PRODUCTS: Equivalent to the following specified as a basis-of-design.

- A. VSF: Sheet Vinyl: Biospec MD by Mannington.

1. Sheet: 6 feet wide by 82 ft. maximum length.
2. Overall thickness: .080 in.
3. Wearlayer thickness: .080 in.
4. Static Load Limit: ASTM F 970 (modified) 750 psi.
5. Average weight: 6.5 lbs / sq yd

2.2 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by sheet flooring manufacturer for applications indicated.
- C. Adhesives (Cements): Water-resistant type recommended by sheet flooring manufacturer to suit resilient sheet flooring products and substrate conditions indicated. Adhesive to be low VOC type as approved and recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine areas where installation of flooring will occur, with Installer present, to verify that substrates and conditions are satisfactory for flooring installation and comply with flooring manufacturer's requirements and those specified in this Section.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
 2. Finishes of subfloors comply with tolerances and other requirements specified in Division 3 Section "Cast-In-Place Concrete" for slabs receiving resilient flooring.
 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with manufacturer's installation specifications to prepare substrates indicated to receive sheet flooring.
- B. Use trowelable leveling and patching compounds per flooring manufacturer's directions to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush. Skim coat all existing substrates with Ardex Feather Finish or equivalent, following manufacturer's instructions for installation.
- D. Broom or vacuum clean substrates to be covered by sheet flooring immediately before flooring installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.3 INSTALLATION

- A. General: Comply with sheet flooring manufacturer's installation directions and other requirements indicated that are applicable to each type of sheet flooring installation included in Project.
- B. Lay out flooring with minimal seaming. Install flooring square with room axis, unless otherwise indicated.
- C. Heat-weld all seams.
- D. Match sheet flooring for color and pattern by selecting from packaging in same sequence as manufactured and packaged, if so numbered. Cut flooring neatly around all fixtures.
- E. Extend sheet flooring up all vertical surfaces, including casework, to form rolled cove base.
- F. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- G. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
- H. Install sheet flooring on covers for telephone and electrical ducts, and similar items occurring within finished floor areas as applicable. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- I. Adhere sheet flooring to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed sheet flooring installation.
- J. Use full spread of adhesive applied to substrate in compliance with flooring manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.
- K. Hand roll flooring where required by flooring manufacturer.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing tile installation:
 - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by sheet flooring manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Damp-mop flooring to remove black marks and soil.
 - 4. Apply protective floor polish to tile surfaces that are free from soil, visible adhesive, and surface blemishes.
 - a. Use commercially available, metal, cross-linked acrylic product acceptable to tile manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
 - c. Apply minimum one coat sealer and three coats polish.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by sheet flooring manufacturer.

END OF SECTION 096516

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Vinyl composition floor tile.
- 2. Rubber tile flooring.
- 3. Resilient Quartz Tile

- B. Resilient wall base, reducer strips, and other accessories installed with resilient floor tiles are specified in Division 9 Section "Resilient Wall Base and Accessories."

- C. Extent of resilient flooring and accessories is shown on drawings, in schedules and specifications.

- 1. Resilient flooring is required under base cabinets and other built-in furniture which rest on floor, unless otherwise specifically noted.
- 2. Resilient flooring will not be required under carpet for new floor areas.
- 3. Apply resilient base to toe recess and base of casework and millwork cabinet work extending to floor, unless otherwise indicated.

- D. Related Section: 079200 "Joint Sealants."

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

- B. Product data for each type of product specified.

- C. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual tiles or sections of tiles showing full range of colors and patterns available for each type of resilient floor tile indicated. Colors and patterns must be equivalent to those indicated on the color schedule.

- D. Samples for verification purposes in full-size tiles of each different color and pattern of resilient floor tile specified, showing full range of variations expected in these characteristics.

- E. Maintenance data for resilient floor tile, to include in Operating and Maintenance Manual specified in Division 1.

- F. Shop Drawings showing floor pattern cuts, pieces and joints.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility for Floor Tile: Obtain each type, color, and pattern of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

- B. Fire Performance Characteristics: Provide resilient floor tile with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.
2. Smoke Density: Less than 450 per ASTM E 662.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver tiles and installation accessories to Project site in original manufacturer's unopened cartons and containers each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store flooring materials in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- C. Store tiles on flat surfaces. Move tiles and installation accessories into spaces where they will be installed at least 48 hours in advance of installation.
- D. The entire quantity of like tiles, including those required under 1.8 of this section, must be supplied with one delivery and from one "dye lot."

1.6 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive tiles for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).
- B. Do not install tiles until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during tile installation.

1.7 SEQUENCING AND SCHEDULING

- A. Install tiles and accessories after other finishing operations, including painting, have been completed.
- B. Do not install tiles over concrete slabs until the slabs have cured and are sufficiently dry to bond with adhesive as determined by tile manufacturer's recommended bond and moisture test.

1.8 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents. Coordinate turn-in to School Maintenance Facility.
 1. Furnish not less than three boxes for each 50 boxes or fraction thereof, of each class, wearing surface, color, pattern and size of resilient floor tile installed.
 2. All extra materials must be from same "dye lot" as installed tile.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, resilient floor tiles that may be incorporated in the Work include, and are limited to, the following without prior approval by Architect:
1. Vinyl Composition Tile:
 - a. Armstrong World Industries, Inc. (Basis of Design).
 - b. Tarkett, Inc.
 - c. Mannington
 - d. Azrock
 - e. Mohawk Congolium "Alternatives" and "Choices."
 2. Rubber Tile Flooring and Rubber Stair Treads and Risers:
 - a. Johnsonite (Basis of Design).
 - b. Endura
 - c. Estrie
 - d. Roppe Corporation
 - e. Johnsonite
 3. Resilient Quartz Tile:
 - b. Upofloor Oy (Basis of Design).

2.2 RESILIENT TILE

- A. Vinyl Composition Floor Tile: Products complying with ASTM F 1066-95a, Class 2 (nonasbestos formulated), and with requirements specified in FS SS-T-312, Type IV; 12"x12" unless otherwise indicated and as follows:
1. Thickness: 1/8"
 2. Colors and Patterns: As indicated on drawings and color schedule, or if not otherwise indicated, as selected by Architect from manufacturer's full range of equivalent colors and patterns.
- B. Rubber Tile: Products complying with ASTM F 1344, Class I-A, homogenous rubber tile.
1. Thickness: 1/8".
 2. Wearing Surface: Square.
 3. Size: 12" x 12".
 4. Hardness: Durometer hardness not less than 85 Shore Type A per ASTM D 2240 as required according to ASTM F 1344.
 5. Colors and Patterns: As selected by Architect from manufacturer's full range of colors and patterns.
- C. Resilient Quartz Tile: Provide flat tile complying with the following:
1. Type: Polyester resin marble chip flooring equivalent to Hovi Mosaic Classic, manufactured by Upofloor.
 2. Facial Dimensions: 24" x 24".
 3. Thickness: 3/16".
 4. Face: Plain square edged.
 5. Colors and Patterns: As indicated on drawings and color schedule, or if not otherwise indicated, as selected by Architect from manufacturer's full range of equivalent colors and patterns.

2.3 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland-cement-based formulation provided or approved by tile manufacturer for applications indicated.
- C. Adhesives (Cements): Water-resistant type recommended by tile manufacturer to suit resilient floor tile products and substrate conditions indicated. Adhesive to be low VOC type as approved and recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. General: Examine areas where installation of tiles will occur, with Installer present, to verify that substrates and conditions are satisfactory for tile installation and comply with tile manufacturer's requirements and those specified in this Section.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by tile manufacturer.
 - 2. Finishes of subfloors comply with tolerances and other requirements specified in Division 3 Section "Cast-In-Place Concrete" for slabs receiving resilient flooring.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits of any kind.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with manufacturer's installation specifications to prepare substrates indicated to receive tile.
- B. Use trowelable leveling and patching compounds per tile manufacturer's directions to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush. Skim coat all existing substrates with Ardex Feather Finish or equivalent, following manufacturer's instructions for installation.
- D. Broom or vacuum clean substrates to be covered by tiles immediately before tile installation. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- E. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

3.3 INSTALLATION

- A. General: Comply with tile manufacturer's installation directions and other requirements indicated that are applicable to each type of tile installation included in Project.
- B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter that equal less than

one-half of a tile. Install tiles square with room axis, unless otherwise indicated. Coordinate layout with patterns as indicated.

- C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles with grain running in alternating directions, checkerboard pattern.
- D. Scribe, cut, and fit tiles to butt tightly to vertical surfaces, permanent fixtures, built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.
- E. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
- G. Install tiles on covers for telephone and electrical ducts, and similar items occurring within finished floor areas as applicable. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- H. Adhere tiles to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections in completed tile installation.
- I. Use full spread of adhesive applied to substrate in compliance with tile manufacturer's directions including those for trowel notching, adhesive mixing, and adhesive open and working times.
- J. Hand roll tiles where required by tile manufacturer.
- K. Install rubber tile flooring in accordance with manufacturer's instructions.
- L. Use computer controlled lazer cuts for cuts required to achieve designated patterns. Minimize the number of small tile pieces, especially at corners. Equivalent to Hydro-Lazer (412) 826-3900.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing tile installation:
 - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by tile manufacturers.
 - 2. Sweep or vacuum floor thoroughly.
 - 3. Damp-mop tile to remove black marks and soil. Additional cleaning and waxing is NIC.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.

END OF SECTION 096519

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient Athletic Flooring
- B. Related Sections:
 - 1. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with flooring.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details and locations of the following:
 - 1. Layout, colors, widths, and dimensions of game lines and markers.
 - 2. Locations of floor inserts for athletic equipment installed through flooring.
 - 3. Seam locations for sheet flooring.
- C. Samples for Initial Selection: For each type of flooring indicated.
 - 1. Game-Line and Marker Paint: Include charts showing available colors and glosses.
- D. Samples for Verification: For each type, color, and pattern of flooring indicated, 6-inch- (150-mm-) square Samples of same thickness and material indicated for the Work.
 - 1. Game-Line- and Marker-Paint Samples: Include Sample sets showing game-line- and marker-paint colors applied to flooring.
 - 2. Seam Samples: For each vinyl sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For flooring to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sheet Flooring: Furnish full-width rolls of not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, and pattern of flooring installed.

1.6 QUALITY ASSURANCE

- A. Sheet Vinyl Flooring Installer Qualifications: An experienced Installer who has completed sheet vinyl flooring installations using seaming methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.
- B. Store materials to prevent deterioration. Store rolls upright.

1.8 FIELD CONDITIONS

- A. Adhesively Applied Products:
 1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
 2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
 3. Close spaces to traffic during flooring installation.
 4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.
- B. Install flooring after other finishing operations, including painting, have been completed.

1.9 COORDINATION

- A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient athletic flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 RESILIENT ATHLETIC FLOORING (**RAF**)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Gerflor Taraflex Multi-Use 5.0 or comparable product by one of the following:
1. Amarco Products.
 2. Johnsonite; a Tarkett company.
 3. Lonseal, Inc.
 4. Robbins Sports Surfaces.
 5. Sport Court; Subsidiary of Connor Sport Court International.
- B. Description: Sheet vinyl flooring specifically designed for adhered athletic flooring applications with ASTM F2772 Class 2 properties.
- C. Sheet Vinyl Flooring with Backing: ASTM F 1303.
1. Overall Thickness: 0.20 inch.
 2. Wear Layer Thickness: 0.08 inch
 3. Backing: Very high density, closed cell foam with reinforced fiberglass grid
 4. Adhesive Method – Full spread adhesive to adhere flooring to substrate to meet manufacturer’s installation requirements.
- D. Seaming Method: Heat welded.
- E. Traffic-Surface Texture: Textured
- F. Applied Finish: Factory-applied UV urethane.
- G. Roll Size: Not less than 59 inches wide by longest length that is practical to minimize splicing during installation.
- H. Color and Pattern: Equivalent to Gerflor #6381 Maple design.

2.3 ACCESSORIES

- A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.
- B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.
- C. Game-Line and Marker Paint: Complete system including primer, if any, compatible with flooring and recommended in writing by flooring and paint manufacturers for use indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

1) Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.

b. Perform relative humidity test using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 SHEET FLOORING INSTALLATION

- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.
- B. Lay out sheet flooring as follows:
 - 1. Maintain uniformity of flooring direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (150 mm) away from parallel joints in flooring substrates.
 - 3. Match edges of flooring for color shading at seams.
 - 4. Locate seams per approved Shop Drawings.
- C. Adhered Flooring: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- D. Vinyl Sheet Flooring Seams: Prepare and finish seams to produce surfaces flush with adjoining flooring surfaces.
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless flooring.
 - 2. Chemically Bonded Seams: Comply with ASTM F 693. Seal seams to prevent openings from forming between cut edges and to prevent penetration of dirt, liquids, and other substances into seams.

3.5 GAME LINES AND MARKERS

- A. Mask flooring at game lines and markers, and apply paint to produce sharp edges. Where crossing, break minor game line at intersection; do not overlap lines.

3.6 FIELD-APPLIED FINISHES

- A. Apply finish after game-line and marker paint is fully cured.
- B. Apply finish according to manufacturer's written instructions to produce a sealed surface that is ready for use.
- C. Do not cover flooring after finishing until finish reaches full cure.

3.7 CLEANING AND PROTECTING

- A. Perform the following operations immediately after completing flooring installation:
 - 1. Remove adhesive and other blemishes from flooring surfaces.
 - 2. Sweep and vacuum flooring thoroughly.

3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.
1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096566

SECTION 096623 – RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

- 1. Thin-set epoxy-resin terrazzo.

- B. Related Sections include the following:

- 1. Division 1 Section 012300 - Alternates.
 - 2. Division 7 Section 07920 - Joint Sealants for sealants installed with terrazzo.

1.3 SUBMITTALS

- A. Product Data: For each type of terrazzo and accessory indicated.

- B. Shop Drawings: Include terrazzo fabrication and installation requirements. Include plans, elevations, sections, component details, and attachments to other Work. Show layout of the following:

- 1. Divider and control- and expansion-joint strips.
 - 2. Base and border strips.
 - 3. Precast terrazzo jointing and edge configurations.
 - 4. Terrazzo patterns.

- C. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare samples of same thickness and from same material to be used for the Work in size indicated below:

- 1. Epoxy-Resin Terrazzo: 6-inch- (150-mm-) square samples.
 - 2. Accessories: 6-inch- (150-mm-) long samples of each exposed strip item required.

- D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

- E. Qualification Data: For Installer.

- F. Material Certificates: For epoxy terrazzo, in lieu of material test reports, when permitted by Architect, signed by manufacturers.

- G. Maintenance Data: For epoxy terrazzo to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is acceptable to epoxy terrazzo manufacturer to install manufacturer's products.

1. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
 2. Engage an installer who is a contractor member of NTMA.
- B. Source Limitations: Obtain primary terrazzo materials through one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of aggregate from one source with resources to provide materials of consistent quality in appearance and physical properties.
- D. NTMA Standard: Comply with NTMA Guide Specification and written recommendations for terrazzo type indicated unless more stringent requirements are specified.
- E. Mockups: Install mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
1. For epoxy-resin terrazzo, install mockups of at least 100 sq. ft. (9 sq. m) of typical flooring and base condition for each color and pattern in locations directed by Architect.
 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.
- B. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- C. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- D. Control and collect dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.
1. Provide dustproof partitions and temporary enclosures to limit dust migration and to isolate areas from noise.

PART 2 - PRODUCTS

2.1 EPOXY-RESIN TERRAZZO

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
1. ChemRex, Inc./SKW-MBT; Novalite.
 2. Crossfield Products Corp., Dex-O-Tex Division.
 3. General Polymers Corporation.
 4. Key Resin Company; Key Epoxy Terrazzo.
 5. Master Terrazzo Technologies, LLC; Morricite.

6. Polymerica Incorporated; MasterPiece ETS.
7. Quadrant Chemical Corporation; Quadset Epoxy Terrazzo.
8. TEC, Inc., an H. B. Fuller Company; Tuff-Lite Epoxy Terrazzo.

B. Thickness: 3/8 inch (9.5 mm).

C. Materials:

1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate crack preparation and reflective crack reduction.
 - a. Reinforcement: Fiberglass scrim.
2. Primer: Product of manufacturer recommended for substrate and use indicated.
3. Epoxy Resin: Manufacturer's standard recommended for use indicated and in color required for mix indicated.
 - a. Physical Properties without Aggregates:
 - 1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
 - 2) Minimum Tensile Strength: 3000 psi (20.68 MPa) per ASTM D 638 for a 2-inch (50.8-mm) specimen made using a "C" die per ASTM D 412.
 - 3) Minimum Compressive Strength: 10,000 psi (68.95 MPa) per ASTM D 695, Specimen B cylinder.
 - 4) Chemical Resistance: No deleterious effects by contaminants listed below after 7-day immersion at room temperature per ASTM D 1308.
 - a) Distilled water.
 - b) Mineral water.
 - c) Isopropanol.
 - d) Ethanol.
 - e) 0.025 percent detergent solution.
 - f) 1.0 percent soap solution.
 - g) 10 percent sodium hydroxide.
 - h) 10 percent hydrochloric acid.
 - i) 30 percent sulfuric acid.
 - j) 5 percent acetic acid.
 - b. Physical Properties with Aggregates: For resin blended with Georgia White marble, ground, grouted, and cured per requirements in NTMA's "Guide Specification for Epoxy Terrazzo," comply with the following:
 - 1) Flammability: Self-extinguishing, maximum extent of burning 0.25 inch (6.35 mm) per ASTM D 635.
 - 2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C) for temperature range of minus 12 to 140 deg F (minus 24 to 60 deg C) per ASTM D 696.
4. Marble Chips: Complying with NTMA gradation standards for mix indicated and containing no deleterious or foreign matter.
 - a. Hardness: Ha-10 minimum per ASTM C 241.
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.

5. Divider-Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use and acceptable to terrazzo manufacturer.
 6. Finishing Grout: Resin based.
 7. Seal Coat: Slip resistant, thin-coat terrazzo sealer of or approved by terrazzo manufacturer.
- D. Mix: Comply with NTMA's "Guide Specification for Epoxy Terrazzo" and manufacturer's written instructions for component proportions and mixing.
1. Color and Pattern: As indicated.

2.2 DIVIDER AND ACCESSORY STRIPS

- A. Heavy-Top Divider Strips: Angle type in depth required for topping thickness indicated.
1. Bottom-Section Material: Galvanized steel.
 2. Top-Section Material: White zinc alloy.
 3. Top-Section Width: 1/8 inch (3.2 mm).
- B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material, thickness, and color of divider strips and in depth required for topping thickness indicated.
- C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
1. Base bead and base dividers.
 2. Edge beads for exposed edges of terrazzo.

2.3 MISCELLANEOUS ACCESSORIES

- A. Patching and Fill Material: Resinous product of or approved by terrazzo manufacturer and recommended by manufacturer for application indicated.
- B. Joint Sealants: Recommended by terrazzo and sealant manufacturers and complying with requirements in Division 7 Section "Joint Sealants."
- C. Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances that might impair epoxy terrazzo bond, including oil, grease, and curing compounds.
- B. Provide clean, dry, and neutral substrate for terrazzo application. Determine dryness characteristics by performing moisture tests recommended by terrazzo manufacturer.

1. Concrete: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with epoxy terrazzo.
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
 2. Concrete Masonry Units: Fill voids and chipped areas with mortar mix to produce smooth, plumb surface.
- C. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.
1. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.
- 3.3 EPOXY-RESIN TERRAZZO INSTALLATION
- A. General:
1. Comply with NTMA's written recommendations for terrazzo and accessory installation.
 2. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Guide Specification for Epoxy-Resin Terrazzo."
 3. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
 4. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.
- B. Flexible Reinforcing Membrane:
1. Prepare and prefill substrate cracks with membrane material.
 2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
 3. Reinforce membrane with fiberglass scrim.
 4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.
- C. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.
- D. Divider and Accessory Strips: Install in locations indicated and as required in adhesive setting bed without voids below strips.
1. Control-Joint Strips: Install back to back directly above substrate control joints.
 - a. Install with 1/4-inch (6.4-mm) gap between strips and install sealant in gap.
- E. Fine Grinding: Grind with 120 or finer grit stones until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.
- F. Remove and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

- G. Construction Tolerances: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m).

3.4 CLEANING AND PROTECTING

- A. Remove grinding dust from installation and adjacent areas.
- B. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow to dry thoroughly.
- C. Seal surfaces according to NTMA's written recommendations. Apply sealer according to sealer manufacturer's written instructions.
- D. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096623

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes resinous flooring systems with epoxy body coat(s).
 - 1. Application Method: troweled.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Initial Selection: For each type of exposed finish required.
- C. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.
- D. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.
- E. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- F. Material Test Reports: For each resinous flooring component.
- G. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
 - 1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for applying resinous flooring systems indicated.
 - 2. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

- B. Source Limitations: Obtain all resinous flooring materials, including but not limited to primers, resins, hardening agents, grouting coats, and topcoats, patching and fill material, joint sealant, and repair materials through one source manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Type-1 Concrete substrate shall be properly cured for a minimum of 30 days. Conduct ASTM-F 1869 Anhydrous Calcium Chloride Test. If moisture vapor emission content of the concrete slab exceeds 5lbs/1000ft² per 24 hrs, Stonhard OP2 Osmotic Vapor Grout must be used prior to resinous flooring installation. Slab-on grade substrates without Poly vapor-retarder may also require osmotic vapor grout. Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, humidity, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING AT TOILET ROOMS

- A. Basis of Design Products: Subject to compliance with requirements, provide Stonblend GSI as manufactured by Stonhard, Inc. Contact Tom Burns (800)854-0310 or equivalent product approved by architect prior to bidding.
- B. System Characteristics:
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range. Up to four (4) total selections, three (3) of which may be custom blend.
 - 2. Wearing Surface: Manufacturer's standard orange-peel texture.
 - 3. Overall System Thickness: 3/16 inch (4.8 mm)
 - 4. Federal Agency Approvals: USDA and FDA approved for food-processing environments.
- C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - 1. Body Coat(s):
 - a. Resin: Bisphenol-A Epoxy.
 - b. Formulation Description: 100 percent solids
 - c. Application Method: Hand-Troweled with notch-free square steel 18" trowel.
 - 1) Thickness of Coats: 3/16 inch (4.8 mm)

- 2) Number of Coats: One.
 - d. Aggregates: Manufacturer's standard.
 2. Primer: Type recommended by manufacturer for substrate and body coat(s) indicated.
 - a. Formulation Description: 100 percent solids
 3. Grout Coat
 - a. Formulation Description: 100 percent solids
 - b. Type: Clear
 - c. Number of Coats: One
 4. Topcoat: Chemical-resistant and UV-resistant sealing or finish coat(s).
 - a. Resin: Aliphatic Urethane.
 - b. Formulation Description: Waterborne Aliphatic Urethane,
 - c. Type: Clear
 - d. Finish: Matte
 - e. Number of Coats: One
- D. At all showers and at alcoves between showers in Locker Rooms, provide Stoneblend GSI with added texture. Install per manufacturer's recommendations.

2.2 RESINOUS FLOORING AT FOOD SERVICE

- A. Basis of Design Products: Subject to compliance with requirements, provide Stonshield UTS Contact Tom Burns (800)854-0310 with texture as manufactured by Stonhard, Inc. or equivalent product approved by architect prior to bidding.
- B. System Characteristics:
 - 1 Color and Pattern: As selected by Architect. One (1) selection from manufacturer's full range of blends.
 - 2 Wearing Surface: Texture for slip resistance.
 3. Integral Cove Base: 4 inches (100 mm) high.
 5. Overall System Thickness: 1/4 inch (6.4 mm).
 6. Federal Agency Approvals: USDA and FDA approved for food-processing environments.
- C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
 1. Body Coat(s):
 - a. Resin: Urethane.
 - b. Formulation Description: 100 percent solids
 - c. Application Method: Troweled.
 - 1) Thickness of Coats: 1/4 inch (6.4 mm).
 - 2) Number of Coats: One.
 - d. Aggregates: Manufacturer's standard.
 2. Topcoat: Chemical-resistant and UV-resistant sealing or finish coat(s).

- a. Resin: Urethane
- b. Formulation Description: 100 percent solids
- c. Type: Clear,
- d. Finish: Gloss.
- e. Number of Coats: One

2.3 ACCESSORY MATERIALS

- A. Patching and Fill Material: Resinous product of single source resinous flooring manufacturer and recommended by manufacturer for application indicated.
- B. Joint Sealant: Type produced by single source resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 1. Roughen concrete substrates as follows:
 2. Concrete preparation shall be by mechanical means only and include use of a scabbler, scarifier or shot blast machine for removal of bond inhibiting materials such as curing compounds or laitance. Surface profile achieved shall be similar to medium grit sandpaper. No acid etching or water blasting permitted.
 3. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 4. Verify that concrete substrates are dry.
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 5 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab in 24 hours.
 - b. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
 5. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed. Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - 3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
- D. Apply troweled body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- E. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.
- F. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 CLEANING AND PROTECTING

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 096815 – CARPET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Extent, location and details of each type of carpeting are indicated on drawings, in schedules, and by specifications.
- B. Work of this section includes furnishing and installation of carpeting, adhesives and accessories.
- C. Perform "outgassing" procedures prior to occupancy and acceptance to free all odors and formaldehyde gassing from carpet. Standard procedure to accelerate the seepage of potential environmental "gassing" of the carpet shall be performed.

1.3 RELATED SECTIONS

- A. The following Section contains requirements that relate to this Section:
 - 1. Division 9 Section "Resilient Wall Base & Accessories" for wall base.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Submit manufacturer's product literature and installation instructions for each type of carpeting material and installation accessory required. Include methods of installation for each type of substrate.
 - 1. Submit written data on physical characteristics, durability, resistance to fading and flame resistance characteristics.
- C. Installer Affidavit: Submit affidavit signed by dealer and carpet manufacturer to confirm and acknowledge that the installer is approved by the manufacturer to install manufacturer's product and will follow all installation instructions recommended or required by carpet manufacturer. Provide written confirmation that all requirements of Paragraph 1.5 will be followed.
- D. Shop Drawings: Submit shop drawings showing carpet layout and seaming diagrams, clearly indicating carpet pile direction, and locations and types of edge strips. Indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Show installation details at any special conditions.
- E. Samples for Initial Selection Purposes: Submit manufacturer's standard size samples and color yarns showing standard range of colors, textures and patterns available for each type of carpet required. Submit samples in full range of manufacturers standard colors of transition strips and accessory items. Architect to select color.
- F. Samples for Verification Purposes: Submit the following:
 - 1. 18"x27" samples of each type of sheet carpeting required.
 - 2. Full-size sample of each type of carpet tile required.

3. 6" long samples of each type exposed edge stripping and accessory item.
 4. Prepare samples from same material to be used for the work.
- G. Submit certification that carpet adhesive meets the requirements of the MSDE technical bulletin "Carpet and Indoor Air Quality in Schools (1993)" for levels of volatile organic compounds.
- H. Manufacturer Guarantee: Provide inspection certification and guarantee from manufacturer confirming installation procedures were followed. Coordinate with warranty offered by manufacturer.
- I. Maintenance Manual, Carpeting: Submit manual of carpet manufacturer's complete recommendations for the care, cleaning and maintenance of each type of carpeting.
- J. The manufacturer awarded the carpeting contract must provide detailed maintenance procedures within forty-five (45) days of award of contract. Documentation that this program is currently in place must be submitted at the time of bid.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm (material producer) with not less than 5 years of production experience, whose published literature clearly indicates general compliance of products with requirements for this section.
- B. Installer Qualifications: Firm specializing in carpet installation with not less than 5 years of experience in installation of carpet similar to type, quantity and installation methods required for this project and approved by carpet manufacturer by submitting written affidavit.
- C. Single Source Responsibility: Provide material produced by a single manufacturer for each carpet type.
- D. Carpet Surface Burning Characteristics: Provide carpet identical to that tested for the following fire performance characteristics, per test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify carpet with appropriate markings of applicable testing and inspecting organization.
1. Test Method: DOC FF 1-70
Rating: Pass
 2. Test Method: ASTM E 84
Flame Spread: 25 or less
Smoke Developed: 450 or less
- E. Certification: Submit manufacturer's certificate stating that materials furnished comply with specified requirements. Include supporting certified laboratory testing data indicating that material meets specified test requirements.
- F. The installation of the carpet must be guaranteed by the manufacturer of the carpet. All installation procedures required/recommended by the manufacturer will be followed and only materials supplied by the manufacturer will be used in order to coordinate with warranties offered by the manufacturer.
- G. A pre-construction meeting will be held once the contract has been awarded to review proper installation methods and seaming diagrams with manufacturer's mill representative, technical installation technician from the mill, carpet installation company or subcontractors if not indicated by "dealer", construction manager, end user and architect.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, quality or grade, fire hazard classification, and lot number. Store materials in original undamaged packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat, blocked off ground to prevent sagging and warping. Maintain temperature in storage area above 68 degrees Fahrenheit (20 deg. C) at least three days prior to and during installation.
- B. Comply with instructions and recommendations of manufacturer for special delivery, storage and handling requirements.

1.7 PROJECT CONDITIONS

- A. Substrate Conditions: No condensation within 48 hours on underside of 4-foot by 4-foot polyethylene sheet, fully taped at perimeter to substrate.
- B. Substrate Conditions: pH of 9 or less when substrate wetted with potable water and pHydron paper applied.

1.8 SEQUENCING AND SCHEDULING

- A. Sequence carpet installation with other work to minimize possibility of damage and soiling during remainder of construction period.

1.9 MAINTENANCE

- A. Maintenance Instructions: Submit three manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated traffic and use conditions. Include precautions against materials and methods which may be detrimental to finishes and performance.
- B. Replacement Materials: After completion of work, deliver not less than 5% of full width of carpet of each type, color, and pattern selected exclusive of material required to properly complete installation. Furnish accessory components; furnish one box each of replacement materials from same production run as materials installed. Package replacement materials with protective covering, identified with appropriate labels.

1.10 WARRANTY

- A. Special Project Warranty: Submit a written warranty, executed by the Contractor, Installer and the Manufacturer, agreeing to repair or replace carpeting which fails in materials or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
 - 1. 10-year stain removal warranty.
 - 2. Lifetime static control warranty.
 - 3. 10-year texture retention warranty.
 - 4. Colorfast warranty which includes 10-year warranty for exposure to sunlight. Five-year warranty for exposure to atmospheric contaminants.
 - 5. Lifetime edge ravel & zippering warranty.
 - 6. Specification Warranty: The manufacturer warrants that the carpet conforms to specifications established for the product identified in the execution section, subject to normal manufacturing tolerances.
 - 7. Five Year Installation Workmanship: Provide special project warranty, signed by contractor and installer, agreeing to repair or replace defective materials and workmanship of carpeting work during 5-year warranty period, without cost to owner, and agreeing to repair or replace other defects beyond

contractor's/installer's/manufacturer's controls at owner's expense at prevailing rates.

1.11 ENVIRONMENTAL CONDITIONS

- A. Airing shall be required during and after carpet installation. The building ventilation system should be continuously operated with maximum outside air for at least 72 hours after the installation is complete. Recirculation of air from area of installation into the HVAC system should be prevented. Reference MSDE Technical Bulletin "Carpet and Indoor Air Quality in Schools (1993)" for more detailed requirements. Items required in this technical bulletin are part of the Contract and will be enforced.

1.12 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below matching products installed, packaged with protective covering for storage and identified with appropriate labels. General Contractor is responsible to coordinate turn-in with Board of Education Maintenance.
1. Carpet: Before installation begins, furnish quantity of full-width units equal to 5.0% of amount installed.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Carpet shall be first quality manufacture, the product of one manufacturer. No seconds or imperfections will be acceptable.
- B. Carpeting shall be permanently moth-proofed by the manufacturer and non-allergenic.
- C. Colors and patterns will be selected from the manufacturer's standard color samples. All carpeting of each color shall be from the same dye lot.

2.2 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
1. Mannington (Basis of Design)
 2. Lee
 3. Shaw
 4. Mohawk
 5. Tandus

2.3 ACCEPTABLE PRODUCTS: Equivalent to the following specified as a basis-of-design.

- A. CPT 1: Carpet Tile: 24" x 24": Elemental Brights II – Carbon 15012: by Mannington
- | | |
|------------------------------|------------------------------|
| 1. Construction | Graphic Loop |
| 2. Gauge | 1/10 |
| 3. Fiber System | Invista Antron Lumena Type 6 |
| 4. Dye Method | Solution |
| 5. Primary Tufting Substrate | Woven Synthetic |

B. CPT 2: Carpet Tile: 24" x 24" Elemental Solids II – Orange 64213: by Mannington

1.	Construction	Graphic Loop
2.	Gauge	1/10
3.	Fiber System	Invista Antron Lumena Type 6
4.	Dye Method	Solution
5.	Primary Tufting Substrate	Woven Synthetic

C. CPT 3: Carpet Tile: 24" x 24" Elemental Solids II – Yellow Orange 63210: by Mannington

1.	Construction	Graphic Loop
2.	Gauge	1/10
3.	Fiber System	Invista Antron Lumena Type 6
4.	Dye Method	Solution
5.	Primary Tufting Substrate	Woven Synthetic

D. CPT 4: Carpet Tile: 24" x 24" Elemental Solids II – Aqua 44185: by Mannington

1.	Construction	Graphic Loop
2.	Gauge	1/10
3.	Fiber System	Invista Antron Lumena Type 6
4.	Dye Method	Solution
5.	Primary Tufting Substrate	Woven Synthetic

E. CPT 5: Carpet Tile: 24" x 24" Elemental Solids II – Blue 35174: by Mannington

1.	Construction	Graphic Loop
2.	Gauge	1/10
3.	Fiber System	Invista Antron Lumena Type 6
4.	Dye Method	Solution
5.	Primary Tufting Substrate	Woven Synthetic

F. CPT6: Carpet Tile: Abrasive Action II by Tandus.

1.	Construction	Accuweave Patterned Loop
2.	Gauge	1/12
3.	Stitches per Inch	8.0
4.	Tuft Density	96 tufts/sq in
5.	Pile Height Average	0.187 inch
6.	Fiber System	TDX Nylon
7.	Dye Method	100% Solution Dyed
8.	Soil/Stain Protection	Ensure

- G. Carpet Color and Certificates: Carpet color shall be selected from manufacturer's stock colors. Contractor shall furnish manufacturer's certification that registers number of rolls furnished were manufactured in accordance with specification requirements, and all from the same dye lot and manufacturer's run.

2.4 CARPET ACCESSORIES

- A. Carpet Edge Guard, Non-Metallic: Extruded or molded heavy-duty vinyl or rubber in colors selected by Architect from standard colors.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

- a. Mercer Plastics Company, Inc., Stock #150 Tile - Carpet Joiner, transition strip between VCT and carpet. Color to be selected by Architect from manufacturers standard colors.
- B. Carpet Adhesive: Water-resistant, non-staining as recommended by carpet manufacturer, which complies with flammability requirements for installed carpet.
 1. Adhesive shall comply with MSDE Technical Bulletin "Carpet and Indoor Air Quality in Schools (1993)" for emitting volatile organic compounds.
- C. Seaming Cement: Hot-melt seaming adhesive or similar product recommended by carpet manufacturer, for taping seams and buttering cut edges at backing to form secure seams and preventing pile loss at seams.
- D. Miscellaneous Materials: As recommended by manufacturers of carpet and other carpeting products, selected by Installer to meet project circumstances and requirements, and to be submitted to Architect for approval.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for moisture content and other conditions under which carpeting is to be installed. Notify contractor in writing of major conditions detrimental to proper completion of the work. The carpet contractor shall examine surfaces scheduled to receive carpeting for: excessive voids in cement or subsurface texture that are questionable for long term quality of patch, outlets (electrical or non-electrical) that will not be flush with surface once carpeted either prepared by carpet installer or other vendor, debris or other defects that will adversely affect the execution and quality of the new carpet installation. The contractor shall broom clean and prepare floors, at the contractor's expense. Any of these conditions not meeting the carpet installer's approval will be brought to the attention of the CONSTRUCTION MANAGER AND OWNER for their final review and recommendation prior to any carpet installation. Do not proceed until satisfactory conditions have been corrected.

3.2 PREPARATION

- A. Repair minor holes, cracks, depressions, and rough areas using material recommended by carpet or adhesive manufacturer. Skim coat all existing substrates with Ardex Feather Finish or equivalent, following manufacturer's instructions for installation.
- B. Clear away debris and scrape up cementitious deposits from surfaces to receive carpeting. Apply sealer to prevent dusting.

3.3 INSTALLATION

- A. Comply with manufacturer's recommendations for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. Follow seaming diagram as submitted and approved. At doorways, center seams under door in closed position; do not place seams perpendicular to door frame, in direction of traffic through doorway. Do not bridge building expansion joints with continuous carpet. NO RAILROADING OF CARPET authorized without approval from end user. Corridors will show directional change of carpet texture rather than seams every 12'. All rooms 12' and under are to be installed in one continuous piece. No fill pieces allowed! No seams shall occur perpendicular to doorways. All meeting rooms/offices of carpet to be installed parallel to the windows. (Carpet to have seams running parallel to the windows.)
- B. Extend carpet under open-bottomed obstructions and under removable flanges and furnishings, and into alcoves and closets of each space.

- C. Provide cut-outs where required, and bind cut edges properly where not concealed by protective edge guards or overlapping flanges.
- D. Install carpet edge guard where edge of carpet is exposed; anchor guards to substrate.
- E. Install transition strips between carpet and other flooring materials.
- F. Expansion Joints: Do not bridge building expansion joints with continuous carpeting; provide for movement.
- G. Glue-Down Installation:
 - 1. The installation of carpet shall be an indication of the contractor's acceptance of the sub floors and the responsibility for any unacceptable finished work caused by the sub floor conditions.
 - 2. Installation of all carpeting shall be by glue down method. Carpet shall be securely bonded to the substrate with adhesive as recommended by carpet manufacturer to assure compliance with warranty requirements. Contractor shall apply adhesive uniformly and cover only that amount of area that can be covered by carpet within the recommended working time of adhesive. All seams shall be trimmed and fitted in a workmanlike manner and shall be bonded at the time of installation.
 - 3. All cut edges of woven interlock carpets must be buttered with latex, as available by the carpet manufacturer, in addition to sealing seams with seam sealer available through the carpet manufacturer.
 - 4. The carpet must be neatly and tightly fitted into breaks and recesses, against bases, around pipes and penetrations, under saddles and thresholds, under removable flanges and around permanent cabinets and equipment.
 - 5. All carpet is to run in one lengthwise run in corridors. NO RAILROADING of carpet in corridors is allowed. The texture change is acceptable at intersections rather than directional change and seams in corridors.

3.4 CLEANING

- A. Remove adhesive from carpet surface with manufacturer's recommended cleaning agent.
- B. Remove and dispose of debris and unusable scraps. Vacuum carpet using commercial machine with face-beater element. Remove spots and replace carpet where spots cannot be removed. Remove any protruding facing yarn using sharp scissors.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer to ensure carpet is not damaged or deteriorated at time of Substantial Completion.

END OF SECTION 096815

SECTION 098413 – FABRIC-WRAPPED ACOUSTICAL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - a. Fabric-wrapped sound-absorbing acoustical panels of size and shape indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for acoustical wall panels, including plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Initial Selection: Manufacturer's color charts showing the standard range of colors, textures, and patterns available for facing materials for each type of acoustical wall panel indicated. Include samples of installation devices and accessories.
- D. Samples for Verification: 8-by-11-inch (200-by-280-mm) units of each type of acoustical wall panel indicated; in sets for each color, texture, and pattern specified for facing materials, showing the full range of variations expected in these characteristics. Include samples of installation devices and accessories.
- E. Product Certificates: Signed by manufacturers of acoustical wall panels certifying that products furnished comply with requirements.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Product Test Reports: From a qualified testing agency indicating acoustical wall panels comply with requirements, based on comprehensive testing of current products.
- H. Maintenance Data: For acoustical wall panels and facings to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing acoustical wall panels similar to those indicated for this Project and with a record of successful in-service performance.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations for Acoustical Wall Panels: Obtain acoustical wall panels from one source with resources to provide products of consistent quality in appearance and physical properties.

- D. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical wall panels with appropriate markings of applicable testing and inspecting agency.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 450 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical wall panels from excessive moisture when shipping, storing, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet-work, such as concrete and plaster, has been completed and cured to a condition of equilibrium. Protect panel edges from crushing and impact.
- B. Factory finish and assemble all components before shipment.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- C. Field Measurements: Verify wall surface dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - a. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish surface dimensions and proceed with fabricating acoustical wall panels without field measurements. Coordinate wall construction to ensure that actual surface dimensions correspond to established dimensions.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by manufacturer agreeing to repair or replace components of acoustical wall panel system that fail in performance, materials, or workmanship within specified warranty period. Failure in performance includes, but is not limited to, acoustical performance. Failure in materials includes, but is not limited to, sagging or distortion of facing or warping of core.
- C. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each commercial appliance is based on the product names. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 FABRIC-WRAPPED ACOUSTICAL PANELS (AWP-1A & AWP-1B)

- A. Fabric-wrapped Sound Absorptive Panels (AWP-1A & AWP-1B) in Student Dining C114, Gym C116, Music C123, and Art C125.
1. Basis-of-Design: Subject to compliance with requirements, provide product by CONWED Designscape, Div. of Owen's Corning or comparable product by one of the following:
 - a. Wenger Corporation.
 - b. Golterman & Sabo.
 - c. Essi Acoustical Products Company.
 2. Absorber Panels: Manufacturer's standard high impact resistant construction consisting of 2" thick, 6-7 pcf dimensionally stable glass fiber core with foil backing (no exposed fiberglass) faced with 1/8" high impact resistant, 16-20 pcf molded glass fiber board.
 - a. Edge: Wood hardened edge detail with half bevel finish.
 - b. Corners: Square.
 - c. Finish: Class A rated fabric according to ASTM E-84, fully covered back.
 - d. NRC: ASTM C423: 1.00-1.10
 3. Sound-Absorption Performance: Provide acoustical wall panels with minimum noise reduction coefficients indicated, as determined by testing per ASTM C 423 for mounting type specified.
 4. Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels to substrates.
 - a. Mounting: Z-Clips
 5. Finishes:
 - a. Wall-mounted panels: Manufacturer's woven plain weave 100% polyester 2-ply fabric wrapping entire core and frame and glued to back of frame.
 - a) AWP-1A: Fabric to be selected by architect from manufacturer's full range.
 - b) AWP-1B: Fabric to be selected by architect from manufacturer's full range.
 6. Locations: As indicated on drawings.
 7. Selections not identified on color schedule will be made from manufacturer's full range of fabrics and colors.
- B. Fabric-wrapped Custom Graphic Acoustic Wall System (AWP-2) in corridor C101C and Corridor C101D.
1. Basis-of-Design: Noise S.T.O.P. Custom Graphic Acoustic Wall Systems by Acoustical Surfaces Inc. or comparable product by one of the following:
 - a. CONWED Designscape, Div. of Owen's Corning.
 - b. Wenger Corporation.
 - c. Golterman & Sabo
 2. Type: Decorative
 3. Thickness: 1"
 4. Size: 4' x 4' with hardened edges. All edges shall be wrapped.
 5. Quantity: 8
 6. Flammability: ASTM E-84, Class 1-A, Nonflammable.
 7. Graphics: custom. To be provided by owner. Full range of color per panel.

8. Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels to substrates.
 - a. Mounting: Z-Clips

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and blocking, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting acoustical wall panel performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, and scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacturer.
- B. Construction Tolerances: As follows:
 1. Variation from Plumb and Level: Plus or minus 1/16 inch (1.6 mm).
 2. Variation of Joints from Hairline: Not more than 1/16 inch (1.6 mm).

3.3 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels with fabric facing, on completion of installation, to remove dust and other foreign materials according to manufacturer's written instructions.
- C. Remove surplus materials, rubbish, and debris resulting from acoustical wall panel installation, on completion of the Work, and leave areas of installation in a neat and clean condition.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 098413

SECTION 098430 – WOOD VENEER WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - a. Acoustical and Flat wood veneer wall panels of size and shape indicated in Main Street 100.
 - b. Flat wood veneer wall panels of size and shape indicated in Auditorium 534 at stage front.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for acoustical wall panels, including plans, elevations, sections, details, and attachments to other Work.
- C. Samples for Verification: 12-by-12-inch units of each type of acoustical wall panel indicated; in sets for each color and pattern specified, showing the full range of variations expected in these characteristics. Include samples of installation devices and accessories.
- D. Product Certificates: Signed by manufacturers of acoustical wall panels certifying that products furnished comply with requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Maintenance Data: For acoustical wall panels and facings to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing acoustical wall panels similar to those indicated for this Project and with a minimum two year record of successful in-service performance.
- B. Source Limitations for Acoustical Wall Panels: Obtain acoustical wall panels from one source with resources to provide products of consistent quality in appearance and physical properties.
- C. Fire-Test-Response Characteristics: Provide acoustical wall panels with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical wall panels with appropriate markings of applicable testing and inspecting agency.
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 450 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical wall panels from excessive moisture when shipping, storing, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet-work, such as concrete and plaster, has been completed and cured to a condition of equilibrium. Protect panel edges from crushing and impact.
- B. Factory finish and assemble all components before shipment.
- C. Store panels in a fully enclosed space, for a minimum of seventy-two (72) hours immediately prior to installation. Store panels in the room in which they will be installed. The temperature and humidity of the room shall closely approximate those conditions that will exist when the building is occupied. Store panels off the floor.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical wall panels until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Air-Quality Limitations: Protect acoustical wall panels from exposure to airborne odors, such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.
- C. Field Measurements: Verify wall surface dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - a. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish surface dimensions and proceed with fabricating acoustical wall panels without field measurements. Coordinate wall construction to ensure that actual surface dimensions correspond to established dimensions.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, signed by manufacturer agreeing to repair or replace components of acoustical wall panel system that fail in performance, materials, or workmanship within specified warranty period. Revise warranty to period required and verify availability.
- C. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Basis-of-Design Product: The design for each product is based on the product names. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 WOOD VENEER WALL PANELS (WP-#)

A. Flat Wood Veneer Wall Panels (WP-1).

1. Basis-of-Design: Subject to compliance with requirements, provide Flat Veneer Panel by Rulon International, St. Augustine, Florida or a comparable product by one of the following:
 - a. Decoustics.
2. Solid Panels: Manufacturer's standard construction consisting of flush panels.
 - a. Edge: Wood hardened edge detail with return to hide attachment to wall.
 - b. Corners: Square.
3. Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels to substrates.
 - a. Mounting: Z-Clips
4. Finishes:
 - a. Veneer species: Cherry.
 - b. Color: As selected by Architect from manufacturer's full range.
 - c. Quartered veneer.
 - d. Slip match.
 - e. Factory-applied custom stain to match Architect's sample color.
5. Locations: As indicated on drawings.

B. Acoustical Wood Veneer Wall Panels (WP-2).

1. Basis-of-Design: Subject to compliance with requirements, provide Aluratone 700 by Rulon International, St. Augustine, Florida or a comparable product by one of the following:
 - a. Decoustics.
2. Absorber Panels: Manufacturer's standard construction consisting of perforated acoustical panels with hole perforations that vary in size, quantity and pattern.
 - a. 6mm holes on 16mm straight centers.
 - b. Edge: Wood hardened edge detail with return to hide attachment to wall.
 - c. Corners: Square.
3. Sound-Absorption Performance: Provide acoustical wall panels with NCR .80 as determined by testing per ASTM C 423 for mounting type specified.
4. Mounting Accessories: Manufacturer's standard or recommended accessories for securely mounting panels to substrates.
 - a. Mounting: Z-Clips
5. Finishes:
 - a. Veneer species: Cherry.
 - b. Color: As selected by Architect from manufacturer's full range.
 - c. Quartered veneer.
 - d. Slip match.

e. Factory-applied custom stain to match Architect's sample color.

6. Locations: As indicated on drawings.

2.3 FINISHES AND COLORS

- A. Panel face and edge surfaces shall be factory finished with a custom stain as selected by the Architect. Product finishes shall be stain or sealer coats – spray applied to a smooth sanded surface.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and blocking, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting acoustical wall panel performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install acoustical wall panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels, and scribed to fit adjoining work accurately at borders and at penetrations. Comply with panel manufacturer's written instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacturer.

3.3 CLEANING

- A. Clean panels to remove dust and other foreign materials according to manufacturer's written instructions.
- B. Remove surplus materials, rubbish, and debris resulting from acoustical wall panel installation, on completion of the Work, and leave areas of installation in a neat and clean condition.

3.4 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure acoustical wall panels are without damage or deterioration at time of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 098430

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Steel.
 - 2. Galvanized metal.
- B. Related Sections include the following:
 - 1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 8 Sections for factory priming windows and doors with primers specified in this Section.
 - 3. Division 9 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
 - 4. Division 9 painting Sections for special-use coatings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. 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. Documentation of SSPC-Paint compliance for each product category specified in Part 2.

1.4 QUALITY ASSURANCE

- A. SSPC (The Society for Protective Coatings)
 - 1. Products: Complying with SSPC Specifications where indicated.
- B. OTC (Ozone Transport Commission)
 - 1. Products: Complying with OTC Regulations regarding lower VOC limits.
- C. MPI Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by Sherwin-Williams Company or an equivalent product by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Columbia Paint & Coatings.
 - 3. Davis Paint Company.
 - 4. Del Technical Coatings.
 - 5. Duron, Inc.
 - 6. Hallman Lindsay Quality Paints.
 - 7. ICI Paints.
 - 8. M.A.B. Paints
 - 9. McCormick Paints
 - 10. PPG Architectural Finishes, Inc.
 - 11. Vista Paint.

2.2 PAINT, GENERAL

- A. 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.
- B. Colors: As selected by Architect from manufacturer's full range. Up to five (5) Exterior Color Selections.

2.3 METAL PRIMERS

- A. Universal Water Based Primer: SSPC-Paint 24
 - 1. Basis of Design: Pro-Cryl (B66-310 Series) by Sherwin-Williams Company.
 - 2. VOC Content: E Range of E1.

2.4 EXTERIOR W.B. COATING

- A. Waterborne Pigmented Emulsion Coating (Semigloss): MPI #163 (Gloss Level 5).
 - 1. Basis of Design: Sher-Cryl (B66-300 Series) by Sherwin-Williams Company.
 - 2. VOC Content: E Range of E1

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- E. 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.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 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.

- 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.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of paint materials with product requirements.
 - 3. Owner 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.

3.5 CLEANING AND PROTECTION

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

3.6 EXTERIOR PAINTING SCHEDULE

- A. Steel and Galvanized-Metal Substrates:
 - 1. Waterborne System:
 - a. Prime Coat: Universal Water Based Primer.
 - b. Intermediate Coat and Topcoat: Exterior W.B. Coating (semigloss).

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior surface materials:

1. Concrete masonry units (CMU).
2. Steel.
3. Galvanized metal.
4. Gypsum board.
5. Wood.

- B. Related Sections include the following:

1. Division 5 Sections for shop priming of metal with primers specified in this Section.
2. Division 6 Sections for shop priming carpentry with primers specified in this Section.
3. Division 8 Sections for factory priming windows and doors with primers specified in this Section.
4. Division 9 Section "Exterior Painting" for surface preparation and the application of paint systems on exterior surface materials.
5. Division 9 Section "High-performance Coatings."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. 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. Documentation of SSPC-Paint compliance for each product category specified in Part 2.

1.4 QUALITY ASSURANCE

- A. SSPC (The Society for Protective Coatings)

1. Products: Complying with SSPC Specifications where indicated.

- B. OTC (Ozone Transport Commission)

1. Products: Complying with OTC Regulations regarding lower VOC limits

- C. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by Sherwin-Williams Company or an equivalent product by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Columbia Paint & Coatings.
 - 3. Davis Paint Company.
 - 4. Del Technical Coatings.
 - 5. Duron, Inc.
 - 6. Hallman Lindsay Quality Paints.
 - 7. ICI Paints.
 - 8. M.A.B. Paints.
 - 9. McCormick Paints.
 - 10. PPG Architectural Finishes, Inc.
 - 11. Vista Paint.

2.2 PAINT, GENERAL

- A. 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.
- B. Colors: As selected by Architect from manufacturer's full range. See color schedule on drawings.
- C. Graphics and Accents: As designated on drawings and in Color Schedule.

2.3 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.
 - 1. VOC Content: E Range of E3. Basis of Design: PrepRite Block Filler (B25W25) by Sherwin-Williams Company.

2.4 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.
 - 1. VOC Content: E Range of E2.
 - 2. Basis of Design: Harmony Interior Latex Primer by Sherwin-Williams Company.
- B. Interior Latex Primer/Sealer for WOOD: MPI #50.
 - 1. VOC Content: E Range of E2.
 - 2. Basis of Design: PrepRite 200 Interior Latex Primer by Sherwin-Williams Company.

2.5 METAL PRIMERS

- A. Universal Water Based Primer: SSPC-Paint 24.
 - 1. VOC Content: E Range of E1.
 - 2. Basis of Design: Pro-Cryl (B66-310 Series) by Sherwin-Williams Company.

2.6 WATERBORNE COATING

- A. Waterborne Pigmented Emulsion Coating (Semigloss): MPI #163 (Gloss Level 5)
 - 1. VOC Content: E Range of E1
 - 2. Basis of Design: Sher-Cryl (B66-300 Series) by Sherwin-Williams Company.

2.7 LATEX PAINTS

- A. Institutional Low-Odor/VOC Latex (Eggshell): MPI #144 (Gloss Level 2).
 - 1. VOC Content: E Range of E3.
 - 2. Basis of Design: Harmony Low Odor Interior Latex Finish by Sherwin-Williams Company.
- B. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
 - 1. VOC Content: E Range of E3.
 - 2. Basis of Design: Harmony Low Odor Interior Latex Finish by Sherwin-Williams Company.

2.8 CONCRETE SEALER / REFINISHING SYSTEM

- A. Concrete re-finishing system: Penetrating, non-film forming concrete treatment.
 - 1. Identified as "Color Sealer" on the Finish Schedule.
 - a. VOC Content: 0
 - b. Skid Resistance: NFSI – Standard 101.A – High Traction
 - c. Static of Coefficient Wet: 0.6 – 1.0.
 - 2. Basis of Design: FGS PermaShine System by L&M Construction Chemicals, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Surface Materials: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Verify suitability of surface materials, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of surface materials and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to surface materials indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
 - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean surface materials of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime with compatible primers as required to produce paint systems indicated.
- D. Concrete: 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. Clay Masonry: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.
- F. Concrete Masonry: Remove 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.
- G. Steel: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

- H. Galvanized-Metal: 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.
- I. Aluminum: Remove surface oxidation.
- J. Wood:
 - 1. Scrape multiple layers of existing paint to ensure proper adhesion of new paint. Field verify existing surfaces to be painted to become familiar with the existing surfaces to be re-painted.
 - 2. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 - 3. Sand surfaces that will be exposed to view, and dust off.
 - 4. Prime edges, ends, faces, undersides, and backsides of wood.
 - 5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Gypsum Board: Do not begin paint application until finishing compound is dry and sanded smooth.
- L. Existing Concrete: Prepare existing surfaces with a dry diamond grinding / vacuum process. Assume 800 grit finish – 5 step minimum process by a Concrete Refinishing System Manufacturer approved installer.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. If primers are chipped, apply additional touch-up primer until full coverage is achieved prior to application of topcoats.
- 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 Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
 - 1. Mechanical Work:
 - a. Uninsulated metal piping.
 - b. Uninsulated plastic piping.
 - c. Pipe hangers and supports.
 - d. Tanks that do not have factory-applied final finishes.
 - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

2. Electrical Work:
 - a. Switchgear.
 - b. Panelboards.
 - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner 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.

3.5 CLEANING AND PROTECTION

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

3.6 INTERIOR PAINTING SCHEDULE

- A. CMU:
 1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Interior/exterior latex block filler.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (semigloss).
- B. Steel and Galvanized-Metal:
 1. Waterborne System:
 - a. Prime Coat: Universal Water Based Primer).
 - b. Intermediate Coat: Waterborne Coating.
 - c. Topcoat: Waterborne Coating (semigloss).
- C. Gypsum Board:

1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (eggshell).

- D. Wood (Opaque finish):
 1. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Interior latex primer/sealer for WOOD.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (eggshell).

- E. Wood (Natural finish):
 1. Institutional Low-Odor/VOC polyurethane system:
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Filler Coat: Institutional low-odor/VOC paste wood filler.
 - c. Intermediate Coat: Institutional low-odor/VOC urethane matching topcoat.
 - d. Topcoat: Institutional low-odor/VOC urethane (gloss).

- F. Existing Concrete:
 1. Concrete re-finishing system:
 - a. Preparation: Dry diamond grinding process, repeated as necessary to a depth no greater than 1/32".
 - b. Two-Coat Application: FGS Hardener Plus.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and application of high-performance coating systems on the following substrates:
 - 1. Interior Substrates:
 - a. Concrete masonry units (CMU) as noted.
 - b. Gypsum board as noted.
 - c. Steel stairs, pipe and tube railings (typical).
- B. Related Sections include the following:
 - 1. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
 - 2. Division 9 painting Sections for special-use coatings and general field painting.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product List: For each product indicated. Cross-reference products to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 QUALITY ASSURANCE

- A. Master Painters Institute (MPI) Standards:
 - 1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 - 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and coating systems indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. Provide products of same manufacturer for each coat in a coating system.
- B. Colors: As selected by Architect from manufacturer's full range. See color schedule on drawings.

2.2 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI#4.
 - 1. Products: Subject to compliance with requirements, provide products by Sherwin-Williams Company or the equivalent products by one of the following:
 - a. Sherwin-Williams Company (The); PrepRite, Int/Ext Block Filler, B25W25
 - b. Benjamin Moore & Co.; Moorcraft, Super Craft Latex Block Filler, 285-01.
 - c. Columbia Paint & Coatings; High Performance, Int/Ext Acrylic Latex Block Filler, 05-055-PP.
 - d. Coronado Paint; Super Kote 5000, Commercial Latex Block Filler, 946-11.
 - e. General Paint; Block Filler, 70-224.
 - f. ICI Paints; Devoe Coatings, Bloxfil Acrylic Block Filler, 4000.
 - g. Miller Paint; Ext. Block Filler, 6015.
 - h. PPG Architectural Finishes, Inc.; Interior/Exterior Latex Block Filler, 6-12.
 - i. Vista Paint; Block Kote, 040.

2.3 EPOXY COATINGS

- A. Epoxy, Cold-Cured, Gloss: MPI #77.
 - 1. Products: Subject to compliance with requirements, provide products by Sherwin-Williams Company or the equivalent products by one of the following:
 - a. Sherwin-Williams Company (The); Pro Industrial High Performance, (Basis-of-Design).
 - b. Benjamin Moore & Co.; Polyamide Epoxy Coating, CM36/CM37.
 - c. Columbia Paint & Coatings; Insl-x, Insl-Tile II, EP-5300.
 - d. Coronado Paint; Polyamide Epoxy Coating, 101 Line.
 - e. ICI Paints; Devoe/Fuller, Guardcote, DP34UXX.
 - f. Miller Paint; PPG Aquapon, Epoxy Cold Cured - Gloss, 95-1.
 - g. PPG Architectural Finishes, Inc.; Aquapon, Epoxy Cold Cured Gloss, 95-1.
 - h. Spectra-Tone; Insl-x, Insl-Tile II, EP5300 Series.
 - i. Tower Paint; Epoxy High Gloss Enamel, T8700.
- B. Water-Based Epoxy (Interior and Exterior): MPI #115.

1. Products: Subject to compliance with requirements, provide products by Sherwin-Williams Company or the equivalent products by one of the following:
 - a. Sherwin-Williams Company (The); Industrial & Marine, Water Based Catalyzed Epoxy, B70W Series (Basis-of-Design).
 - b. Benjamin Moore & Co.; Acrylic Epoxy Gloss "A", Hardener "B", M43/M44.
 - c. Columbia Paint & Coatings; Dupont, Corlar Waterborne Acrylic Epoxy, 76P.
 - d. Coronado Paint; Water-Based Amine Adduct Epoxy, 142 Line.
 - e. General Paint, Ameron; Amercoat 335, 96 Line.
 - f. ICI Paints; Devco Coatings, Tru Glaze WB Epoxy Coating, 4418.
 - g. Miller Paint; Waterborne Epoxy Gloss, 4300/4440.
 - h. PPG Architectural Finishes, Inc.; Aquapon, Waterborne Epoxy, 98-1/98-98.
 - i. Spectra-Tone; Insl-x Aqua-Tile W.B. Epoxy, ATA 100 Series.
 - j. Tower Paint, Sierra, Wall & Trim Enamel, S50.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Masonry (Clay and CMU): 12 percent.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 4. Coating application indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
- D. Clay Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.

E. CMU Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU / Glazed CMU Substrates:

1. Water-Based Epoxy Coating System:

- a. Prime Coat: Interior/exterior latex block filler, MPI #4.
- b. Intermediate Coat: Water-based epoxy (interior and exterior), MPI #115.
- c. Topcoat: Water-based epoxy (interior and exterior), MPI #115.

B. Gypsum Board Substrates:

1. Epoxy System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
- b. Intermediate Coat: Epoxy, gloss, MPI #77.
- c. Topcoat: Epoxy, gloss, MPI #77.

C. Steel Substrates:

1. Pigmented Polyurethane over High-Build Epoxy System:

- a. Prime Coat: Primer, epoxy, as recommended in writing by topcoat manufacturer.
- b. Intermediate Coat: Epoxy, high-build, low gloss, MPI #108.
- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6), MPI #72.

END OF SECTION 099600

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Markerboards.
 - 2. Tackboards.
 - 3. Visual display rails.
- B. Related Sections:
 - 1. Section 097723 "Fabric-Wrapped Panels" for tackable, fabric-covered wall surfaces.
 - 2. Section 101200 "Display Cases" for bulletin boards in built-in trophy and display cases.

1.3 DEFINITIONS

- A. Tackboard: Framed or unframed, tackable, visual display board assembly.
- B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
- C. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.
 - 2. Include sections of typical trim members.
- C. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:
 - 1. Actual sections of porcelain-enamel face sheet, tackboard assembly, and display rail.
- D. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
- B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.9 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.

2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Porcelain-enamel-clad, ASTM A 463/A 463M, Type 1, stretcher-leveled aluminized steel, with 0.024-inch (0.60-mm) uncoated thickness; with porcelain-enamel coating fused to steel at approximately 1000 deg F (538 deg C).
 1. Gloss Finish: Low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.
- B. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.
- C. Hardboard: ANSI A135.4, tempered.
- D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- E. Adhesives: Manufacturer's standard product that complies 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."

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Magnetic, Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.013-inch- (0.33-mm-) thick, porcelain-enamel face sheet with low-gloss finish.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AARCO Products, Inc.
 - b. Claridge Products and Equipment, Inc.
 - c. Marsh Industries, Inc.; Visual Products Group.
 - d. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - e. PolyVision Corporation; a Steelcase company.
 2. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
 3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 TACKBOARD ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AARCO Products, Inc.
 2. Claridge Products and Equipment, Inc.
 3. Marsh Industries, Inc.; Visual Products Group.
 4. Platinum Visual Systems; a division of ABC School Equipment, Inc.

5. PolyVision Corporation; a Steelcase company.

B. Plastic-Impregnated-Cork Tackboard (TB): 1/4-inch- (6-mm-) thick, plastic-impregnated cork sheet factory laminated to 1/4-inch- (6-mm-) thick hardboard backing.

2.4 VISUAL DISPLAY RAILS

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

1. AARCO Products, Inc.
2. Claridge Products and Equipment, Inc.
3. Marsh Industries, Inc.; Visual Products Group.
4. Platinum Visual Systems; a division of ABC School Equipment, Inc.
5. PolyVision Corporation; a Steelcase company.

B. General: Manufacturer's standard, aluminum-framed, tackable cork visual display surface fabricated into narrow rail shape and designed for displaying material.

2.5 MARKERBOARD AND TACKBOARD ACCESSORIES

A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.

1. Factory-Applied Trim: Manufacturer's standard.

B. Map Rail: Provide the following accessories:

1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches (25 to 50 mm) wide.
2. End Stops: Located at each end of map rail.
3. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches (1219 mm) of map rail or fraction thereof.
4. Flag Holder: One for each room.

2.6 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
2. Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
3. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.

4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

- D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.7 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 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.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.
 - 1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches (610 mm) o.c.
 - a. Attach chalktrays to boards with fasteners at not more than 12 inches (300 mm) o.c.

3.5 INSTALLATION OF VISUAL DISPLAY RAILS

- A. Display Rails: Install rails in locations and at mounting heights indicated on Drawings. Attach to wall surface with fasteners at not more than 16 inches (400 mm) o.c.

3.6 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101200 - DISPLAY CASES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonilluminated display cases.
- B. Related Sections:
 - 1. Section 101100 "Visual Display Units" for tackboards.

1.3 DEFINITIONS

- A. Bulletin Board: Tackable visual display surface or tackboard enclosed in a display case.
- B. Display Case: Glazed cabinet with visual display surface background and adjustable shelves.

1.4 PERFORMANCE REQUIREMENTS

- A. 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 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for display cases.
- B. Shop Drawings: For display cases. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show location of seams and joints in visual display surfaces.
 - 2. Include sections of typical trim members.
- C. Samples for Initial Selection: For units with factory-applied color finishes, and as follows:
 - 1. Actual sections of visual display surfaces.
- D. Samples for Verification: For each type of product indicated.

1. Visual Display Surface: Not less than 8-1/2 by 11 inches (215 by 280 mm), mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch- (152-mm-) long sections of each trim profile including corner section.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display surfaces, operating hardware to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain display cases from single source from single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install display cases until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings for display cases by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hardboard: ANSI A135.4, tempered.
- B. Fiberboard: ASTM C 208.
- C. Hardwood Plywood: HPVA HP-1.
- D. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto burlap backing; with washable vinyl finish and integral color throughout.
- E. Extruded-Aluminum Bars and Shapes: ASTM B 221 (ASTM B 221M), Alloy 6063.
- F. Aluminum Tubing: ASTM B 429, Alloy 6063.
- G. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed before tempering, and 6 mm thick unless otherwise indicated.
- H. High-Pressure Plastic Laminate: NEMA LD 3.

- I. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened, except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types, sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.
- J. Adhesives: Manufacturer's standard product that complies 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."

2.2 TACKBOARD ASSEMBLIES

- A. Plastic-Impregnated-Cork Tackboard: 1/4-inch- (6-mm-) thick, plastic-impregnated cork sheet factory laminated to 1/4-inch- (6-mm-) thick hardboard backing.

2.3 DISPLAY CASE (DC-#)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AARCO Products, Inc.
 - 2. Claridge Products and Equipment, Inc.
 - 3. PolyVision Corporation; a Steelcase company.
- B. Recessed Cabinet: Factory-fabricated cabinet; with tackboard assembly on back inside surface, operable glazed doors at front, and trim on face to cover edge of recessed opening.
 - 1. Cabinet Box: Extruded aluminum.
 - 2. Cabinet Frame and Trim: Aluminum.
 - 3. Aluminum Finish: Clear anodic.
- C. Glazed Sliding Doors: Tempered glass; unframed; with extruded-aluminum top and bottom track; supported on nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull and adjustable cylinder lock with two keys.
 - 1. Thickness: Not less than 6 mm thick.
 - 2. Number of Doors: As recommended by Manufacturer.
- D. Shelves: 6-mm-thick tempered glass; supported on adjustable shelf standards and supports.
 - 1. Shelf Width: Minimum 12", Maximum 18".
 - 2. Number of Shelves: As required to provide 12" between shelves within full height of cabinet.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112; recess mounted in rear surface. Provide standards full height of display case.
- F. Tack Surface: Plastic-impregnated-cork tackboard assembly.
- G. Sizes: See Schedule in Part Three of this Section.

2.4 FABRICATION

- A. Fabricate display cases to requirements indicated for dimensions, design, and thickness and finish of materials.

- B. Use metals and shapes of thickness and reinforcing to produce flat surfaces, free of oil-canning, and to impart strength for size, design, and application indicated.
- C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.
- D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

2.5 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 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.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power system to verify actual locations of connections before installation of illuminated units.
- C. Examine walls and partitions for proper backing for display cases.
- D. Examine walls and partitions for suitable framing depth if recessed units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for display cases as required by type and size of unit.

3.3 INSTALLATION

- A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

- B. Recessed Display Cases: Attach units to wall framing with fasteners at not more than 16 inches (400 mm) o.c. Attach aluminum trim over edges of recessed display cases and conceal grounds and clips. Attach trim with fasteners at not more than 24 inches (600 mm) o.c.
- C. Install display case shelving level and straight.

3.4 ADJUSTING AND CLEANING

- A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.5 SCHEDULE

- A. Display Case DC-1: 5'-0"W x 4'-0"H x 1'-6"D
 - 1. Locations: (1) at Corridor C100C, (1) at Lobby C100D, (1) at Corridor C200
- B. Display Case DC-2: 5'-0"W x 4'-0"H x 1'-0"D
 - 1. Locations: (1) at Lobby C100D

END OF SECTION 101200

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of signs:

- 1. Interior ADA Room Signs.
- 2. Symbols of Accessibility.
- 3. Special Signs.
- 4. Interior Cast Letters.
- 5. Exterior Cast Letters on building.
- 6. Miscellaneous signage.

- B. Related Sections: The following sections contain requirements that relate to this section:

- 1. Division 1 "Temporary Facilities and Controls" for temporary project identification signs.
- 2. Division 10 "Site LED Signs" for messaging signs located elsewhere on site.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.
- C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.
 - 1. Provide message list for each sign required, including large-scale details of wording and layout of lettering.
 - 2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
 - 3. Furnish full-size spacing templates for individually mounted dimensional letters and numbers.
- D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
 - 1. Samples for initial selection of color, pattern, and texture:
 - a. Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.
 - 1) Transparent Sheet: Where sheet material is indicated as "clear" provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested in accordance with the requirements of

ASTM D 1003.

- b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.
2. Samples for verification of color, pattern, and texture selected, and compliance with requirements indicated:
 - a. Cast Acrylic Sheet and Plastic Laminate: Provide a sample of each type of sign. Include a sign for each color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.
 - b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate. Where finishes involve normal color and texture variations include sample sets showing the full range of variations expected.
 - c. Dimensional Letters: Provide one full-size representative sample of each dimensional letter type required, showing letter style, color, and material finish and method of attachment.
 - E. Certification: Provide written certification from the sign manufacturer that signage meets ADA requirements.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.
- B. Design Criteria: The drawings and specifications indicate size, profiles, and dimensional requirements of signs and are based on the specific type and model indicated. Signs by other manufacturers may be considered provided that deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.
- C. Signage must comply with "Americans with Disabilities" (ADA) standards.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers" Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
 1. Andco Industries Corp.
 2. A.C. Davenport & Son Co.
 3. A.S.I. Sign Systems
 4. Inter Sign National, Inc.
 5. Spanjer Brothers, Inc.
 6. The Supersine Company.
 7. Southwell Company.
 8. Leeds.
- B. General Requirements

1. All letters shall be Helvetica Medium, upper case, unless otherwise noted.
2. Letters shall be centered on signs unless otherwise indicated.
3. Panel backgrounds shall be colored from manufacturer's standards with a matte finish.

2.2 MATERIALS

- A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested in accordance with ASTM D 790, a minimum allowable continuous service temperature of 176 deg F (80 deg C), and of the following general types:
 1. Transparent Sheet: Where sheet material is indicated as "clear," provide colorless sheet in matte finish, with light transmittance of 92 percent, when tested in accordance with the requirements of ASTM D 1003.
- B. Plastic Laminate: Provide high-pressure plastic laminate engraving stock with face and core plies in contrasting colors, in finishes and color combinations indicated or, if not indicated, as selected from the manufacturer's standards.
- C. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the aluminum producer and finisher for the casting process used and for the use and finish indicated.
- D. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.
- E. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel of lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
- F. Unexposed Solid Wood Frame: Unexposed solid wood may be of any suitable hardwood species, unselect as to grain or color, but free of defects affecting structural soundness. Unexposed wood must be straight, free of surface blemishes, and dimensionally stable.

2.3 ROOM SIGNS

- A. Sign Size: Minimum 6" x 6".
- B. Type: 1/32" raised letter and numerals on plastic laminate.
- C. Letter Size: 5/8" high.
- D. Numeral Size: 1¼" high.
- E. Locations: Provide new signage identifying each room listed on Finish Schedule at each door, excluding exterior and vestibule doors. Mount at 60" AFF on wall at latch side of door, in accordance with ADA guidelines.
- F. Provide type 2 braille plate with room name and number as part of all room signs.
- G. Comply with all ADA requirements.
- H. Wording on Sign: Text will approximate that which is shown on the finish schedule. Owner will review the shop drawing submittal and advise the Contractor of any revisions.
- I. Provide rear blanks at all glass mounted locations.

2.4 SYMBOL OF ACCESSIBILITY

- A. Provide 6"x 6" medium blue plastic laminate square with 6" international handicapped insignia engraved in white

at all restrooms which are equipped for handicapped use. Mount on wall adjacent to opening as directed by Architect. Top of sign shall be 42" above finished floor.

2.7 EXTERIOR CAST LETTERS

- A. Type: Cast aluminum letters. Provide cast metal letters cast aluminum with baked enamel finish. Furnish cast units with smooth flat faces, sharp corners, true lines and accurate profiles. Provide units free of pits, scale, sand holes, or other defects. Protect exposed surfaces with two coats of clear, non-yellowing lacquer. Provide five-year finish guarantee.
- B. Size: As indicated in Calibri font.
- C. Location: As shown on drawings at building exterior entrance.
- D. Mounting: Provide bottom stud mounting. Provide tiebacks as required. See drawings for configuration. Finish color shall be black.
- E. Representative Manufacturer: Andco Industries Corp.
- F. Color: White.
- G. Wording and numbering: As designated on elevations.

2.8 MISCELLANEOUS SIGNS

- A. Provide as part of Base Bid Work of this section a \$3,000.00 allowance for additional signage as directed by Owner/Architect.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
 - 1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.
 - 2. Attach signs with concealed theft-proof fasteners.
- B. Installation of Room Signs:
 - 1. Mount on wall or glass sidelight with top of sign four feet above floor on the latch side of single doors and on the right side when facing double doors from corridor side, unless specifically shown or approved otherwise.

3.2 CLEANING AND PROTECTION

- A. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Repair or replace damaged signs as directed by the Architect. Protect units from damage until acceptance by Owner.

END OF SECTION 101400

RED CLAY CONSOLIDATED SCHOOL DISTRICT
WILLIAM F. COOKE, JR. ELEMENTARY SCHOOL

APPROVED 2012 – COMPLETED 2015

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WHITING-TURNER CONTRACTING COMPANY, CONSTRUCTION MANAGER

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-polymer / solid color reinforced composite toilet compartments configured as toilet enclosures and urinal screens.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of cutouts for compartment-mounted toilet accessories.
 - 2. Show locations of reinforcements for compartment-mounted grab bars.
 - 3. Show locations of centerlines of toilet fixtures.
- C. Samples for Initial Selection: For each type of unit indicated involving material and color selection.
- D. Samples for Verification: 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.

1.4 QUALITY ASSURANCE

- A. 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.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Castings: ASTM B 26/B 26M.
- B. Aluminum Extrusions: ASTM B 221.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless-Steel Castings: ASTM A 743/A 743M.

2.2 SOLID-POLYMER OR SOLID COLOR REINFORCED COMPOSITE UNITS

- A. Basis of Design Product: Subject to compliance with requirements, provide Comtec Industries/Capitol Partitions: "Solid Plastic or comparable product by one of the following:
 - 1. Accurate Partitions Corporation "Solid Plastic"
 - 2. Ampco, Inc. "Solid Plastic High Density Polyethylene"
 - 3. Bradley Corporation; Mills Partitions "Bradmar Solid Plastic Series 400 – Sentinel"
 - 4. Global Steel Products Corp. "Polymer"
 - 5. Hadrian Manufacturing Inc. "Solid Plastic"
 - 6. Knickerbocker Partition Corporation. "Pastique SP"
 - 7. Metpar Corp. "Polly SPR"
 - 8. Rockville Partitions Incorporated. "High Density Polymer"
 - 9. Santana Products, Inc. "Solid Plastic"
 - 10. Bobrick Washroom Equipment, Inc. "Sierra Series (Solid Color Reinforced Composite)"
- B. Toilet-Enclosure Style: Overhead braced / Floor mounted.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid high density polyethylene (HDPE) or polypropylene (PP) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
 - 2. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range (all categories).
- E. Pilaster Shoes: Manufacturer's standard design; polymer.
 - 1. Polymer Color and Pattern: Matching pilaster.
- F. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard design; polymer.
 - a. Polymer Color and Pattern: Matching panel.
 - b. Provide continuous double ear anodized aluminum wall brackets at urinal screens.

2.3 ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Continuous, cam type that swings to a closed or partially open position.
3. Latch and Keeper: Manufacturer's standard latch unit (provide recessed if available as an option) designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

- B. 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 with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel.

2.4 FABRICATION

- A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- 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

3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace 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.

3.2 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102123 - CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Curtain tracks and carriers.
- 2. Cubicle curtains.

B. Related Requirements:

- 1. Section 092216 "Non-Structural Metal Framing" for supplementary metal framing and blocking for mounting items requiring anchorage.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. Include durability, laundry temperature limits, fade resistance, applied curtain treatment, and fire-test-response characteristics for each type of curtain fabric indicated.
- 2. Include data for each type of track.

B. Shop Drawings:

- 1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
- 2. Include details on blocking above ceiling.

C. Samples: For each exposed product and for each color and texture specified, 10 inches (254 mm) in size.

D. Samples for Initial Selection: For each type of curtain material indicated.

E. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:

- 1. Curtain Fabric: 10-inch- (254-mm-) square swatch or larger as required to show complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
- 2. Mesh Top: Not less than 10 inches (254 mm) square.

F. Curtain and Track Schedule: Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For curtains, track, and hardware to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Curtains: Provide curtain fabrics with the following characteristics:
1. Launderable to a temperature of not less than 160 deg F (71 deg C).
 2. Flame resistant and identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CURTAINS AND CURTAIN SUPPORT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ADC Hospital Equipment; Division of Automatic Devices Company.
 2. Alderman Acres Mfg, Inc.
 3. Barjan Manufacturing Ltd.
 4. Coldraco, Inc.
 5. Covoc Corporation.
 6. K. N. Crowder Manufacturing, Inc.
 7. C/S General Cubicle.
 8. Cubicle Curtain Factory, Inc.
 9. Diamond Drapery Co.
 10. Erwin and Associates, Inc.
 11. Hospi-Tel Manufacturing Co.
 12. Imperial Fastener Company, Inc.
 13. InPro Corporation.
 14. A. R. Nelson Co.
 15. Pryor Products.
 16. Salsbury Industries.
 17. Silent Gliss USA Inc.
 18. Standard Textile Company, Inc.
 19. Tubular Specialties Manufacturing, Inc.
- B. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inches wide by 3/4 inch high (32 mm wide by 19 mm high); with 0.062-inch (1.57-mm) minimum wall thickness.
1. Curved Track: Factory-fabricated, 12-inch- (305-mm-) radius bends.
 2. Finish: Clear anodized.
- C. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
- D. Curtain Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.

- E. Exposed Fasteners: Stainless steel.
- F. Concealed Fasteners: Stainless steel.
- G. Cubicle Curtain Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. INVISTA; Avora FR.
 - b. Trevira, R-M Schulz Consulting, Inc.; Trevira CS.
 - 2. Pattern: As selected by Architect from manufacturer's full range.
 - 3. Color: As selected by Architect from manufacturer's full range.
- H. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches (152 mm) o.c.; machined into top hem.
- I. Mesh Top: Not less than 20-inch- (508-mm-) high mesh top of No. 50 nylon mesh.
- J. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.3 CURTAIN FABRICATION

- A. Fabricate curtains as follows:
 - 1. Width: Equal to track length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches (305 mm) added fullness.
 - 2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor as follows:
 - a. Cubicle Curtains: 15 inches (381 mm).
 - 3. Top Hem: Not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, triple thickness, reinforced with integral web, and double lockstitched.
 - 4. Mesh Top: Top hem of mesh not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, triple thickness, reinforced with integral web, and double lockstitched. Double lockstitch bottom of mesh directly to 1/2-inch (13-mm) triple thickness, top hem of curtain fabric.
 - 5. Bottom Hem: Not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, double thickness and double lockstitched.
 - 6. Side Hems: Not less than 1/2 inch (13 mm) and not more than 1-1/4 inches (32 mm) wide, with double turned edges, and single lockstitched.
- B. Vertical Seams: Not less than 1/2 inch (13 mm) wide, double turned and double stitched.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates 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.

3.2 INSTALLATION

- A. General: Install tracks level and plumb, according to manufacturer's written instructions.
- B. Up to 20 feet (6.0 m) in length, provide track fabricated from single, continuous length.
 - 1. Curtain Track Mounting: Surface.
- C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
 - 1. Mechanically fasten directly to bottom of concrete deck with post-installed anchors.
 - 2. Mechanically fasten directly to finished ceiling with toggle bolts.
 - 3. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
 - 4. Mechanically fasten to suspended ceiling grid with screws.
 - 5. Attach track to suspended ceiling grid with manufacturer's proprietary clip.
- D. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
- E. Curtain Carriers: Provide curtain carriers adequate for 6-inch (152-mm) spacing along full length of curtain plus an additional carrier.
- F. Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

END OF SECTION 102123

SECTION 102239 - FOLDING PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Manually operated, acoustical panel partitions.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.

1.3 DEFINITIONS

- A. STC: Sound Transmission Class.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For operable panel partitions.

- 1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
 - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.

- 1. Include Samples of accessories involving color selection.

- D. Delegated-Design Submittal: For operable panel partitions.

- 1. Include design calculations for seismic restraints.

1.5 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. Partition track, track supports and bracing, switches, turning space, and storage layout.
2. Suspended ceiling components.
3. Structural members to which suspension systems are attached.
4. Size and location of initial access modules for acoustical tile.
5. 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.
6. Plenum acoustical barriers.

- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- C. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. 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.
 - b. Seals, hardware, track, track switches, carriers, and other operating components.
 - c. Electric operator and controls.

1.7 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.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.
- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- D. Pre-installation Conference: Conduct conference at Project site.

- E. Fire Marshal approval: Do not purchase products prior to approval from local Fire Marshal.

1.9 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.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable 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 operable panel partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
 - 2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
- C. Fire-Test-Response Characteristics: Provide panels with finishes complying with 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: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol.

2.2 OPERABLE ACOUSTICAL PANELS

- A. Operable Acoustical Panels: Operable acoustical panel partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
 - 1. Basis of Design Product: Subject to compliance with requirements. Provide Modernfold Acousti-Seal #932 or comparable product by one of the following:
 - a. Hufcor.
 - b. Moderco Inc.
 - c. Modernfold, Inc.; a DORMA Group Company.
 - d. Panelfold Inc.
- B. Panel Operation: Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals.
- 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. All panel horizontal and vertical framing members fabricated from minimum 18-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
 - 1. Panel Width: Forty-eight inch (48") widths.
- E. Acoustics: Meet STC 50 / NIC 42.
- F. Panel Skin: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction.
- G. Panel Weight: 8 lb/sq. ft. (40 kg/sq. m) maximum.
- H. Panel Thickness: Not less than 3 inches (75 mm).
- I. Panel Closure: Horizontally expanding panel edge with removable crank.
- J. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.
 - 1. Hinges for panels, closure panels: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragals are not acceptable.

2.3 SEALS

- A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:

1. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.
- 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. Automatically Operated for Acoustical Panels: Extension and retraction of bottom seal automatically operated by movement of partition, with operating range not less than 1-1/2 inches (38 mm) between retracted seal and floor finish.

2.4 PANEL FINISH FACINGS

- 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 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, repeating, or matching grain are indicated, mark facing top and attach facing in same direction.
 3. Match facing pattern 72 inches (1830 mm) above finished floor.
- B. Wood Veneer: Laminated to noncombustible core with moisture-resistant adhesive.
 1. Species and Cut: As selected by Architect from manufacturer's full range.
 2. Matching of Adjacent Veneer Leaves: Slip match.
 3. Veneer Matching within Panel Face: Balance match.
 4. Panel-Matching Method: No matching between panels is required. Select and arrange panels for similarity of grain pattern and color between adjacent panels.
 5. Vertical Panel-Matching Method: Panel vertical slip match; panels are slip matched from lower panels to upper panels.
 6. Wood-Veneer Finish: As selected by Architect from manufacturer's full range, as follows:
- C. 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.

2.5 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for 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 (2.54 mm) 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 guide on both sides of the track to facilitate straightening of the panels; 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 intersections without track switches.
- C. Track Intersections, Switches, and Accessories: As required for 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.
- 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.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557 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 in area of partition installation.
- 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.
- F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 ADJUSTING

- A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Verify that safety devices are properly functioning.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102239

SECTION 102800 – TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Toilet and bath accessories.
- B. Extent of each type of Toilet Accessories is indicated on drawings and schedules.
- C. Related Sections include the following:
 - 1. Division 6 Section “Miscellaneous Rough Carpentry” for blocking at end walls.
 - 2. Division 10 Section "Toilet Compartments” for partitions and screens.
 - 3. Division 22 for pipe protection
 - 4. Division 26 for hand dryers

1.3 SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.
- D. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
- B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
 - 1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
 - 2. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, 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. Coordinate requirements and locations for blocking as required.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
 - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:
 - 1. General Toilet and Bath Accessories: (Items on schedule utilize Bobrick Mfg. numbers unless otherwise indicated.)
 - a. Bobrick Washroom Equipment, Inc.
 - b. Bradley Corporation.
 - c. McKinney/Parker Washroom Accessories Corp.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Toilet and Bath Accessory Schedule on the Drawings.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- F. Baked-Enamel Finish: Factory-applied, gloss-white, baked-acrylic-enamel coating.
- G. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.
- H. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- I. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

- A. General: One, maximum 1-1/2-inch- (38-mm-) diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- C. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- D. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.
- E. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.
 - 1. Provide galvanized steel backing sheet, not less than 0.034 inch (0.85 mm) and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.
- F. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:
 - 1. One-piece, galvanized steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
 - 2. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- G. Keys: Provide universal keys throughout Project for internal access to accessories for servicing and resupplying. Provide minimum of twelve keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

- A. See Plans for locations and types.
 - 1. Confirm exact location with the Owner.

END OF SECTION 102800

SECTION 104161 – SITE LED SIGNS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. New Site LED messaging sign on masonry support.
- B. Related Sections include the following:
 - 1. Division 26 for electric service and connections.
 - 2. Division 27 for communications.

1.3 SUBMITTALS

- A. Product Data: For each model indicated. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop Drawings: For each type of sign required.
 - 1. Include dimensioned plans, elevations and details, large-scale sections of typical members, and other components. Show anchors, grounds, reinforcement and layout, and indicate finishes.
 - 2. Include setting drawings, templates, and directions for installing anchor bolts and other anchorages to be installed as a unit of Work in other Sections.
 - 3. Wiring diagrams from manufacturer for sign.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available for the following:

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the LED sign manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain sign components through one source from a single manufacturer.
- C. Product Options: Size, profiles, and dimensional requirements of signs are based on the specific model indicated. Other manufacturers' signs with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- D. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval and only to the extent needed to comply with performance requirements. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in the National Electrical code, Article 100.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify rough openings for signs by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating signs without field measurements. Coordinate wall construction to ensure actual opening dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements provide 32”x 128” DayStar by Stewart Signs or a comparable product from a manufacturer approved prior to bidding.

2.2 MATERIALS

- A. Aluminum Extrusions: Manufacturer’s standard extruded-aluminum sections with not less than the strength and durability properties specified in ASTM B 221 (ASTM B 221M) for 6063-T5 alloy.
- B. Clear Float Glass: ASTM C 1036 Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), 6 mm thick, unless otherwise indicated.

2.3 DOUBLE-FACED LED SIGNS

- A. LED Cabinets: Provide protection of internal electronic components. Each cabinet is NEMA 4X style. Internal temperature is controlled with cooling fans and heating bars, Surge protection built into both the power input as well as the data input.
- B. LED Vandal Covers: Provide protection from vandalism, graffiti and UV damage by a polycarbonate matte finish vandal cover.
- C. Versatile Displays: Double-sided LED displays allowing different messages to be shown on each side. Scheduling software to allow display of messages at certain times, up to a year in advance! All messages and schedules to be stored onboard the sign.
- D. Video & Graphics Capabilities: Provide capability to text as well as display video clips, animations and still images. Provide full-color shaded display.
- E. Time & Temperature: date and temperature can be displayed at any point and embedded with your own text or graphics. Temperature is derived from the included temperature probe attached to the sign. Time and date are derived from the internal clock with battery, and does not have to be reset in the event of a power-outage.
- F. Adjustable Brightness & Scheduled Dimming: Provide capability to automatically or manually set brightness. A light meter on each side of a double-sided sign allows their brightness to be adjusted individually; an important consideration for signs facing East and West. If using the manual setting, different brightness levels can be set for daytime and nighttime use. Your display can even be set to turn off and back on at certain times.

- G. Graphics Library: Provide unlimited lifetime access to manufacturer's [LED Graphics Library](#).
- H. Security: Provide password-protected software with a "bad word checker" that will block offensive words in the event that the password is compromised.
- I. Communications Method: Wired.

2.4 FABRICATION

- A. General: Fabricate signs to requirements indicated, including dimensions, design, and thickness and finish of materials. Use metals and shapes of thickness, with reinforcing if needed, to produce flatness, free of oil canning, and to impart strength for size, design, and application indicated.
- B. Fabricate perimeter cabinet and cover frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.
- C. Hardware for Covers: Equip covers with hardware of type indicated.

2.5 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Colors: Provide colors as selected by Architect from manufacturer's full range of colors.
- C. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- D. 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 607.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine masonry support, with the Installer present, for compliance with requirements and other conditions affecting installation of directory.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units plumb and level, in locations and with mountings shown. Securely attach to supporting structure with concealed fasteners, according to manufacturer's written installation instructions.

3.3 CLEANING AND PROTECTING

- A. At completion of installation, clean surfaces according to manufacturer's written instructions.
- B. Protect installed signs from damage until acceptance by Owner at the time of Substantial Completion.

END OF SECTION 104160

SECTION 104200 - PLAQUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Work includes furnishing one plaque and all required accessories.
- B. Related work not included in this Section consists of:
 - 1. Installation of plaques is part of Section 061000.

1.3 SUBMITTALS

- A. Submit shop drawings for initial approval.
- B. Submit rubbing of final plaque for final approval before casting.
- C. Submit complete catalogs and specifications of approved equal.

PART 2 - MATERIALS

2.1 GENERAL

- A. Equivalent to the Southwell Company, San Antonio, Texas 78291.
- B. Approved equivalents:
 - 1. Spanjer Brothers, Inc., Parsippany, New Jersey.
 - 2. United States Bronze Sign Co., Inc., New York, New York.
 - 3. James H. Matthews & Company, Pittsburgh, Pennsylvania.
- C. Specified items and requirements are for Southwell plaques and letters.

2.2 PLAQUES

- A. Type: Bronze, 85-5-5-5 standard U.S. bronze alloy.
- B. Sizes:
 - 1) 18" W x 24" H each.
- C. Background: Stippled and oxidized.
- D. Border and Face: Raised letters, satin finish.
- E. Border: Single line.
- F. Letter Style: Ribbon.

- G. Custom Logos: Manufacturer will pay all costs attributed to production of graphics necessary, including conversion of graphic found at the end of this section to a vector image.
- H. Mounting: Concealed, on masonry.
- I. Quantity: One.
- J. Locations: As designated on drawings.

PART 3 - EXECUTION

3.1 GENERAL

- A. According to manufacturer's printed instruction.
- B. Should it be decided to erect plaques before final completion of building, Contractor shall box-in plaques to protect from damage. Remove before final inspection.
- C. Persons named on enclosed samples shall be checked by Contractor with the Architect prior to initial sample submission of the sign samples in order to verify persons so named are still maintaining said state and local office positions following most recent elections.

3.2 LAYOUT: EXAMPLE OF INFORMATION FOLLOWS THIS SECTION.

END OF SECTION 104200

SECTION 104413 - FIRE EXTINGUISHER AND DEFIBRILLATOR CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.
 - 2. Defibrillator Cabinets
- B. Related Sections:
 - 1. Division 10 Section "Fire Extinguishers."

1.3 ACTION 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. 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.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

1.6 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless-Steel Sheet: ASTM A 666, Type 304.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE PROTECTION CABINET (FEC):

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. J. L. Industries, Inc., a division of Activar Construction Products Group; Cosmopolitan Stainless Steel FX
 - b. Larsen's Manufacturing Company; Architectural Fire Rated
 - c. Potter Roemer LLC; FRC 1780 Series.
- B. Cabinet Construction: 1-hour fire rated.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.
 - 2. Stainless Steel Tub
- C. Cabinet Material: Stainless-steel sheet.
- 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 (32- to 38-mm) backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Vertical Duo with SAF-T-LOK
- H. Door Glazing: Laminated Safety.
- 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 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. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Etched.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical.

K. Finishes:

1. Stainless Steel: No. 4.

2.3 FIRE VALVE CABINET (FVC):

- A. Fire Rated Cabinet: Basis of Design: Larsen Manufacturing Company, Model: FS-VCSS1818
1. Locations: Stair C100A and Lobby C100D.
- B. Standard Cabinet: Basis of Design: Larsen Manufacturing Company, Model: VCSS1818
1. Locations: At all other locations.

2.4 AUTOMATIC EXTERNAL DEFIBRILLATOR CABINET (AED)

- A. Basis-of-Design: Subject to compliance with requirements, provide the following:
 1. Cabinet: JL Industries, Inc., Metal AED Cabinet #1413.
 - a. Quantity: 2
 - b. Locations to be determined by owner
 2. Product substitutions shall be made during the bidding period according to the requirements specified in "Material and Equipment."
- B. Mounting: Surface Mounted.
- C. Accessories: Provide manufacturer's standard battery pack with standby life of not less than seven years, two sets of defibrillation pads, emergency instruction card, and all other equipment required for proper use and maintenance.

2.5 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.

- 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 (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 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.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
 - 1. Fire Protection Cabinets: 54 inches (1372 mm) 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. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4 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.
- 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

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Sections:
 - 1. Division 10 Section "Fire Extinguisher Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.7 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide J.L. Industries – Cosmic 10E or comparable product by one of the following:
 - a. Larsen's Manufacturing Company.
 - b. Potter Roemer LLC.
 2. Valves: Manufacturer's standard.
 3. Handles and Levers: Manufacturer's standard.
 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container (FE) & (FEC): UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS (FE):

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide J.L. Industries, Inc. – MB846C or comparable product by one of the following:
 - a. Larsen's Manufacturing Company.
 - b. Potter Roemer LLC.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Standard metal lockers.

1.3 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 type of metal locker and bench.
- B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locker trim and accessories.
 - 2. Include locker identification system and numbering sequence.
- C. Qualification Data: For qualified Installer.
- D. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
- E. Warranty: Sample of special warranty.

1.4 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 metal lockers, locker benches, and accessories from single source from single manufacturer.
- C. Regulatory Requirements: Where metal lockers and benches are indicated to comply with accessibility requirements, comply with 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.
- B. Deliver combination control charts to Owner by registered mail or overnight package service.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases for metal lockers.
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Faulty operation of latches and other door hardware.
 - 2. Damage from deliberate destruction and vandalism is excluded.
 - 3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

1.9 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. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:
 - a. Identification plates.
 - b. Hooks.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
- B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Plastic Laminate: NEMA LD 3, Grade HGP.
- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
- F. Steel Tube: ASTM A 500, cold rolled.
- G. Particleboard: ANSI A208.1, Grade M-2.

- H. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.
- I. Anchors: Material, type, and size required for secure anchorage to each substrate.
 - 1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
 - 2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.2 STANDARD METAL LOCKERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Plus Lockers by Penco Products, Inc. or comparable product by one of the following:
 - 1. Republic Storage Systems Company.
 - 2. Art Metal Products.
 - 3. Hadrian Products, Inc.
 - 4. Keystone Locker Company.
- B. Locker Arrangement: Single tier, Double tier
 - 1. See Schedule at end of this specification for sizes.
- C. Material: Cold-rolled Metallic-coated steel sheet.
- D. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet as follows:
 - 1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
 - 2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
 - 3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.
- E. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.
 - 1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
 - 2. Frame Vents: Fabricate face frames with vents.
- F. Doors: One piece; shall consist of 20 gauge over panel welded to form into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.
 - 1. Doors 24 inner panel.
 - 2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
 - 3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
 - 4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
 - 5. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
 - 6. Door Style: Unperforated panel.

- G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; self-closing.
1. Continuous Hinges: Manufacturer's standard, steel, full height.
- H. Recessed Door Handle and Latch: Manufacturer's standard housing, formed from 0.0359 inch (0.90 mm) thick nickel-plated steel or stainless steel, with integral door pull, recessed for latch lifter and locking devices; non-protruding latch lifter; and automatic, pre-locking, pry-resistant latch, as follows:
1. Provide minimum three-point latching for each door more than 42 inches (1067 mm) high; minimum two-point latching for each door 42 inches (1067 mm) high or less.
 - a. Provide strike and eye for padlock.
- I. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:
1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
 2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
- J. Continuous Zee Base: Fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet.
1. Height: 4 inches (102 mm).
 - 2.
- K. Accessories:
1. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.
 2. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.
 3. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.
 4. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet.
- L. Finish: powder coat.
1. Color(s): Custom color to match Architect's sample. See Color Schedule on drawings.

2.3 FABRICATION

- A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
 2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.
- B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.
- C. Knocked-Down Construction: Fabricate metal lockers using nuts, bolts, screws, or rivets for nominal assembly at Project site.
- D. Accessible Lockers: Fabricate as follows:
1. Locate bottom shelf no lower than 15 inches above the floor.

2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

- E. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.
- F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.
- G. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.
- H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.
 - 1. Sloping-top corner fillers, mitered.
- I. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.
- J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.
- K. Boxed End Panels: Fabricated with 1-inch wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.
- L. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.
 - 1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.4 STEEL SHEET FINISHES

- A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.
- B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, and support bases, 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.

3.2 INSTALLATION

- A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
 2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
- B. Knocked-Down Metal Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.
- C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.
1. Attach hooks with at least two fasteners.
 2. Attach door locks on doors using security-type fasteners.
 3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
 - a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
 - b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.
 4. Attach recess trim to recessed metal lockers with concealed clips.
 5. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
 6. Attach sloping-top units to metal lockers, with closures at exposed ends.
 7. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
 8. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.3 ADJUSTING, CLEANING, AND PROTECTION

- A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.
- B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

3.4 LOCKER SCHEDULE

- A. ML-1 Standard double tier (15" W x 18" D x 60" H) at corridors
- B. ML-2 Standard single tier (12" W x 12" D x 72" H) at kitchen area

END OF SECTION 105113

SECTION 105613 - METAL STORAGE SHELVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Four-post metal storage shelving.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance for Four-Post Metal Storage Shelving: Capable of withstanding the loads indicated according to MH 28.1.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.
- B. Shop Drawings: For metal storage shelving. Include plans, elevations, sections, details, and attachments to other work. Include installation details of connectors, lateral bracing, and special bracing.
- C. Samples for Initial Selection: For units with factory-applied color finishes. Include similar Samples of accessories involving color selection.
- D. Product Schedule: For metal storage shelving, use same designations as Metal Storage Shelving Schedule.

1.5 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 metal storage shelving from single source from single manufacturer.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install metal storage shelving 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.

1.7 COORDINATION

- A. Coordinate locations and installation of metal storage shelving that may interfere with ceiling systems including lighting, HVAC, speakers, sprinklers, access panels, electrical switches or outlets, and floor drains.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- B. Steel Tubing: ASTM A 513, Type 2.

2.2 FOUR-POST METAL STORAGE SHELVING

- A. Open Four-Post Metal Storage Shelving MS-#: Factory-formed, field-assembled, freestanding system, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Burroughs Corporation: Box Edge Plus or comparable product by one of the following:
 - A. Adjustable Shelving Products; a division of Karp Associates, Inc.: ACR Series
 - B. Equipto: Iron Grip
 - C. Penco Products, Inc.: Clipper Industrial Shelving
 - D. Tennsco: Q-Line
 - 2. Load-Carrying Capacity per Shelf: 400 lb. minimum.
 - 3. Posts: Fabricated from hot-rolled steel; in offset angle shape; with perforations at 1-1/2 inches o.c. to receive shelf-to-post connectors.
 - A. Steel Thickness, Nominal: 14 gauge (0.075 inch) or as required for load-carrying capacity per shelf and number of shelves.
 - B. Post Base: Bolt leveler.
 - 4. Bracing: Manufacturer's standard, single or double diagonal cross bracing at back and ends; as required for stability, load-carrying capacity of shelves, and number of shelves.
 - 5. Solid-Type Shelves: Fabricated from steel sheet as follows:
 - A. Steel-Sheet Thickness, Nominal: 18 gauge (0.048 inch) or as required for load-carrying capacity per shelf.
 - B. Fabricate fronts and backs of shelves with box-formed edges, with corners lapped and welded.
 - a) Where required by Manufacturer to meet loading requirements, fabricate fronts and backs of shelves with vertical edges that are flanged and returned, with edges reinforced with steel bars or channels.
 - 6. Shelf-to-Post Connectors: Compression clips.
 - 7. Base: Closed, with base strips fabricated from same material and with same finish as shelving.
 - 8. Metal Storage Shelving Schedule: (Width x Depth x Height)
 - a. MS-1: 48" x 18" x 84"
 - b. MS-2: 36" x 24" x 84"
 - c. MS-3: 48" x 24" x 84"

9. Finish: powder coat.
 - a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 FABRICATION

- A. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate metal storage shelving square and rigid, with posts plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.
 1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
 2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
 3. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
 4. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.
- C. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- D. Form edges and corners free of sharp edges or rough areas. Fold back and crimp exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side; ease edges of metal plate to radius of approximately 1/32 inch. Shear and punch metals cleanly and accurately. Remove burrs.
- E. Weld corners and seams continuously to develop strength, minimize distortion, and maintain the corrosion resistance of base metals. At exposed locations, finish welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces before finishing.

2.4 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.

2.5 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" or SSPC-SP 8, "Pickling."
- B. Powder-Coat Finish: Manufacturer's standard Epoxy Polyester Hybrid powder coat applied in an electrostatic-charged powder coat factory spray-painting system. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine floors for suitable conditions where metal storage shelving will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
 - 1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
 - 2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
 - 3. Adjust post-base bolt leveler to achieve level and plumb installation.
 - 4. Install shelves in each shelving unit at spacing indicated on Drawings or, if not indicated, at equal spacing.
 - a. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

3.3 ERECTION TOLERANCES

- A. Erect four-post metal storage shelving to a maximum tolerance from vertical of 1/2 inch in up to 10 feet of height, not exceeding 1 inch for heights taller than 10 feet.

3.4 ADJUSTING

- A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.
- B. Adjust and lubricate operable components to operate smoothly and easily, without binding or warping. Check and readjust operating hardware.
- C. Touch up marred finishes or replace metal storage shelving that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal storage shelving manufacturer.
- D. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 105613

SECTION 107316 - PREFABRICATED CANOPY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes design, fabrication and installation of complete welded, extruded aluminum wall mounted canopies. All work shall be in accordance with the drawings and this specification.
 - 1. Manufacturer's standard building components and accessories may be used, provided components, accessories, and complete structure conform to design indicated and specified requirements.
- B. Custom extruded aluminum canopies as shown on drawings at entrance.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Engineer, design, fabricate and erect the pre-engineered building system to withstand loads from winds, gravity, structural movement including movement thermally induced, and to resist in-service use conditions that the building will experience, including exposure to the weather, without failure.
- B. Submittals:
 - 1. Product Data: Submit manufacturer's product information, specifications and installation instructions for building components and accessories.
 - 2. Shop Drawings: Submit complete shop drawings including all necessary plan dimensions, elevations and details. Contractor shall verify all dimensions and provide elevations at each column, finish floor, and related soffit before releasing to manufacturer for fabrication.
 - 3. Certification: Submit design calculations signed and sealed by a Registered Professional Engineer. Design calculations shall state that the protective cover system design complies with the wind requirements of ANSI/ASCE 7-88, the stability criteria of applicable building code, and all other governing criteria. Engineer to be registered in state where project is located.
- C. Quality Assurance:
 - 1. Protective cover shall be wholly produced by a recognized manufacturer with at least **10** years experience in the design and fabrication of extruded aluminum protective cover system. Components shall be installed by manufacturer. Protective cover system, including material and workmanship, shall be warranted from defects for a period of one year from substantial completion.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

- A. Basis of Design: Subject to compliance with requirements, provide **Mapes Architectural Products; Super Lumideck**, or comparable product by one of the following:
 - 1. Dittmer Architectural Aluminum
 - 2. Peachtree Protective Covers
 - 3. E.L. Burns Co., Inc.

2.2 DESIGN

- A. Protective cover shall be all welded extruded aluminum system complete with internal drainage. Non-welded systems are not acceptable. Roll formed deck is not acceptable. Expansion joints shall be included to accommodate temperature changes of 120°F.

2.3 MATERIALS

- A. Aluminum Members: All sections shall be extruded aluminum 6063 alloy, Heat treated to a T-6 Temper.
- B. Fasteners: Fasteners shall be aluminum, 18-8 stainless steel, 300 series stainless steel, or 410 stainless steel.
- C. Protective coating: Aluminum columns embedded in concrete or solid grouted cmu shall be protected by clear acrylic.
- D. Grout:
 - 1. Portland Cement: ASTM C 150, Type 1.
 - 2. Sand: ASTM C 404.
 - 3. Water: Potable
- E. Gaskets: Gaskets shall be dry seal santoprene pressure type.
- F. Aluminum Flashing: ASTM B 209, Type 3003 H14, 0.040 inch, minimum.

2.4 COMPONENTS

- A. Beams: Beams shall be open-top tubular extrusion of size and shape shown on drawings, top edges thickened for strength and designed to receive deck members in self-flashing manner. Extruded structural ties shall be installed in tops of all beams.
- B. Deck: Deck shall be extruded self-flashing sections interlocking into composite unit with sufficient chamber to offset dead load deflection and cause positive drainage. Welded plates shall be used as closures at deck ends.
- C. Fascia: Fascia shall be manufacturer's standard shape. Size as indicated on drawings.
- D. Flashing: Flashing shall be .040 aluminum (min.). All thru-wall flashing by others.
- E. Hanger rods: Manufacturer's standard, as required to comply with structural performance requirements.

2.5 FABRICATION

- A. Bent Construction: Beams and columns shall be factory welded with neatly mitered corners onto one-piece rigid bents. All welds shall be smooth and uniform using an inert gas shielded arc. Suitable edge preparation shall be performed to assure 100% penetration. Grind welds only where interfering with adjoining structure to allow for flush connection. Field welding is not permitted. Rigid mechanical joints shall be used shipping limitations prohibit the shipment of fully welded bents.
- B. Deck Construction: Deck shall be manufactured of extruded modules that interlock in self-flashing manner. Interlocking joints shall be positively fastened at 8²⁰.C. creating a monolithic structural unit capable for developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Deck shall be assembled with sufficient camber to offset dead load deflection.

2.6 FINISHES

- A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear top coat. 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 Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Erection shall be performed after all curtain wall, EIFS and roofing work in the vicinity is complete and cleaned.
- B. Contractor shall verify and approve dimensions and elevations shown on shop drawings with actual field dimensions to verify conditions are satisfactory for installation.

3.2 INSTALLATION

- A. Column Sleeves: Column sleeves (styrofoam blockouts) or anchor bolts (if required) shall be furnished by the protective manufacturer and installed by Contractor.
- B. Erection: Protective cover shall be erected true to line, level and plumb. Aluminum columns embedded in concrete shall be filled with grout to the discharge level to prevent standing water. Non-draining columns shall have weep holes installed at top of concrete to remove condensation.
- C. Coordination: Coordinate installation with other trades as necessary for a complete and operable installation.

3.3 CLEANING

- A. All protective cover components shall be cleaned promptly after completion of installation.

3.4 PROTECTION

- A. Extreme care shall be taken to protect materials during and after installation.

END OF SECTION 107316

SECTION 107500 - FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes One (1) aluminum ground-mounted flagpole as designated on Civil drawings.
- B. Owner-Furnished Material: Flags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpole.
- B. Shop Drawings: For flagpoles. Include plans, elevations, details, and attachments to other work. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
 - 1. Include section, and details of foundation system for ground-mounted flagpoles.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Flagpole; a Kearney-National Inc. company.
 - 2. Atlantic Fiberglass Products, Inc.
 - 3. Baartol Company.
 - 4. Concord Industries, Inc.
 - 5. Eder Flag Manufacturing Company, Inc.
 - 6. Ewing Flagpoles.

7. Lingo Inc.; Acme Flagpole Company Division.
8. Millerbernd Manufacturing Company.
9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
10. PLP Composite Technologies, Inc.
11. Pole-Tech Company Inc.
12. U.S. Flag & Flagpole Supply, LP.
13. USS Manufacturing Inc.

2.2 FLAGPOLES

- A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
 1. Fabricate shop and field joints without using fasteners, screw collars, or lead caulking.
 2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
 3. Provide self-aligning, snug-fitting joints.
- B. Exposed Height: 30 feet.
- C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, not less than 0.064-inch- nominal wall thickness. Provide with 3/16-inch steel bottom plate and support plate; 3/4-inch-diameter, steel ground spike; and steel centering wedges welded together. Galvanize steel after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.
 1. Provide flashing collar of same material and finish as flagpole.

2.3 FITTINGS

- A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
 1. 0.063-inch spun aluminum with gold anodic finish.
- B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
 1. Halyard Flag Snaps: Provide two bronze swivel snap hooks per halyard.
 - a. Provide with neoprene or vinyl covers.

2.4 MISCELLANEOUS MATERIALS

- A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.
- B. Sand: ASTM C 33, fine aggregate.
- C. Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant complying with requirements in Division 07 Section "Joint Sealants" for Use NT (nontraffic) and for Use M, G, A, and, as applicable to joint substrates indicated, for Use O.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 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.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.
- B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
- C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
- D. Place concrete, as specified in Division 03 Section "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.
- E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION

- A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.
- B. Ground Set: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure. Install flagpole, plumb, in foundation tube.
 - 1. Foundation Tube: Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.
 - 2. END OF SECTION 107500

SECTION 113100 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Refrigeration appliances.
 - 2. Cleaning appliances.
- B. Related Sections:
 - 1. Section 112600 "Unit Kitchens" for small, compact kitchen units that include residential appliances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.
 - 1. Product Data for: For appliances indicated, documentation that products are ENERGY STAR rated.
- B. Product Schedule: For appliances.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain residential appliances from single source and each type of residential appliance from single manufacturer.

- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.7 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 REFRIGERATOR/FREEZERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [LG Appliances.](#)
 2. [Samsung.](#)
 3. [Sears Brands LLC \(Kenmore\).](#)
 4. [Whirlpool Corporation.](#)
- B. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.
 1. Basis-of-Design Product: Whirlpool Gold – WRT771REYM
 2. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 3. Appliance Color/Finish: Stainless steel.

2.2 CLOTHES WASHERS AND DRYERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. [LG Appliances.](#)
 2. [Samsung.](#)
 3. [Sears Brands LLC \(Kenmore\).](#)
 4. [Whirlpool Corporation.](#)
- B. Clothes Washer CW #: Complying with ASSE 1007.
 1. Type: Stacking, front-loading unit.
 2. Basis-of-Design Product: Whirlpool Duet – WFW70HEBW
 3. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
 4. Water-Efficient Clothes Washer: Provide clothes washer with modified energy factor greater than or equal to 2.0 and water factor less than 5.5.
 5. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides.
 - a. Color: White.

6. Front-Panel Finish: Manufacturer's standard.
 - a. Panel Color: White.
- C. Clothes Dryer: Complying with AHAM HLD-1.
 1. Type: Stacking, frontloading, electric unit.
 2. Basis-of-Design Product: Whirlpool Duet – WED70HEBW
 3. Features:
 - a. Stacking kit to stack dryer over washer.
 4. Appliance Finish: Porcelain enamel on top and lid; baked enamel on front and sides.
 - a. Color: White.
 5. Front-Panel Finish: Manufacturer's standard.
 - a. Panel Color: White.

2.3 MICROWAVE OVENS

- A. Manufacturer's: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
 1. [LG Appliances.](#)
 2. [Samsung.](#)
 3. [Sears Brands LLC \(Kenmore\).](#)
 4. [Whirlpool Corporation.](#)
- B. Microwave Oven – Provide 1 at Teacher's Lounge C112
 1. Basis-of-Design Product: Whirlpool – WMC50522AS.
 2. Material: Stainless steel.

2.4 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- C. Utilities: Comply with plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

- A. 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.
- B. Tests and Inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- C. An appliance will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113100

SECTION 11 4000**FOODSERVICE EQUIPMENT****PART 1 - GENERAL****1.01 DESCRIPTION**

- A. Scope: Furnish all labor, materials, services, equipment and appliances required to provide and deliver all foodservice equipment hereinafter specified into the building, uncrate, assemble, hang, set-in-place, level, and completely install, exclusive of final utility connections.
- B. Related Work Specified Elsewhere:
1. All plumbing, electrical and ventilating work required in conjunction with commercial foodservice equipment including rough-in to points indicated on mechanical drawings, and final connections from rough-in points, electrical service to points of connection and final connections shall be by Divisions 22, 23 and 26.
 2. Refrigeration work will be done by the Kitchen Equipment Contractor except for electrical connections to and between compressors, blower coils, controls, etc. These final connections shall be by Divisions 22 and 26.
 3. All traps, steam traps, grease traps, line strainers, tail pieces, valves, stops, shut-offs, and fittings necessary for equipment specified will be furnished and installed under mechanical contract by Division 22 unless specifically called for otherwise under each item.
 4. All line and disconnect switches, safety cut-offs and fittings, convenience boxes or other electrical controls, fittings and connections will be furnished and installed under electrical contract by Division 26, unless specifically indicated otherwise in the item specifications. Starting switches for certain specified pieces of foodservice equipment are to be provided by Kitchen Equipment Contractor. Those starting switches, if furnished loose as standard by Foodservice Manufacturers (other than fabricated items), shall be mounted and wired complete under Division 26.
 5. Any sleeves or conduit required for refrigeration, syrup tubing, or carbonation tubing will be furnished and installed under Division 22.
 6. Unless specifically called for in the Item Specifications, ventilating fans and all duct work between same and ceiling rough-in openings, and from same to discharge opening in building will be furnished and installed by Division 22.

1.02 DEFINITIONS

- A. All references to the terms "Contractor", "Kitchen Equipment Contractor", or "K.E.C." in the specifications and/or on the drawings shall be defined to mean the Kitchen Equipment Contractor.
- B. All references to the term "Owner" in the specifications and/or on the drawings shall be defined to mean the Owner or Owner's designated representative and the Foodservice Equipment Consultant.
- C. All references to the term "Consultant" or "Foodservice Equipment Consultant" in the specifications and/or on the drawings shall be defined to mean **NYIKOS ASSOCIATES, INC.** its employees, and authorized representatives and is referred to throughout the contract documents as if singular in number and masculine in gender.
- D. The phrase "The K.E.C. shall" or "by the K.E.C.", as applicable, is understood to be included as a part of each sentence, paragraph or article of these specifications unless otherwise indicated or specified.

1.03 QUALITY ASSURANCE

- A. Qualification of Suppliers:
1. Commercial foodservice equipment suppliers shall submit satisfactory evidence of compliance with the following qualifications and conditions to be approved.
 - a. Successful completion of jobs of comparable scope.
 - b. Have manufacturer's authorization to distribute and install specified factory items of equipment.
 - c. Maintain a permanent staff experienced in the installation of foodservice equipment and preparation

- of professional style rough-in drawings and brochures.
- d. Maintain or have access to fabrication shop meeting N.S.F. requirements. If other than foodservice equipment suppliers own fabrication shop, obtain Consultant approval of fabrication shop desired to be used.
 - e. Maintain or have access to a readily available stock of repair and replacement parts, together with authorized service personnel.
- B. Qualification of Fabricators:
1. Fabricators shall be an N.S.F. approved organization with trained personnel and facilities to properly design, detail and fabricate equipment in accordance with the specifications and standard details contained herein.
 2. Custom fabricated equipment shall bear the National Sanitation Foundation seal of approval and listed as such under N.S.F. Standards No. 2 and No. 33.
 3. Only one (1) fabricator shall be used for this project, and all equipment will be fabricated at the same shop. Where units cannot be fully shop-fabricated, complete fabrication at project site.
 4. Acceptable fabricators are:
 - a. Pro Stainless, Inc.; Keyser, WV
 - b. Commercial Stainless, Inc.; Bloomsburg, PA
 - c. Keystone Custom Fabricators, Inc.; Elizabeth, PA
 - d. Eagle Spec Fab; Symrna, DE
 - e. Select Stainless Inc.; Matthews, NC
 - f. Other fabricators, as approved by Consultant.
- C. Qualification of Manufacturers:
1. Manufacturers shall be regularly engaged in the production of items furnished and shall have demonstrated the capability to furnish similar equipment that performs the functions specified or indicated herein.
- D. Standard Products:
1. Materials, products, and equipment furnished under this contract shall be the standard items of manufacturers regularly engaged in the production of such materials, products, and equipment and shall be of the manufacturer's latest design that complies with the specifications which have been produced and used successfully on other projects and in similar applications.
 2. Discrepancies within contract documents should immediately be brought to the attention of the Consultant in writing for clarification prior to fabrication or ordering of standard items.

1.04 PLANS & SPECIFICATIONS

- A. Specifications and drawings have been prepared to form the basis for procurement, erection, start-up and adjustment of all equipment in this contract. Plans and specifications shall be considered as mutually explanatory and work required by one, but not the other, shall be performed as though required by both. Items required by one, but not by the other shall be provided as though required by both. Work shall be accomplished as called for in specifications and shown on drawings, so that all items of equipment shall be completely functional for purpose for which they were designed. When there is any discrepancy between drawings and specifications, drawings shall govern. Bidders should seek clarification of any discrepancies from the Consultant prior to bidding.

1.05 SUBMITTALS

- A. General Requirements:
1. Within six (6) weeks or earlier, as required, assemble and submit all shop drawings, rough-in drawings, brochures, color samples, etc. as a complete package. There will be no review of partial submittals.
 2. Any and all costs, to all trades and parties involved, arising from delay of project due to non-submittal of the complete package by the K.E.C. within a reasonable time period shall be borne solely by the K.E.C.
 3. Identify each submittal by project name, date, contractor, submittal name, and any other necessary information to distinguish it from other submittals.
- B. Shop Drawings:
1. Submit one (1) set of paper sepia and one (1) set of bond prints on sheets equal in size to Contract Documents of equipment specified for custom fabrication including all accessories attached to each item.

2. Drawings shall be detailed and fully dimensioned to a minimum scale of 3/4"=1'-0" for plan and elevation views, and 1-1/2"=1'-0" for sections, based on the floor plan(s) and following item specifications. Drawings will be checked for thoroughness, accuracy, completeness, neatness, and returned for corrections, if necessary.
- C. Rough-in Drawings:
1. Submit one (1) set of paper sepia and one (1) set of bond prints on sheets equal in size to Contract Documents of detailed arrangement plans professionally prepared from architects dimensioned plans (not traced from Contract Documents) at a minimum scale of 1/4"=1'-0".
 2. Equipment Layout Plan showing arrangement of all items specified and identified on schedule of equipment listing item number, description, quantity, manufacturer, model number, and remarks.
 3. Ventilation Plan showing dimensioned locations of all duct openings for ventilators and dishmachines identifying size, c.f.m. required (exhaust and supply), static pressures, and connection heights.
 4. Plumbing/Electrical Plans showing dimensioned locations, sizes, elevations and capacities of all utility services required for each item of equipment in relation to finished walls, columns, and heights above finished floor.
 5. Special Conditions Plan showing exact dimensions and details of all masonry bases, floor depressions, critical partition locations/heights, wall openings, reinforcing for wall and/or ceiling mounted equipment, and conduit locations for soda and compressed gas lines.
- D. Equipment Brochures:
1. Submit two (2) hard bound copies of manufacturer's illustrations and technical data for approval prior to procurement. All items of Standard Manufacture shall be submitted, including items purchased to be built into fabricated equipment. Each illustration shall be marked to accurately describe the item to be furnished as specified. Include all deviations from standard information (i.e., voltage, phase, load, etc.).
 2. Include a separate information sheet ahead of each illustration sheet showing all service connection sizes, electrical requirements, loads, consumptions, and all accessories specified.
 3. Manufacturer's suggested schematic drawings for connection of mechanical and electrical services for such items as booster heaters, disposers, or any other item of equipment that may require the same.
- E. Miscellaneous Shop Drawings:
1. Submit one (1) set of paper sepia and one (1) set of bond prints of manufactured equipment specified requiring clarification and approval such as, walk-in cooler/freezer drawings, ventilator drawings, utility raceway drawings, and refrigeration system drawings.
- F. Operation and Maintenance Manuals:
1. Submit four (4) sets bound in hard covered book form for all mechanically operated equipment of standard manufacture. Include operating and cleaning/maintenance instructions, parts listing, recommended parts inventory listing and purchase source, copy of warranties, and similar applicable information.
 2. Brochure covers shall bear the job name, date, and name of contractor.
- G. Manufacturer's List:
1. The K.E.C. shall submit in writing a list of all manufacturer's representatives of the food service equipment such as convection ovens, ranges, etc., and their authorized service agencies' addresses and telephone numbers; to be presented after submission of manufacture data.
- H. Samples:
1. Samples of materials, products, and fabrication methods, shall be submitted for approval upon request at no additional cost, before proceeding with work.
- I. Re-submission Requirements:
1. Shop Drawings:
 - a. Revise initial drawings as required and resubmit in accordance with submittal procedures.
 - b. Indicate on drawings all changes which have been made in addition to those requested by Consultant.
 2. Product Data and Samples:
 - a. Submit new data and samples as required for initial submittal.
 - b. Make all re-submittals within fourteen (14) working days from date of Consultants previous action.
- J. Approvals:

1. After approval of the submittals listed above, furnish as many prints and copies as are required for the various trades, the Owner, the Architect, and the Consultant.
2. The approval of the shop drawings will be general and shall not relieve the K.E.C. of responsibility for proper fitting, finishing, quantities, and erection of work in strict accordance with the contract requirements, nor does it relieve him of the responsibility of furnishing material and workmanship not indicated on approved shop drawings but required for the completion of his work.
3. Approval by the Consultant and/or Owner of the manufacturer's data submitted by the K.E.C. does not waive the responsibility of K.E.C. to furnish each item of equipment in complete compliance with the specifications and drawings. Discrepancies between Contract Documents and furnished equipment shall be corrected even after approval and installation of this equipment at no additional cost to the Owner.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. Equipment shall be delivered to the job site only after the building is weather-safe and vandal-safe.

B. Storage:

1. Store equipment in an area convenient to the point of installation in such a way that it can be protected from the weather and job hazards.

C. Protection:

1. Wrapping and protective coatings shall remain on all items until ready for use and in the case of stainless steel items, until installation is complete and the job is ready for cleaning.
2. Existing equipment not scheduled for removal but to remain within the construction area shall be wrapped with protective plastic and/or padding to prevent damage and shall remain on all items until installation is complete and the job is ready for cleaning.

D. Damage:

1. All responsibility shall rest with the K.E.C. for any damage or loss incurred prior to final acceptance. Such items as may be lost or damaged shall immediately be replaced or repaired to a new condition to the complete satisfaction of and at no additional cost to the Owner.

1.07 JURISDICTION TRADE AGREEMENTS AND RESTRICTIONS

- A. Include the work specified, shown or reasonably infer able as part of foodservice equipment. Portions of this work may be subcontracted to those qualified to do such work, as may be necessary because of jurisdictional trade agreements and restrictions.

1.08 REGULATIONS AND CODES

- A. Except as otherwise indicated, each item of equipment shall comply with the latest current edition of the following standards as applicable to the manufacture, fabrication, and installation of the work in this section.
 1. N.S.F. Standards: Comply with National Sanitation Foundation Standards and criteria, and provide N.S.F. "Seal of Approval" on each manufactured item and major items of custom-fabricated work.
 2. U.L. Standards: For electrical components and assemblies, provide either U.L. labeled products or, where no labeling service is available, provide a complete index of the components used as selected from the U.L. "Recognized Component Index".
 3. A.N.S.I. Standards: For gas-burning equipment, comply with A.N.S.I. Z21-Series standards. Comply with A.N.S.I. B57.1 for compressed gas cylinder connections and with applicable standards of the Compressed Gas Association for water connection air gaps and vacuum breakers.
 4. A.G.A.: All gas-fired equipment shall be A.G.A. Approved, equipped to operate on the type gas available at the job site and shall contain 100% automatic safety shut-off devices.
 5. N.F.P.A. Standards: Comply with N.F.P.A. Bulletin 96 for exhaust systems and with N.F.P.A. Bulletins 17, 17A & 96 and U.L. 300 for fire extinguishing systems.
 6. A.S.M.E. Code: Comply with A.S.M.E. boiler code requirements for steam generating and steam heated equipment. Provide A.S.M.E. inspection, stamps, and certification of registration with National Board.
 7. National Electric Code: Comply with N.E.C. Volume 5 for electrical wiring and devices included with foodservice equipment.
 8. All authorities having jurisdiction over this type of equipment and/or installation.

9. Where specifications and/or drawings require mechanical, electrical or refrigeration work to be performed, such work shall be done in strict conformance to other portions of the Base Building Specification which sets forth standards for this type of work.
10. Where there exists two standards or codes for one type of work, the stricter method shall govern.

1.09 WARRANTIES

- A. Warrantee in writing all equipment and fabrication against defects and workmanship for a period of two (2) years from date of acceptance.
 1. Each piece of mechanical equipment shall be listed, together with the authorized service and repair agency whom the Owner will call should malfunctions occur within the one-year (1) guarantee period.
- B. Refrigeration system compressors shall be warranted for five (5) years by the manufacturer. Free refrigeration service, including parts and labor, shall be furnished for two (2) years from date of acceptance.

1.10 JOB CONDITIONS

- A. Visit the job site to field check actual wall dimensions and roughing-in and shall be responsible for fabricating and installing the equipment in accordance with the available space and utility services as they exist on the job site.
- B. Check all door openings, passageways, elevators, etc., to be sure that the equipment can be conveyed to its proper location within the building and if necessary, check the possibility of holding wall erection, placement of doorjambs, windows, etc. for the purpose of moving the equipment to its proper location with the Contractor. Any removal and rebuilding of walls, partitions, doorjambs, etc. necessary to place the equipment, or if caused by incorrect information on the Contractor's drawings, shall be done at the expense of the K.E.C., at no additional cost to the Owner.
- C. Notify the Consultant and Owner before fabrication of equipment of any discrepancies between plans and specifications and actual conditions on the job.
- D. Before finished floors, walls, and/or ceilings are in place, physically check the location of all "rough-ins" at the job site. Report discrepancies in writing.
- E. Any changes required after fabrication has been started to ensure equipment accurately fitting the space as it exists and conforming to actual field dimensions on the job shall be made at no additional cost to the Owner.
- F. If special hoisting equipment and operators are required, include such cost as part of the bid for this work.

1.11 CHANGES IN THE WORK

- A. The Owner reserves the right to require reasonable modification to be made in the routing of work and relocation of equipment. This specifically refers to conditions where interference occurs or where more desirable accessibility can be obtained or whose materials cannot be installed because of structural or mechanical conditions encountered. Such changes shall be made at no additional cost to the Owner.

1.12 PATENTS

- A. Hold harmless and save the Owner and its officers, consultants, servants and employees from liability of any nature or kind, including costs and expenses for or on account of any copyrighted, patented, or un-patented invention, process, trademark, design, device, material, article, or appliance manufactured or used in the performance of the contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.
- B. If the Contractor has information that the process or article specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the Owner in writing. The contract price shall include all royalties or costs arising from the use of any or all of the above which are, in any way, involved in the contract.

1.13 CONTRACTOR'S WARRANTY

- A. The Contractor represents and warrants:
1. That he is financially solvent and that he is experienced in and competent to perform the types of work or to furnish the plans, materials, supplies or equipment, to be so performed or furnished by him.
 2. That he is familiar with all Federal, State, municipal, and department laws, ordinances, orders, and regulations, which may, in any way, affect the work of those employed therein, including, but not limited to, any special acts relating to the work or to the project of which it is a part.
 3. That such temporary and permanent work required by the contract as is to be done by him can be satisfactorily constructed and used for the purpose for which it is intended and that such construction will not injure any person or damage any property.
 4. That he has carefully examined the plans, specifications, addenda, if any, and the site of the work and that, from his own investigations, he has satisfied himself as to the nature and location of the work, the character, quality, and quantity of materials likely to be encountered, the character of equipment and other facilities needed for the performance of the work, the general and local conditions, and all other materials which may, in any way, affect the work or its performance.
 5. That he has satisfied himself as to the existing openings and accesses to the foodservice area through which his equipment shall be required to pass and that he is responsible for his equipment being delivered in as many sections as necessary to conform to the available space dictated by these existing limitations.

1.14 SUBSTITUTIONS

- A. Bids submitted shall be for the specific manufacturer and model, size, capacity, and accessories, as specified or shown on the drawings.
- B. The K.E.C. may quote upon brands and models of equipment other than those specified as a substitute. In the event that it is desired to request approval of substitute material, product, article, process, or item of equipment in lieu of that which is specified, submit a written request at least (10) working days prior to date of bids, setting forth the proposed substitution in detail, including an itemized analysis of the addition or deduction in the amount of the contract, if any, which will result if the substitution is approved. Each such request shall include a complete description of the proposed substitute, the name of the material or equipment for which it is to be substituted, drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation. If approved, bidders will be notified in the form of addendum.
- C. The Contractor shall be held responsible for additional costs to himself or any other prime contractor for changes required to install materials, devices, equipment, etc., which the Contractor has substituted for that specified.
- D. The Owner reserves the right to award a contract or contracts based upon the inclusion or exclusion of one or more of the alternate estimates. The description of all workmanship and materials under the various headings of the specifications shall have the same meaning and force when applied to similar workmanship and materials in the alternate. If the descriptions are not specific, the workmanship shall be the best quality and the materials the best commercial grade.
- E. Whenever any product is specified in the Contract Documents by reference to the name, trade name, make, or catalog number of any manufacturer or supplier, the intent is not to limit competition but to establish a standard of quality which is necessary for the project. Products of other manufacturers meeting the established criteria will be considered. However, please take note that the plumbing, electrical, steam, heating, ventilating, and air-conditioning drawings prepared by the consulting engineers, have been engineered based on the first product named under each item number designation. Therefore, any other product which is submitted for approval in lieu of the primary item specified, shall conform to the rough-in requirements established for the first product named, as well as physical size and building construction requirements.
- F. Any equipment listed which is not in accordance with the provisions of these specifications will be rejected. If the Contractor fails to submit for approval within the specified time the list of equipment as required herein, the Consultant shall then have the right to make the final equipment selection. The selection made by the Consultant shall strictly conform to these specifications and will be final and binding, and the items shall be furnished and installed by the Contractor without change in the contract price at the time of completion.
- G. It shall be the responsibility of the K.E.C. to prove that substitutions are equal to specified items. **NYIKOS ASSOCIATES, INC.** as the Owner's representative, shall be the determining authority as to the acceptability or equality of the substitutions. No substitutions shall be approved after bids are received.

1.15 DESIGN/MODEL CHANGE, DISCONTINUED ITEMS

- A. All equipment specified shall be of latest design. Any improvements made in design and construction of prefabricated items before equipment is actually delivered to the project site, shall be incorporated in equipment, at no additional cost, provided such incorporation does not delay delivery date of equipment.
- B. In the event of an item being discontinued after specified and prior to delivery to project site, the K.E.C. shall be responsible for notifying the Consultant in writing of the discontinued item and request an alternate of equal performance, including all accessories, at no additional cost to the Owner.

PART 2 - PRODUCTS**2.01 GENERAL**

- A. The equipment and its component parts shall be new and unused. All items of standard manufactured equipment shall be current models at the time of delivery. All parts subject to wear, breakage, or distortion shall be accessible for adjustment, replacement, and repair.
- B. Means shall be provided to ensure adequate lubrication for all moving parts. All oil holes, grease fittings, and filler caps shall be accessible without the use of tools.
- C. The design of the equipment shall be such as to provide for safe and convenient operation. Covers or other safety devices shall be provided for all items of equipment presenting safety hazards. Such guards or safety devices shall not present substantial interference to the operation of the equipment. All guards shall provide easy access to the guarded parts.
- D. Trim shall not be an acceptable substitute for accuracy and neatness. When trim is required and accepted by the Consultant and the Owner in lieu of rejection of items of equipment, it shall be the K.E.C.'s responsibility to provide same at no additional cost.
- E. Unless otherwise specified herein, no material lighter than #20 gauge shall be incorporated into the work. All gauges for sheet iron and sheet steel shall be U.S. Standard Gauges, and finished equipment gauge thickness shall not vary more than 5% plus or minus from the thickness indicated below.

<u>GAUGE</u>	<u>THICKNESS</u>	<u>GAUGE</u>	<u>THICKNESS</u>
#10	0.1406	#16	0.0625
#12	0.1094	#18	0.0500
#14	0.0781	#20	0.0375

- F. Materials or work described in words which have a well-known and acceptable trade meaning shall be held to refer to such accepted meanings.

2.02 MATERIALS

- A. Refrigeration Systems:
 - 1. Self-contained:
 - a. Whether the units be top-mounted or cabinet-mounted, they shall be started by the K.E.C. and shall be tested for maintenance of temperature.
 - b. All units shall be furnished with condensate evaporators.
 - 2. Remote: Provide and install complete refrigeration system(s), charged, started, and operating properly, according to the Item Specifications and the following.
 - a. Single stage compressors with air-cooled condensers operating within the recommended range of suction discharge pressure of economical operation and within the required capacity.
 - b. All units shall be new and factory assembled, to operate with the refrigerant specified. Refrigerant R-404A shall be used for all medium and low temperature applications. Due to the unsettled nature of refrigerants, no refrigerant shall be used with a phase-out date of less than ten (10) years from the date of installation.
 - c. Compressors shall be accessible hermetic type, Copeland or approved equal, and shall be equipped with high-low pressure control, liquid line drier, sight glass, suction and discharge vibration eliminator, and head pressure control.
 - d. The system shall have a factory mounted and pre-wired control panel complete with main fused

- disconnect, compressor circuit breakers, contactors, and time clocks wired for single point power connection.
- e. The supporting frame shall be constructed of structural steel, fully welded, and protected against rust and corrosion with one (1) coat primer, and two (2) coats paint, unless otherwise specified.
 - f. Systems specified for outdoor installation shall be fully protected in a weather-proofed housing with louvered front panel and hinged top, constructed to resist rust and corrosion, and furnished with low ambient controls. Crankcase heater shall be provided with every compressor.
3. Where specifications call for pre-piped lines (i.e., from a fixture to a valve compartment, etc.), provide such work in strict conformance with other sections of the specifications which set forth standards for this type of work or in conformity with the requirements of the Board of Fire Underwriters or ASHRAE Standards, whichever is greater.
 4. Each refrigeration item specification is written to provide minimum specifications and scope of work. All refrigeration equipment shall be designed and installed to maintain the following general temperatures unless otherwise specified.

<u>TYPE</u>	<u>REFRIGERATORS</u>	<u>FREEZERS</u>
a. Walk-In	+35° F./1.7° C.	-10° F./-23.3° C.
b. Reach-In	+35° F./1.7° C.	-10° F./-23.3° C.
c. Undercounter	+35° F./1.7° C.	-10° F./-23.3° C.
d. Fabricated	+35° F./1.7° C.	-10° F./-23.3° C.
e. Cold Pans	+0° F./-17.8° C.	
f. Work Rooms	+50° F./10° C.	

5. Provide (including payment if subcontracted) all electrical and refrigeration components needed by the completed system and complete (or have completed by the respective trades) all connections of and to said components.
6. An evaporator coil defrost system shall be provided and installed by the K.E.C. on all refrigeration systems designed to operate at an evaporator coil temperature of less than +35° F. Evaporator coil units provided without electric defrost feature shall be installed with a solenoid valve in the liquid line, controlled by the time clock so as to shut off the flow of refrigerant and allow the compressor to pump down and shut off by activation of the pressure control switch.
7. Verify the requirements of and provide any or all additional refrigeration specialty(s) or component(s) required or recommended by the manufacturer for proper operation under the specific operating conditions and location of each system specified.
8. Verify and provide manufacturer's certification that the equipment selection hereinafter specified for each refrigeration system is properly sized and shall meet the operating requirements set forth for each system regarding maintaining specified operating temperature, hours of compressor running time, and system pressures and velocities as recommended by the equipment manufacturer(s).
9. All refrigeration systems shall be installed and wired in strict conformance with the manufacturer's instructions and recommendations.

B. Motors and Heating Elements:

1. Motors up to and including 1/2 HP shall be wired for 120 volt, single phase service. Motors larger than 1/2 HP shall be wired for 208 volt, single or three phase service as indicated. Motors shall be of the drip-proof, splash-proof, or totally enclosed type, having a continuous duty cycle and ball bearings, except small timing motors which may have sleeve bearings. All motors shall have windings impregnated to resist moisture. Motors located where subject to deposits of dust, lint, or other similar matter shall be of the totally enclosed type. Motors shall have ample power to operate the machines for which designated under full load operating conditions without exceeding their nameplate ratings. Insulation shall be N.E.M.A. Class B or better.
2. Heating elements having a connected load up to and including 1,000 watts shall be wired for 120 or 208 volt, single phase service, or as indicated on the drawings.
 - a. Any heating element larger than 1,000 watts or any combination of elements in one fixture totaling more than 1,000 watts shall be wired for 208 volt single or three phase service, as indicated on the drawings.
 - b. Fixtures having multiple heating elements may be wired for three phase service with the load balanced as equally as possible within the fixture.

C. Switches and Controls:

1. Provide recognized commercial grade signals, "on-off" pushbuttons or switches, and other speed and temperature controls as required for operation of each item, complete with pilot lights and permanent graphics, conspicuously labeled, to assist the user of each item.
 2. Mount switches and controls directly adjacent the piece of equipment for which it involves, on operator's side of counter body apron, out of view to the public.
 3. Provide on or for each motor-driven appliance or electrical heating or control unit, a suitable control switch or starter of the proper type and rating and in accordance with Underwriter's Code wherever such equipment is not built in. All other line switches, safety cut-outs, control panels, fuse boxes, other control fittings and connections, when not an integral part of the unit or furnished loose by the manufacturer will be furnished and installed by the Electrical Contractor, unless otherwise specified. All electrical controls, switches, or devices provided loose for field installation as a part of the item specified shall be installed in the field by the Contractor unless otherwise specified.
 4. Appliances shall be furnished complete with motors, driving mechanisms, starters, and controllers, including master switches, timers, cut-outs, reversing mechanisms, and other electrical equipment if and as applicable.
- D. Cover Plates:
1. All controls mounted on vertical surfaces of fixtures shall be set into recessed die stamped stainless steel cups, or mounted onto removable cover plates in such a fashion as to not protrude or interfere with the operation of each item.
 2. Cover plates shall be furnished and installed for all electrical outlets, receptacles, switches and controls furnished by the K.E.C., and shall match the material and finish of the equipment to which they will be fastened.
- E. Wiring and Conduit:
1. Wiring shall be properly protected in N.E.M.A. and U.L. approved metal enclosures. Only rigid steel conduit shall be used, zinc coated where unexposed and chrome plated where exposed. All wiring shall be run concealed wherever possible.
 2. All equipment furnished under this contract shall be so wired, wound, or constructed so as to conform with the electrical characteristics at the job site.
 3. Wiring and connection diagrams shall be furnished with electrically operated machines and for all electrically wired fabricated equipment.
 4. Furnish all foodservice equipment completely wired internally using wire and conduit suitable for a wet location. Where an Electrician's services are required, the work shall be done in the K.E.C.'s factory or at his expense at the job site at no additional cost to the Owner. Provide all electrical outlets and receptacles required to be mounted on or in fabricated equipment and interconnect to a master circuit breaker panel with all wires neatly tagged showing item number, voltage characteristics, and load information. Final connection shall be made by the Electrical Contractor.
- F. Cords, Plugs, and Receptacles:
1. The Electrical Contractor shall provide three- or four-wire, grounding-type receptacles for all wall and floor mounted outlets to be used for plug-in equipment with characteristics as noted on the drawings. Provide Hubbell three-wire or four-wire grounding-type connectors and neoprene cords installed on each item of plug-in equipment, as indicated on drawings and item specifications.
 2. K.E.C. shall coordinate with the Electrical Contractor so that the receptacles provided will match the specific plugs provided as part of the plug-in equipment. Any changes in cords and plugs required in the field due to lack of coordination between the Electrical Contractor and the K.E.C. shall be the latter's responsibility.
 3. Reduce the length of all cords furnished with the specified equipment to a suitable or appropriate length so they do not interfere with other equipment or operations.
 4. Pedestal receptacles that are part of fabricated equipment exposed to view, shall be similar to T&S Model #B-1508DD single face, single gang or Model #B-1528DD single face, double gang.
- G. Water Inlets:
1. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be placed on the fixture to form a part of same to prevent siphoning. Where exposed to view, piping and fittings shall be chrome-plated.

H. Drain Lines:

1. Plumbing Contractor shall provide and install indirect waste lines from equipment which will discharge into floor drains or safe wastes in accordance with Plumbing Rough-In Plans, chrome-plated where exposed. Extend to a point at least 1" (or as required by local codes) above the rim of the floor drain, cut bottom on 45° angle and secure in position.
2. All horizontal piping lines shall be run at the highest possible elevation and not less than 6" above finished floor, through equipment where possible.
3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks of more than one thread at the fitting.
4. All steam operating valves on or in fabricated and purchased foodservice equipment shall be provided with composition hand wheels, which shall remain reasonably cool in service.
5. Provide suitable pressure regulating valves for all equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions.

I. Faucets, Valves and Fittings:

1. All sinks shall be fitted with chromium plated, swing spout faucets of same manufacturer throughout as follows, or otherwise specified in Item Specifications.
 - a. Prep and Utility Sinks:
 - 1.) Splash-Mounted:
 - a.) T&S Brass and Bronze Works, Inc., Model #B-231.
 - b.) Fisher Manufacturing Company, Model #3253.
 - 2.) Deck-Mounted:
 - a.) T&S Brass and Bronze Works, Inc., Model #B-221.
 - b.) Fisher Manufacturing Company, Model #3313.
 - b. Pot Sinks:
 - 1.) Splash-Mounted:
 - a.) T&S Brass and Bronze Works, Inc., Model #B-290.
 - b.) Fisher Manufacturing Company, Model #5214.
2. Pre-Rinse Assemblies:
 - a. Splash-Mounted:
 - 1.) T&S Brass and Bronze Works, Inc., Model #B-133 with #B-109 wall bracket.
 - 2.) Fisher Manufacturing Company, Model #2210 with #2902-12 wall bracket.
 - b. Deck-Mounted:
 - 1.) T&S Brass and Bronze Works, Inc., Model #B-143 with #B-510 mixing valve and #B-109 wall bracket.
 - 2.) Fisher Manufacturing Company, Model #2810 with #2805-CV mixing valve and #2902-12 wall bracket.
3. Vacuum Breakers:
 - a. General Use:
 - 1.) Fisher Manufacturing Company, Model #3990-8000.
 - b. Disposers:
 - 1.) Splash-Mounted:
 - a.) T&S Brass and Bronze Works, Inc., Model #B-455.
 - b.) Fisher Manufacturing Company, Model #3990.
 - 2.) Deck-Mounted:
 - a.) T&S Brass and Bronze Works, Inc., Model #B-456.
 - b.) Fisher Manufacturing Company, Model #3991.
4. Trough Inlets:
 - a. Fisher Manufacturing Company, Model No. #2905.
5. Other specialty faucets, pre-rinse assemblies, vacuum breakers, and trough inlets, as specified under Item Specifications.
6. All sink compartments shall be fitted with 2" NPT male, chrome-plated, brass rotary waste valves complete with overflow assemblies and stainless steel strainers.
 - a. Prep and General Utility Sinks:
 - 1.) Fisher Manufacturing Company, Model #6100.
 - b. Pot Sinks:
 - 1.) Fisher Manufacturing Company, Model #6102.
7. Refer to Division 22 for all other fittings.

J. Metals and Alloys:

1. Stainless steel sheets shall conform to ASTM 240, Type 302, Condition A, 18-8, of U.S. Standard Gauges as previously indicated under paragraph 2.1.E.
 - a. All exposed surfaces shall have a No. 4 finish. A No. 2B finish shall be acceptable on surfaces of equipment not exposed to view.
 - b. All sheets shall be uniform throughout in color, finish, and appearance.
 - c. Rolled shapes shall be of cold rolled type conforming to ASTM A36.
2. Stainless steel tubing and pipe shall be Type 304, 18-8, having a No. 4 finish, and shall conform to either ASTM A213 if seamless or ASTM A249 if welded.
3. Where galvanized metal is specified, it shall be copper-bearing galvanized iron, cold-rolled, stretcher leveled, bonderized, re-rolled to insure a smooth surface, and used in the largest possible sizes with as few joints as necessary.
4. Galvanizing shall be applied to rolled shapes in conformance with ASTM A123, and to sheets in conformance with ASTM A526, coating designation G-90.

K. Castings:

1. Castings shall consist of corrosion resisting metal (white metal) containing not less than 30% nickel. All castings shall be rough ground, polished, and buffed to bright lustre and free from pit marks, runs, checks, burrs, and other imperfections. In lieu of corrosion resisting metal castings, die-stamped or cast 18-8 stainless steel will be acceptable.

L. Hardware and Casters:

1. All hardware shall be of heavy duty type, satin finished chromium plated brass, cast or forged or highlighted stainless steel of uniform design. All hardware shall be a well-known brand, and shall be identified by the manufacturer's name and model number for easy replacement of broken or worn parts.
2. Casters on custom-built equipment shall be heavy duty type, ball bearing, solid or disc wheel, with grease-proof rubber, neoprene, or polyurethane tire. Wheel shall be 5" diameter, minimum width of tread 1-3/16", minimum capacity per caster 250 pounds, unless otherwise noted.
 - a. Solid material wheels are to be provided with stainless steel rotating wheel guard.
 - b. All casters shall have sealed wheel and swivel bearings, polished plated finish and be N.S.F. approved.
 - c. All equipment specified with casters shall have a minimum of two (2) with brakes installed on opposite corners, unless otherwise noted.

M. Locks:

1. When specified, doors and drawers of all custom fabricated or manufactured equipment shall be provided with cylinder locks, disc tumbler type with stainless steel faceplate as manufactured by Standard-Keil Mfg. Co., or approved equal.
 - a. Provide two (2) sets of keys for each lock.
 - b. All locks shall be keyed alike, except at cashiers stations or unless otherwise specified.

N. Thermometers:

1. All fabricated refrigerated compartments shall be fitted with exterior mounted, adjustable, dial or digital thermometers with flush bezels, and shall be calibrated after installation.

O. Sealants:

1. Sealant, wherever required, shall conform to ASTM C 920; Type S Grade NS, Class 25, Use Nt, with characteristics that when fully cured and washed meets requirements of Food and Drug Administration Regulation 21 CFR 177.2600 and N.S.F. RTV-732 for use in areas where it comes in contact with food.
2. Dow-Corning #780 or General Electric "Silastic", or approved equal, in either clear or approved color to match surrounding surfaces and applied in accordance with sealant manufacturers recommendations for a smooth, sealed finish.

P. Millwork:

1. All millwork materials shall be free from defects impairing strength, durability, or appearance; straight and free from warpage; and of the best grade for their particular function. All wood shall be well-seasoned, kiln dried, and shall have an average moisture content of 8%, a max. of 10% and a min. of 5%.
2. Plywood and other woodwork of treatable species, where so required by code, shall be fire-retardant treated to result in a flame spread rating of 25 or less with no evidence of significant progressive combustion when

tested for 30 minutes duration under ASTM E84 and shall bear the testing laboratory mark on the surface to be concealed.

3. Concealed softwood or hardwood lumber shall be of poplar, douglas fir, basswood, red oak, birch, maple, beech or other stable wood and shall be select or better grade, unselected for color and grain, surfaced four sides, square-edged, and straight. Basswood may be used where fire-retardant materials are required.
4. Plywood for transparent finish shall conform to U.S. Product Standard PS-51-71, Type I (fully waterproofed bond), with architectural grade face veneers of species as specified, free of all pin knots, patches, color streaks and spots, sapwood, and other defects. Plywood designated to have plywood cores shall be of either 5 or 7 ply construction. Plywood so designated on the drawings and plywood not otherwise shown shall have a particleboard core, cross banding of veneers, and face and back veneers. Particleboard cores shall have a 45-pound density, except where the fire retardant treatment requires cores of lesser density.
5. Face veneers shall be matched for color and grain to produce balance and continuity of character. Mineral streaks and other discolorations, worm-holes, ruptured grain, loose texture, doze, or shake will not be permitted. Face veneer leaves on each surface shall be full-length, book-matched, center-matched, and sequence-matched. Surfaces shall be sequence and blueprint matched. Veneers not otherwise indicated shall be plain sliced. Backing veneers for concealed surfaces shall be of a species and thickness to balance the pull of the face veneers.
6. Hardwood plywood for painted surfaces shall conform to U.S. Product Standard PS-51-71, Type I, and shall have sound birch, maple or other approved close grain hardwood faces suitable for a paint finish.
7. Perforated hardboard shall be a tempered hardboard, 1/4" thick, conforming to Federal Specification LLL-B-810B, Type I, SIS, Finish B (primed), Design B (perforated), with 1/4" diameter holes spaced on 1" centers both ways.
8. Plywood for laminate assemblies shown or specified with plywood core shall be of the 5 or 7 ply construction with sanded close-grain hardwood face and back veneers, laminated with waterproof glue, in thickness shown, conforming to U.S. Product Standard PS-51-71.
9. Particle board for plastic laminate assemblies shown or specified with particle board wood core shall conform to U.S. Product Standard CS-236-66, Type 1, or 2, Grade B (45 pound density), class 2: except where fire-retardant treatment is required the density shall conform to the treatment requirements.

Q. Plastic Laminate:

1. Plastic laminate surfaces shall be laminated with thermosetting decorative sheets of the color, pattern, and style as selected by the Architect.
 - a. Horizontal surfaces shall be laminated with sheets conforming to Federal Specification L-P-508F, Style D, Type I (general purpose), Grade HP, Class 1, 1/16" thick, satin finish, with rough sanded backs.
 - b. Vertical surfaces shall be laminated with sheets conforming to Federal Specification L-P-598F, Style D, Type II, (vertical Surface), Grade HP, Class 1, non-forming, satin finish, 1/32" thick or heavier.
 - c. Curved surfaces shall be laminated from sheets conforming to Federal Specification L-P-508F, Style D, Type III (post-forming), Grade HP, Class 1, satin finish.
 - d. Balance sheets for backs in concealed locations shall be either reject material of the same type and thickness as the general purpose grade facing or may be .020" thick laminate backing sheets conforming to Federal Specification L-P-00508E, Style ND, Type V (backing sheet), Grade HP.
2. Adhesives:
 - a. For application of plastic laminate to wood substrates of horizontal surfaces shall be a phenolic, resorcinol, or melamine adhesive conforming to Federal Specification MMM-A-181C, producing a waterproof bond.
 - b. For applying plastic laminate to vertical surfaces shall be either a waterproof type or a water-resistant type such as a modified urea-formaldehyde resin liquid glue conforming to Federal Specification MMM-A-188C.
 - c. Contact adhesive will not be acceptable.

2.03 FABRICATION AND MANUFACTURE

A. Materials and Workmanship:

1. Unless otherwise specified or shown on drawings, all materials shall be new, of best quality, perfect, and without flaws. Material shall be delivered and maintained on the job in an undamaged condition.

2. Fabrication shall be equal to the standards of manufacture used by all first class equipment manufacturers, performed by qualified, efficient, and skilled mechanics of the trades involved.
3. All items of standard equipment shall be the latest model at time of delivery.
4. All fabricated work shall be the product of one manufacturer of uniform design and finish.
5. Each fabricated item of equipment shall include all necessary reinforcing, bracing, and welding with the proper number and spacing of uprights and cross members for strength.
6. Wherever standard sheet sizes will permit, the tops of all tables, shelves, exterior panels of cabinet type fixtures, and all doors and drainboards shall be constructed of a single sheet of metal.
7. Except where required to be removable, all flat surfaces shall be secured to vertical and horizontal bracing members by welding or other approved means to eliminate all buckle, warp, rattle, and wobble. All equipment not braced in a rigid manner and which is subject to rattle and wobble shall be unacceptable, and the K.E.C. shall add additional bracing in an approved manner to achieve acceptance.

B. Sanitary Construction:

1. All fabricated equipment shall be constructed in strict compliance with the standards of the National Sanitation Foundation as outlined in their Bulletin on Food Service Equipment entitled "Standard No. 2" dated October 1952, and in compliance with the local and State Public Health Regulations in which the installation will occur.
2. All fabricated equipment shall bear the N.S.F. "Seal of Approval".

C. Construction Methods:

1. Welding:
 - a. All welding shall be the heliarc method with welding rod of the same composition as the sheets or parts welded. Welds shall be complete, strong, and ductile with excess metal ground off and joints finished smooth to match adjoining surfaces; free of mechanical imperfections such as gas holes, pits, cracks, etc., and shall be continuously welded so that the fixtures shall appear as one-piece construction. Butt welds made by spot solder and finished by grinding shall not be acceptable.
 - b. Spot welds shall have a maximum spacing of 3". Tack welds shall be of at least 1/4" length, and spaced no greater than 4" from center to center. Weld spacing at the ends of the channel battens shall not exceed 2" centers.
 - c. In no case shall soldering be considered as a replacement for welding, nor shall any soldering operation be done where dependence is placed on stability and strength of the joint.
 - d. Fixtures shall be shop fabricated of one piece and shipped to the job completely assembled wherever possible. Equipment too large to transport or enter the building in one piece shall be constructed so that the field joints can be welded at the job site.
 - e. All exposed joints shall be ground flush with adjoining material and finished to harmonize therewith. Whenever material has been sunk or depressed by welding operation, depression shall be suitably hammered and peened flush with the adjoining surface and ground to eliminate low spots. In all cases the grain of rough grinding shall be removed by successive fine polishing operations.
 - f. All unexposed welded joints on undershelves of tables or counters of stainless steel shall be suitably coated at the factory with an approved metallic-based paint.
 - g. After galvanized steel members have been welded, all welds and areas where galvanizing has been damaged shall have a zinc dust coating applied in conformance with Military Specification Number MIL-P-26915.
2. Joints:
 - a. Butt joints and contact joints wherever they occur, shall be close fitting and shall not require a filler. Wherever break bends occur, they shall be free of undue extrudence and shall not be flaky, scaly, or cracked in appearance; where such breaks do mar the uniform surface appearance of the material, all such marks shall be removed by suitable grinding, polishing, and finishing. Wherever sheared edges occur, they shall be free of burrs, fins, and irregular projections and shall be finished to obviate all danger of laceration when the hand is drawn over them. In no case shall overlapping materials be acceptable where miters or bullnosed edges occur.
 - b. Field welded joints shall be ground smooth without dips and irregularities and finished to match original finish.
3. Bolt, Screw and Rivet Construction:
 - a. All exposed surfaces shall be free from bolt and screw heads. When bolts are required, they shall be of the concealed type and be of similar composition as the metal to which they are applied.
 - b. Where bolt or screw threads on the interior of fixtures are visible or may come into contact with hands

- or wiping cloths, they shall be capped with a stainless steel or chrome acorn nut and stainless steel lock washer.
 - c. If rivets are used to fasten rear paneling to the body of the fixture, such rivets shall be stainless steel. In no case shall iron rivets be used.
 - 4. Sound Deadening:
 - a. Schnee Butyl-Sealant 1/2" wide rope continuously between all frame members and underside of stainless steel table tops, overshelves and undershelves.
 - a. Tighten stud bolts for maximum compression of sealant.
 - 5. Hi-Liting:
 - a. All horizontal edges of stainless steel tops, splashes, tops of raised rolled rims, and edges of all exposed doors, handles and shelf edges shall be hi-lited, in uniform design by grinding with abrasive not coarser than #240 grit, then polishing with compound to a uniform mirror finish.
 - 6. Polishing:
 - a. The grain of polishing shall run in the same direction on all horizontal and on all vertical surfaces of each item of fabricated equipment except in the case where the finish of the horizontal sections of each shall terminate in a mitered edge.
 - b. Where sinks and adjacent drainboards are equipped with backsplash, the grain of the polishing shall be consistent in direction throughout the length of the backsplash and sink compartment.
 - 7. Finishes:
 - a. Paint and coatings shall be of an N.S.F. approved type suitable for use in conjunction with foodservice equipment. Such paint or coating shall be durable, non-toxic, non-dusting, non-flaking and mildew resistant, shall comply with all governing regulations, and shall be applied in accordance with the manufacturers recommendations.
 - b. All exterior, galvanized parts, exposed members of framework, and wrought steel pipe where specified to be painted shall be cleaned, primed with rust inhibiting primer, de-greased, and finished with two (2) coats of glossy enamel grey hammertone paint, unless otherwise noted.
 - c. Where baked enamel finishes are specified, they shall be oven baked on the fixtures for a minimum of 1-1/2 hours at a minimum temperature of 300° F.
 - d. Fabricated equipment shall be spray coated with plastic suitable for protecting the equipment during transport and installation. The coating shall be easily removable after the equipment installation is complete at the job site, and final clean-up has begun.
- D. Construction:
1. Legs:
 - a. All tubular stands for open base tables, sinks, or dishtables shall have legs constructed of 1-5/8" O.D. stainless steel tubing, with 1-1/4" O.D., #16 gauge stainless steel crossbracing running between legs at a point 10" above finished floor.
 - b. All joints between legs and crossbracing shall be welded and ground smooth, full 360°.
 - c. The top end of legs shall be closely fitted into fully-enclosed stainless steel conical gussets no less than 3" high, similar to Klein #481-58 or #483-58, or approved equal.
 - d. Gussets shall be fully welded to framing reinforcing members, so that, set screw is not visible from front.
 - e. Legs without crossrails will not be accepted.
 - f. Legs shall be spaced at not more than 5'-6" on centers, unless otherwise specified.
 2. Feet:
 - a. All tubular legs will be swedged for appearance and close fit to United Show Case #BF-158, or approved equal, fully enclosed, stainless steel bullet-shaped foot.
 - 1.) The foot shall be threaded into a collar and completely welded inside the tubular leg to permit a maximum adjustment of 2" without any thread exposure.
 - 2.) Threads shall be National Course Series Class 2 fit or better, machined to prevent end play when foot is at maximum adjustment.
 - 3.) The bullet-shaped foot shall have slightly rounded bottom to protect the floor, and a minimum bearing surface of 3/4" diameter of stainless steel-to-floor contact.
 - 4.) Bottom of tubular leg shall be finished off smoothly to provide a sanitary fitting and prevent the accumulation of grease or other debris.
 - b. Cabinet type fixtures shall be mounted on 8" high die-stamped, sanitary, two-piece stainless steel legs no less than 2-3/4" in diameter at the top, Component Hardware #A72-0811, or approved equal.
 - 1.) The bottom fully enclosed, stainless steel, bullet-shaped foot threads up into the inside of the

- upper member, with a male threaded 5/8" bushing to permit maximum adjustment of 2" without thread exposure.
- 2.) The upper section shall be stamped in a neat design with a flared inverted shoulder and fully welded to a base plate designed for anchoring to the channel underbracing.
3. Table Tops:
- Tables shall be constructed of stainless steel, and of a thickness not less than #14 gauge with 1-3/4" by 120° rolled edges, or as otherwise specified and detailed.
 - All corners shall be bull-nosed and of the same radius as rolled edges.
 - Joints where required shall be butt-welded and ground smooth to present a uniform one-piece appearance.
 - All tops shall be reinforced on the underside with a fully welded framework of 1-1/2"x1-1/2"x1/8" galvanized steel angles with the framing extending around the top perimeter and crossbraced on 24" maximum centers.
 - 1"x4"x1" galvanized or stainless steel, fully welded, cross channel, closed end members placed at each pair of legs with one (1) channel running lengthwise will also be acceptable.
 - All tops shall be reinforced so that there will be no noticeable deflection.
 - Metal tops where adjacent to walls or other items of equipment, shall be constructed with integral, coved, back and/or endsplashes as required and specified in accordance with the standard details contained herein. Close all ends of splashes.
4. Enclosed Bases:
- All enclosed bases or cabinet bodies shall be of seamless #18 gauge stainless steel construction, enclosed on the ends and sides as required and called for under each item.
 - Ends of body shall terminate at front or operator's side in a 2" wide mullion, vertical, and completely enclosed. All intermediate mullions shall be completely enclosed.
 - The bases shall be reinforced at the top with a framework of 1-1/2"x1-1/2"x1/8" galvanized angles, with all corners mitered and welded solid.
 - Underside of top shall be reinforced with channels and gussets where necessary. Additional angles and cross members shall be provided to reinforce shelves and support tops under heavy tabletop equipment.
 - Where sinks or other drop-in equipment occur, provide additional reinforcing extending crosswise, both sides of opening.
 - In the case of fixtures fitting against or between walls, the bodies shall be set in 1" or 2" from the wall line, with the tops continuing to the wall line with integral, coved splashes as specified. Extend vertical face of body to the wall line only. This will permit adjustment to wall irregularities. Vertical trim strips will not be accepted.
 - Bodies shall be fitted with counter style stainless steel legs as hereinbefore specified.
5. Drawers:
- Drawers, where specified, shall have removable pan inserts of #18 gauge stainless steel, and shall be approximately 20"x20"x5" deep unless otherwise specified.
 - Perimeter top edge shall be flanged out 1/2".
 - All interior horizontal corners shall be rounded on a 1" radius, and all interior vertical corners shall be rounded on a 2" radius.
 - Fronts shall be double pan #16 gauge stainless steel construction, 1" thick, insulated with a semi-rigid, fiberglass board, un-faced, having a three-pound density.
 - The top of the drawer face shall be formed as an integral pull by breaking the front pan back on a 45° angle 1", then straight up 1", back to front 1", and then down at the front 3/4".
 - Drawer front shall have all edges and corners ground smooth with a radius edge pull.
 - The drawer shall have an all welded frame of 1"x1", #16 gauge stainless steel angles sized to fit the removable pan insert.
 - Drawers shall operate on #12 gauge slides with roller bearings with hardened and ground raceways, Grant, Model #3320, or approved equal. Slides shall be pitched approximately 3/8" per foot to permit self-closing action.
 - Drawers shall be adequately and neatly fitted to the guides to permit easy operation without rattle or binding.
 - Slides and frame shall be reinforced to support a dead weight of 150 pounds when drawer is fully extended.
 - Adjustable stops shall be provided for each drawer at the fully-opened position, and be readily lift-able by hand for easy removal of drawer.

- h. All drawers not mounted inside a cabinet body shall be completely enclosed in an #18 gauge stainless steel box-type enclosure and suspended from angle framing under the fixture top. The housing bottom shall be flanged and welded to an #18 gauge stainless steel reinforcing channel extending across the open end.
6. Sliding Doors:
- a. Sliding doors shall be of the double pan type, with the exterior pan constructed of #18 gauge stainless steel with all four sides channeled and corners welded. The interior pan shall be similarly constructed of #20 gauge stainless steel, set into the exterior pan, and welded in place.
 - b. All doors shall be insulated with semi-rigid fiberglass board, un-faced, having a three-pound density. Styrofoam shall not be acceptable.
 - c. Doors 18" wide or greater, shall have internally welded 4" wide reinforcing channels to prevent warpage.
 - d. Each door shall be fitted with a positive flush-type stainless steel pull, Standard-Kiel #1262-1014-1283 recessed handle, or approved equal.
 - e. In the back of each door install a 1"x1", #16 gauge stainless steel angle stop welded in a suitable location to prevent the doors from overpassing the flush pulls.
 - f. Doors in the closed position shall overlap each other by no more than 2".
 - g. Each door shall be fitted with two (2), 1-3/8" ball bearing sheaves fastened to 1"x1/8" stainless steel bar stock welded to the top corners of each door for suspending on an overhead #16 gauge stainless steel channel track. The hangers shall be tapped for 1/4"-20 thumb screw vertical locks which prevent the doors from jumping the track in operation while permitting easy removal for cleaning without tools.
 - h. Insure that the bottom of the doors are positively and continuously guided to assure proper alignment and passing regardless of the position of each door.
 - i. Provide hard rubber bumpers for doors to close against to insure quiet operation.
7. Hinged Doors:
- a. Hinged doors shall be of the same materials and construction as sliding doors previously specified.
 - b. Hinges shall be heavy duty, stainless steel, removable type, and fastened by tapping into 1/4"x3/4" stainless steel bar stock inside the door pan and behind the door jamb.
 - c. The door face shall be flush with the cabinet body when fully closed.
 - d. Size widths of doors equally when installed in pairs, or in series with other pairs, with no door being greater than 36" in width.
 - e. Doors shall be held closed by permanent magnetic closure devices of an approved type and of sufficient strength to hold the doors shut. Install two (2) per door (minimum), mounted to the door jamb, top and bottom, with opposing chrome-plated steel plates securely fastened to the inner panel of the doors.
8. Undershelves:
- a. All open base tables shall be provided with full-length undershelves of #16 gauge stainless steel fully welded to legs with all joints ground smooth and polished.
 - b. Front edge shall turn down 1-1/2" and under 1/2".
 - c. Turn up rear and ends 2", with integral coved radius, when specified.
 - d. If required by width, provide 1-1/2"x1-1/2"x1/8" galvanized angle bracing mounted to underside, full length.
9. Interior Shelves:
- a. All interior shelves within cabinet bodies, enclosed bases and overhead cabinets, shall be of #16 gauge stainless steel.
 - b. Removable shelves shall be constructed in equal sections, and rest in 1-1/2"x1-1/2"x1/8" stainless steel angle frame. Cove all horizontal corners in accordance with N.S.F. requirements.
 - c. Stationary shelves shall have 2" turn-up on back and ends, and continuously welded to cabinet body, polished and ground smooth to form a one-piece interior free of any crevices.
 - d. Front edge shall turn down 1-1/2" and under 1/2", and finished with "z" bar forming completely enclosed edge for maximum strength and sanitation.
 - e. Provide 1-1/2"x1-1/2"x1/8" angle bracing mounted to underside, full length.
10. Elevated Shelves:
- a. Shelves over equipment not adjacent to a wall shall be mounted on 1" diameter #16 gauge stainless steel tubular standards neatly fitted with stainless steel base flanges, unless otherwise specified.
 - b. The top of the tubular standards shall be completely welded to #14 gauge stainless steel support channels, full width of overshelf.

- c. Inside the tubular standard, and welded to same, provide 1/2" diameter steel tension rod extended through countertop and securely anchored to lower framework reinforcing with nuts and lock washers in such a manner as to assure a stable, sway-free structure.
 - d. If required by width, provide 1-1/2"x1-1/2"x1/8" stainless steel angle bracing mounted to underside, full length.
 - e. Cantilevered shelves, when called for, shall be #16 gauge stainless steel supported on #14 gauge stainless steel brackets welded to 1-5/8" O.D. stainless steel tubular standards extending through the backsplash, and fully welded to the table framework. Provide Klein #481-SH welded sleeves where standards penetrate backsplash.
11. Wall Shelves:
- a. Open wall shelves shall be constructed of #16 gauge stainless steel with back and ends turned up 2", positioned 2" out from face of wall, with all corners welded, and supported on #14 gauge stainless steel brackets.
 - b. Brackets shall be flanged inward beneath the shelf and at the wall 1-1/2" with intersecting flanges completely welded, and attached to shelf with studs welded to the underside and bolted with stainless steel lock washers and chrome-plated cap nuts.
 - c. Each bracket shall be fastened to the wall with a minimum of two (2) 1/4"-20 stainless steel bolts anchored securely by means of toggles or expansion shields.
12. Sinks:
- a. All sinks shall be the size and shape as shown on drawings, and constructed of #14 gauge stainless steel with backs, bottoms and fronts formed of one continuous sheet and the ends welded in place.
 - b. Sinks shall have all corners, both vertical and horizontal, coved on a 3/4" radius electrically welded, ground smooth and polished. Solder in filleted corners will not be acceptable.
 - c. Multiple compartment sinks shall be divided with double wall, #14 gauge stainless steel partitions with a 1/2" radius on top and all corners rounded as other corners, continuously welded, ground smooth and polished.
 - d. The bottom of each compartment shall be creased to a die stamped recess, tapered and shaped to receive a lever type waste without the use of solder, rivets, or welding.
 - e. Provide #14 gauge stainless steel waste lever angle bracket mounted to underside of compartment at front.
 - f. The front and exposed ends of sinks shall be fabricated with a 1-1/2", 180° rolled edge. The back and ends adjacent to walls or other fixtures shall be turned up with integral coved edge 12" high and returned 2-1/2" at the top on a 45° angle. Cap ends of all exposed splashes.
 - g. Unless otherwise specified, two (2) faucet holes on 8" centers shall be provided, located over the center line of partitions between compartments, 2-1/2" down from splash break.
 - h. Gussets for legs shall be fully welded all around to #12 gauge stainless steel triangular plates fully welded to underside of sink.
 - i. Sinks fabricated into working surfaces shall be constructed of the same material and in like manner to sinks specified above, except rolled edge and backsplash shall be omitted and the bowl shall be completely welded integral and flush with the working surface. Where basket type wastes are called for, they shall be fitted with removable seats.
 - j. Where sink bowls are exposed, the exterior shall also be polished to a #4 finish.
13. Sink Drainboards:
- a. Drainboards shall be constructed of the same material as the sinks and shall be welded integral to same.
 - b. The front portion of drainboards shall continue the 1-1/2", 180° rolled edge of sink bowls on a continuous and level horizontal plane.
 - c. The surface of the drainboard shall pitch from 2-1/2" at the end furthest from the sink, to 3" at the bowl; or 1/8" per foot. In addition, the bottom surface shall be dished toward the center for complete drainage.
 - d. The backsplash of the drainboard shall match the rear of the sink contour and shall be welded integral thereto, running parallel to the floor.
 - e. Drainboards shall be reinforced on the underside with a framework of 1"x4"x1" stainless steel channel underbracing placed at each pair of legs, with exposed ends capped, and one (1) channel running lengthwise.
 - f. Where disposer cones are fabricated into drainboards, additional 1"x4"x1" stainless steel channels shall be welded into the top framing, spanning the drainboard from front-to-back on both sides of the cone and located not more than 3" to either side.

- g. Disposer control panels or switches shall be supported beneath drainboards, when specified, by means of a #12 gauge stainless steel mounting bracket.
14. Dishable Tops:
- a. Dishables shall be constructed of #14 gauge stainless steel with all corners, both vertical and horizontal, coved on a 3/4" radius electrically welded, ground smooth and polished. Solder in filleted corners will not be acceptable.
 - b. Fronts and exposed ends shall be fabricated with a 3" high, 1-1/2", 180° rolled edge with rounded corners. The back and ends adjacent to walls or other fixtures shall be turned up with integral coved edge 12" high and returned 2-1/2" at the top on a 45° angle. Cap ends of all exposed splashes.
 - c. All tops shall slope 1/8" per foot (minimum).
 - d. Dishables shall be reinforced on the underside with a framework of 1"x4"x1" stainless steel channel underbracing placed at each pair of legs, with exposed ends capped, and one (1) channel running lengthwise fully welded between front-to-back channels.
 - e. Where tops fit into dishmachines, they shall turn down and into, forming a sealed watertight fit, and attached according to dishmachine manufacturers instructions.
 - f. On each side of dishmachine, tables shall be provided with integral splash shields as part of the backsplash.
 - g. Silicon filling of gaps caused by poor fit will not be acceptable.
 - h. On corner-type door machines, provide #14 gauge stainless steel wall-mounted, splash panel to protect adjacent wall, full width of door opening.
15. Cafeteria Style Counters:
- a. All counters shall be constructed as previously specified under Enclosed Bases.
 - b. Provide top and bottom framing for each counter food pan, cold pan, coffee urn, ice cream unit, ice bin, dish dispenser, etc., whether a drop-in unit or a cutout for a portable unit.
 - c. Where plate shelves occur, frame horizontally 8-1/2" back from counter edge or as design dictates, and at bottom of shelf at counteredge.
 - d. The countertop shall be constructed of #14 gauge stainless steel, as previously specified, with all joints welded, ground and polished.
 - e. Fronts and exposed ends shall be stainless steel, plastic laminate or other material as noted in the Item Specifications.
 - f. All display glass shelving shall be 1/4" polished plate glass and fully trimmed with #18 gauge stainless steel formed channels. Top shelves shall be the same width as the shelf below. Shelves shall be supported on 5/8" square, #16 gauge stainless steel perimeter tubing fully welded to 1-1/4" square, #16 gauge stainless steel tubing uprights.
 - g. Provide appropriate adjustable glass sneeze or breath guards trimmed in stainless steel along front, entire length, mounted in Klein 4465-A brackets.
 - h. Protector shelf over hot food wells shall be #16 gauge stainless steel supported on 1-1/4" square, #16 gauge stainless steel tubing uprights, with 1/4" polished plate glass front and end panels trimmed in #18 gauge stainless steel channels. When specified for self-service, mount bottom edge of front panel 8" above countertop.
 - i. All display and protector shelves shall be furnished with full-length fluorescent lights wired to on/off switch in counter apron, with lamps and protective shields. Conceal all wiring in tubular uprights.
 - j. Refer to Item Specification for changes, as required.
 - k. Counter shall be internally wired complete by the K.E.C., and in such a way as to meet the requirements of the Electrical Code of the job location.

2.04 EQUIPMENT

- A. All items listed on the Contract Documents under the heading "Equipment Schedule" shall be furnished in strict accordance with the foregoing specifications and with the following detailed Itemized Specifications.
- B. Manufacturer's names and model numbers are shown establishing quality, size, and finish required, representing the Owner's and Consultant's requirements and basis for bid. Equipment is listed hereinafter with same item numbers as shown on Contract Documents.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Before beginning the installation of foodservice equipment, the spaces and existing conditions shall be examined by the K.E.C. and any deficiencies, discrepancies, or unsatisfactory conditions for proper installation of foodservice equipment shall be reported to the Architect in writing.
 - 1. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner satisfactory to the installer.
 - 2. Beginning installation shall constitute acceptance of the area.

3.02 PREPARATION

- A. Foodservice equipment drawings are diagrammatic and intended to show layout, arrangement, mechanical and electrical requirements.
- B. Field verify all measurements at the building prior to fabrication of custom equipment. Coordinate measurements and dimensions with rough-in and space requirements.

3.03 INSTALLATION

- A. The K.E.C. shall coordinate his delivery schedule with the Contractor to ensure adequate openings in the building to receive the equipment.
- B. Equipment shall be un-crated, fully assembled and set level in position for final connections. Parts shipped loose but required for connection shall be properly tagged and shall be accompanied by the necessary installation instructions.
- C. Provide a competent, experienced foreman to supervise installation and final connections with other trades.
- D. Remote Refrigeration Systems:
 - 1. All refrigeration work where applicable to this contract shall be accomplished in an approved manner, using finest quality fittings, controls, valves, etc.
 - 2. Refrigeration items shall be started up, tested, adjusted, and turned over to the Owner in first class condition and left running in accordance with the manufacturer's instructions.
 - 3. Refrigeration lines and hook-ups shall be completed by the K.E.C. with the exception of electric, water, and drain line final connections unless otherwise specified.
 - 4. All copper tubing shall be refrigerant grade A.C.R. or type "L".
 - 5. Silver solder and/or Sil-Fos shall be used for all refrigerant piping. Soft solder is not acceptable.
 - 6. All refrigerant lines in pipe sleeves or conduit shall be effectively caulked at ends to prevent entrance of water or vermin and at penetrations through walls or floors.
 - 7. All tubing shall be securely anchored with clamps, and suspended lines shall be supported with adjustable hangers at 6'-0" o.c. maximum.
 - 8. Wrap drain line in freezer compartment(s) with approved heat-tape for final connection by Electrical Contractor.
- E. Sealing and Caulking:
 - 1. Prior to the application of sealant, all surfaces shall be thoroughly cleaned and de-greased.
 - 2. Apply around each unit of permanent installation at all intersections with walls, floors, curbs or other permanent items of equipment.
 - 3. Joints shall be air-tight, water-tight, vermin-proof, and sanitary for cleaning purposes.
 - 4. In general, joints shall be not less than 1/8" wide, with backer rod to shape sealant bead properly at 1/4" depth. Shape exposed surfaces of sealant slightly concave, with edges flush with faces of materials at joint.
 - 5. At internal corner joints, apply sealant or gaskets to form a sanitary cove, of not less than 3/8" radius.
 - 6. Provide sealant-filled joints up to 3/4" in joint width. Trim strips for wider joints shall be set in a bed of sealant and attached with stainless steel fasteners, 48" o.c., or less, to insure suitable fastening and prevent buckling of the metals fastened.
- F. Cutting:
 - 1. All cutting, fitting, or patching required during installation shall be accomplished by the K.E.C., at his own expense, so as to make the work conform to the plans and specifications.
 - 2. The K.E.C. shall not cut or otherwise alter, except with the consent of the Owner, the work of any other Contractor.

3. Provide cut-outs in foodservice equipment where required to run plumbing, electric, or steam lines through equipment items for final connections.

3.04 FIELD QUALITY CONTROL

- A. Inspection:
 1. Provide access to shop fabrication areas during normal working hours to facilitate inspection of the equipment, during construction, by the Architect or his authorized representative.
 2. Errors found during these inspections shall be corrected to the extent required within the scope of the plans, specifications, and approved drawings.
- B. Start-Up and Testing:
 1. Delay start-up of foodservice equipment until service lines have been tested, balanced, and adjusted for pressure, voltage, and similar considerations; and until water and steam lines have been cleaned and treated for sanitation.
 2. Before testing, lubricate each equipment item in accordance with manufacturer's recommendations.
 3. Supply a trained person or persons who shall start up all equipment, test and make adjustments as necessary, resulting in each item of equipment, including controls and safety devices, performing in accordance with the manufacturer's specifications.
 4. All gas-fired equipment shall be checked by the local gas company as to calibration, air adjustments, etc., and adjustments made as required.
 5. Repair or replace any equipment found to be defective in its operation, including items which are below capacity or operating with excessive noise or vibration.
- C. Demonstration:
 1. Provide an operating demonstration of all equipment at a time of Owner's convenience, to be held in the presence of authorized representatives of the Architect and Owner.
 2. Demonstration shall be performed by manufacturer's representative knowledgeable in all aspects of his equipment.
 3. During the demonstration, instruct the Owner's operating personnel in the proper operation and maintenance of the equipment.
 4. Furnish complete, bound, operation/maintenance manuals and certificates of warranty for all items of equipment provided, in accordance with Article 1.5 Submittals, Paragraph F, at this demonstration time.

3.05 ADJUST AND CLEAN

- A. Upon completion of installation and tests, clean and sanitize foodservice equipment, and leave in condition ready for use in food service.
- B. Remove all protective coverings, and thoroughly clean equipment both internally and externally.
- C. Make and check final adjustments required for proper operation of the equipment.
- D. Restore finishes marred during installation to remove abrasions, dents, and other damages. Polish stainless steel surfaces, and touch-up painted surfaces with original paint.
- E. Clean up all refuse, rubbish, scrap materials, and debris caused by the work of this Section, and put the site in a neat, orderly, and broom-clean condition.

3.06 ITEMIZED EQUIPMENT

ITEM #1: UTILITY CART, MOBILE

QUANTITY:	Two (2)
MANUFACTURER:	Lakeside Manufacturing Company
MODEL NO.:	544 (N058)
PERTINENT DATA:	700-lb. Capacity, Three-Shelf, N.S.F. Model
UTILITIES REQ'D:	----
ALTERNATE MFRS.:	Piper Products

ITEM #1: (Continued)

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. All four (4) casters swivel-type, in lieu of two (2) swivel, two (2) fixed.

ITEM #2: WALK-IN COOLER/FREEZER

QUANTITY: One (1)
 MANUFACTURER: Thermo-Kool
 MODEL NO.: Indoor Installation (N058)
 PERTINENT DATA: 4" Thick Durathane Construction - Class I; NSF Construction
 UTILITIES REQ'D: 1750W, 120V, 1PH; (2) 3/4" IW
 ALTERNATE MFRS.: Bally; ThermalRite

Furnish and set-in-place per Equipment Plan, Sheet QF101; Building Conditions Plan, Sheet QF102; Manufacturer's Shop Drawing and the following:

1. Two Section Unit: 18'-3½" L x 7'-9" W x 9'-0" H. Interior width: Freezer - 9'-4" wide; Cooler - 7'-11½" wide.
2. Exterior Finish:
 - 26 GA stucco embossed galvanized steel where unexposed.
 - 20 GA stucco embossed stainless steel where exposed.
3. Interior Finish:
 - White acrylic enamel baked-on .040 stucco embossed aluminum walls.
 - White acrylic enamel baked on 26 GA smooth galvanized steel ceiling.
4. Interior Floor:
 - 4" prefabricated floor panels installed in 6" deep floor recess over hot asphalt paper or 10 MIL polyethylene sheets on building floor slab.
 - 2" setting bed with two (2) layers of wire reinforcing mesh fabric and finish floor material with 6" high integral coved base, interior and exterior of box, installed over prefabricated floor panel by Tile Contractor.
5. Entrance Door:
 - Two (2) flush-mounted, self-closing right-hand hinged doors with 34" x 76" net opening.
 - Polished chrome camlift hinges with lift-off capability. One (1) extra hinge per door, three (3) total.
 - Kason #1236 polished chrome lever-action handle with knob-turn release and cylinder lock.
 - Kason #09440004 polished chrome mortise dead-bolt lock, factory mounted.
 - Hydraulic door closer.
 - Standard 2" diameter dial indicating thermometer factory mounted, each compartment.
 - Pilot light and switch assembly factory mounted in door frame with stainless steel coverplate.
 - 36" high aluminum diamond tread kickplates, interior and exterior of door, frame and jamb.
 - 14" x 24" heated observation windows, both compartments.
 - Undercut doors for epoxy floor.
 - Cool Curtain Clear-Vu Model #SS3678 vinyl swinging curtains factory installed at each entrance door.
 - Kason #1806 LED light fixture with high-impact plastic cover centered over door opening to avoid conflict with shelving, each compartment. Extend wiring in conduit, foamed within door panel header, to junction box mounted on top of walk-in ceiling, each compartment.
 - Kason #907 interior door handle, factory mounted, with concealed metal backing plate.
 - Round vinyl door bumper mounted to front exterior face to protect handle from puncturing wall when door in full open position.
 - Engraved phenolic plastic compartment sign - 12" long x 2" high; white in color with 1" high blue CAPITAL letters mounted on each door above observation window; (1) - COOLER, (1) - FREEZER.
 - Stainless steel heated threshold, each compartment.
6. Heated pressure relief port in freezer, ceiling mounted.

ITEM #2: (Continued)

7. Two (2) Kason #1810L21248LB 48" long twin-tube LED light fixtures with shatter-proof high impact plastic covers centrally-mounted to walk-in ceiling per Detail, Sheet QF104; one (1) for the cooler, one (1) for the freezer. Provide low-temperature ballast (-20°F.) in freezer. Fixtures shipped loose and installed by K.E.C.; final connection by Electrical Contractor.
8. Modularm Model #75LC recessed flush-mount digital thermometer with audio-visual temperature alarm factory mounted in door frames for both cooler and freezer compartments inter-wired with building monitoring system by Electrical Contractor, as required. Extend temperature probe to rear wall of each compartment.
9. Provide and install trim strips of matching exterior finish between ends of walk-in panels and building walls from finish floor to 6" above finish ceiling; verify finished ceiling height.
10. Provide and install closure panels of matching exterior finish between top of walk-in and finish ceiling per Detail Sheet QF102; K.E.C. to verify finished ceiling height.
11. All electrical conduit shall be run concealed above walk-in ceiling, per Detail Sheet QF104.
12. Evaporator coil drain lines shall be run to floor drain with "P"-trap on exterior of box by K.E.C. Pitch drain lines 1" per foot of horizontal run.
13. Black flexible "Armaflex" insulation applied to exposed drain lines and fittings within interior of box by K.E.C.
14. Spiral heat tape applied to drain line within interior of freezer compartment prior to application of insulation by K.E.C. Drain line heating cable shall be installed for continuous 24-hour operation.
15. Coordinate location of sprinkler head drops and provide penetrations, where necessary.
16. Seal and insulate all openings to prevent infiltration of warm air into cooler/freezer compartments.
17. Quality Inspection Requirement:
 - Walk-In shall be completely erected at the manufacturer's facility prior to shipment and a quality control inspection performed on the assembled structure. A digital photograph of factory assembled walk-in shall be provided for the K.E.C. permanent records and included in the operation and maintenance manuals.

ITEM #3: COOLER REFRIGERATION SYSTEM

QUANTITY: One (1)
 MANUFACTURER: ColdZone
 MODEL NO.: ORE-H080M44-2S (N058)
 PERTINENT DATA: Uni-Pak, Air-Cooled, Outdoor Installation, Remote
 UTILITIES REQ'D: 4.6A, 208V, 1PH
 ALTERNATE MFR.: RDT; Omni-Temp

Furnish and set-in-place per Equipment Plan, Sheet QF101; Building Conditions Plan, Sheet QF102; Manufacturer's Shop Drawing and the following:

1. Condensing Unit: Factory Pre-Assembled, Hermetic, Medium Temperature, R-404A.
2. System located outdoors on roof. Curb with pitch-pocket furnished and installed by General Contractor.
3. Complete winterization package and condensing unit weatherproof cover.
4. Factory installed air defrost timer with contactors and relays.
5. Overall size: 28" L x 28" W x 17" H.

ITEM #3: (Continued)

6. Weight: 152 lbs.
7. Evaporator Coil with High-Efficiency EC Motors: Low-Profile, End-Mount Type, Model AA26-70B; 1.8A, 120V, 1PH
 - System to operate at +35°F.
 - Furnished complete with thermostat, solenoid and expansion valves factory mounted ready for final connection by Refrigeration Contractor.
8. Complete refrigeration system warrantee: five (5) years for the compressor, Two (2) years for the condensing unit, and Two (2) years for all parts of the evaporator coil.
9. Factory installed main-fused disconnect switch.

ITEM #4: FREEZER REFRIGERATION SYSTEM

QUANTITY: One (1)
 MANUFACTURER: ColdZone
 MODEL NO.: ORE-H215L44-2T (N058)
 PERTINENT DATA: Uni-Pak Air-Cooled, Outdoor Installation, Remote
 UTILITIES REQ'D: 13.1A, 208V, 3PH
 ALTERNATE MFR.: RDT; Omni-Temp

Furnish and set-in-place per Equipment Plan, Sheet QF101; Building Conditions Plan, Sheet QF102; Manufacturer's Shop Drawing and the following:

1. Condensing Unit: Factory Pre-Assembled, Hermetic, Medium Temperature, R-404A.
2. System located outdoors on roof. Curb with pitch-pocket furnished and installed by General Contractor
3. Complete winterization package and condensing unit weatherproof cover.
4. Factory installed air defrost timer with contactors and relays.
5. Overall size: 40" L x 28" W x 17" H.
6. Weight: 243 lbs.
7. Evaporator Coil with High-Efficiency EC Motors: Low-Profile, End-Mount Type, Model AE26-75B; 0.9A, 208V, 1PH (Fan); 7.0A, 208V, 1PH (Defrost Heater)
 - System to operate at -10°F.
 - Furnished complete with thermostat, solenoid and expansion valves factory mounted ready for final connection by Refrigeration Contractor.
8. Complete refrigeration system warrantee: five (5) years for the compressor, Two (2) years for the condensing unit, and Two (2) years for all parts of the evaporator coil.
9. Factory installed main-fused disconnect switch.

ITEM #5: SHELVING

QUANTITY: Eleven (11)
 MANUFACTURER: InterMetro Industries Corporation
 MODEL NO.: MetroMax i (N058)
 PERTINENT DATA: Free-Standing, Open-Grid Shelf Mat, Polymer
 UTILITIES REQ'D: ----
 ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

Cooler:

1. Two (2) #MX1836G sections; 18" W x 36" L x 4-tier high.
2. Two (2) #MX1842G sections; 18" W x 42" L x 4-tier high.
3. One (1) #MX1854G section; 18" W x 54" L x 4-tier high.
4. Twenty (20) #MX63P polymer posts, 63" high.
5. Plastic wedge lock connectors, quantity as required.
6. Locate bottom shelf @ 12" A.F.F.; space remaining shelves equally.

Freezer:

1. Two (2) #MX1836G sections; 18" W x 36" L x 4-tier high.
2. Three (3) #MX1842G sections; 18" W x 42" L x 4-tier high.
3. One (1) #MX1848G section; 18" W x 48" L x 4-tier high.
4. Twenty-four (24) #MX63P polymer posts, 63" high.
5. Plastic wedge lock connectors, quantity as required.
6. Locate bottom shelf @ 12" A.F.F.; space remaining shelves equally.

ITEM #6: SHELVING

QUANTITY: Eight (8)
 MANUFACTURER: InterMetro Industries Corporation
 MODEL NO.: Super Erecta (N058)
 PERTINENT DATA: Stationary, Free-Standing, Chrome-Plated, Wire
 UTILITIES REQ'D: ----
 ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

Dry Storage:

1. Eight (8) #2142NC sections; 21" W x 42" L x 5-tier high.
2. Thirty-two (32) #74P chrome-plated posts; 74-5/8" high.
3. Plastic split sleeves, quantity as required.

ITEM #6: (Continued)

4. Locate bottom shelf @ 12" A.F.F.; space remaining shelves equally.

ITEM #7: HAND SINK

QUANTITY: Three (3)
 MANUFACTURER: Eagle Foodservice Equipment Company
 MODEL NO.: HSA-10-FAW-LRS (N058)
 PERTINENT DATA: Wall Mounted, Wrist Action Faucet
 UTILITIES REQ'D: 1/2" HW, 1/2" CW, 1-1/2" W
 ALTERNATE MFRS.: Advance/Tabco; Universal

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Complete sink assembly consisting of: gooseneck faucet, p-trap, tailpiece and basket drain.
2. Accessories (each unit):
 - #606215 skirt assembly.
 - Integral right and left stainless steel splash shield.

ITEM #8: SOAP & TOWEL DISPENSER

QUANTITY: Three (3)
 MANUFACTURER: Bobrick Washroom Equipment, Inc.
 MODEL NO.: B-5050/B-262 (N058)
 PERTINENT DATA: Surface Wall Mounted, Stainless Steel Finish (400) C-Fold Capacity
 UTILITIES REQ'D: ----
 ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Mount units above hand sink and seal perimeter to wall.

ITEM #9: PREP SINK

QUANTITY: One (1)
 MANUFACTURER: Custom Fabricated
 MODEL NO.: #14 GA Stainless Steel
 PERTINENT DATA: 8'-0" Long x 2'-6" Wide x 2'-10" High
 UTILITIES REQ'D: 1/2" HW, 1/2" CW, (2) 1-1/2" IW
 ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet QF101; Fabrication Detail, Sheet QF501; and the following:

1. Front and end edge rolls per Detail 1.02B.
2. 13" high backsplash per Detail 1.04A with finished back.
3. Framework per Detail 1.05.
4. Legs per Detail 1.07. Flanged feet on each corner leg.
5. Stainless steel undershelf on both ends per Detail 1.11.

ITEM #9: (Continued)

6. Sound-deaden underside of sinks and drainboards with NSF-approved sound dampening material.
7. Accessories:
 - One (1) T&S #B-0231 backsplash-mounted swing spout faucet with #B-0199-1 aerator.
 - Two (2) T&S #B-3950-01 twist waste valves with overflow assemblies and #010387-45 basket strainers.
 - Two (2) duplex receptacles with stainless steel faceplates mounted in finished backsplash. Final connection by Electrical Contractor.
8. Item will remain shrink-wrapped until ready for final connection by Plumbing Contractor. Immediately following completion of final connections, K.E.C. shall re-shrink-wrap tubs or provide removable panel to avoid use by construction trades. Post sign on wall above sink tubs in English and Spanish stating: **WARNING! NOT TO BE USED BY CONSTRUCTION TRADES. FAILURE TO COMPLY WILL RESULT IN \$500.00 FINE AND ALL COSTS TO REPLACE ITEM WITH NEW.**

ITEM #10: REACH-IN REFRIGERATOR, MOBILE

QUANTITY: One (1)
 MANUFACTURER: Continental Refrigerator
 MODEL NO.: DL2R-SS-HD (N058)
 PERTINENT DATA: Designer Line Series, Two-Section, Self-Contained, Stainless Steel Interior/Exterior
 UTILITIES REQ'D: 9.1A, 120V, 1PH
 ALTERNATE MFR.: True Food Service Equipment

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Half-height doors hinged per Equipment Plan.
2. Cylinder door locks, keyed-alike.
3. Interior fitted with standard wire shelves, three (3) per compartment, twelve (12) total.
4. Exterior mounted digital thermometer.
5. 5" diameter heavy-duty swivel casters, front two (2) with brakes.
6. Cord and plug set.

ITEM #11: UNDERCOUNTER BLAST CHILLER

QUANTITY: One (1)
 MANUFACTURER: Piper Products
 MODEL NO.: RCR051S (N058)
 PERTINENT DATA: One-Section, Self-Contained, Stainless Steel Interior/Exterior
 UTILITIES REQ'D: 5.4A, 208V, 1PH
 ALTERNATE MFRS.: Delfield

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. 2½" high stainless steel legs with adjustable bullet feet.
2. Cord and plug set with matching receptacle furnished and installed by Electrical Contractor.

ITEM #12: SLICER

QUANTITY: One (1)
 MANUFACTURER: Hobart Corporation
 MODEL NO.: 2712-1 (N058)
 PERTINENT DATA: Automatic 2-Speed Carriage Drive, 12" Diameter Blade, With Low Fence
 UTILITIES REQ'D: 1/2 HP, 120V, 1PH
 ALTERNATE MFRS.: Berkel; Globe

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Accessories:
 - One (1) #161712-FENHGH adjustable high fence.
 - One (1) #FOOD-CHUTE tubular chute with plunger.
 - Operator training video tape.
2. Cord and plug set.

ITEM #13: FOOD PROCESSOR

QUANTITY: One (1)
 MANUFACTURER: Robot Coupe USA, Inc.
 MODEL NO.: R-602V (N058)
 PERTINENT DATA: Continuous Feed Hopper, Dual Purpose, Variable Speed, 7-Qt. Bowl
 UTILITIES REQ'D: 15.0A, 120V, 1PH
 ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Standard food processor package consisting of: food processor, 7-qt. stainless steel bowl, continuous feed vegetable preparation attachment, (1) #28058 1/8" grating disc and (1) #28064 1/8" slicing disc.
2. Accessories:
 - One (1) #R255 disc rack.
3. Cord and plug set.

ITEM #14: WORKTABLE

QUANTITY: One (1)
 MANUFACTURER: Custom Fabricated
 MODEL NO.: #14 GA Stainless Steel
 PERTINENT DATA: 8'-0" Long x 2'-6" Wide x 3'-0" High
 UTILITIES REQ'D: ----
 ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet QF101; Fabrication Detail, Sheet QF501; and the following:

1. Perimeter edge rolls per Detail 1.02M.
2. Framework per Detail 1.05.
3. Legs per Detail 1.07.
4. Stainless steel undershelf per Detail 1.11.

ITEM #14: (Continued)

5. One (1) stainless steel drawer assembly per Detail 1.14, Type I with locks.
6. Worktable per Detail 2.01.
7. Sound-deaden underside of tabletop with NSF-approved sound dampening material.

ITEM #15: POT WASHING SINK

QUANTITY: One (1)
 MANUFACTURER: Custom Fabricated
 MODEL NO.: #14 GA Stainless Steel
 PERTINENT DATA: 12'-0" Long x 2'-6" Wide x 3'-0" High
 UTILITIES REQ'D: (2) 3/4" HW, (2) 3/4" CW, (3) 2" IW
 ALTERNATE MFR.: None

Fabricate and set-in-place per Equipment Plan, Sheet QF101; Fabrication Detail, Sheet QF501; and the following:

1. Front and end edge roll per Detail 1.02B.
2. 13" high backsplash per Detail 1.04A with finished back.
3. Framework per Detail 1.05
4. Legs per Detail 1.07. Flanged feet on each corner leg.
5. Crossbracing per Detail 1.10.
6. Stainless steel undershelf on both ends per Detail 1.11.
7. Pot sink and drainboards per Detail 3.01.
8. Sound-deaden underside of sinks and drainboards with NSF-approved sound dampening material.
9. Accessories:
 - Two (2) T&S #B-290 backsplash mounted swing spout faucets.
 - Three (3) T&S #B-3950-01 twist waste valves with overflow assemblies and #010387-45 basket strainers.
 - Two (2) duplex receptacles with stainless steel faceplates mounted in finished backsplash. Final connection by Electrical Contractor.
10. Item will remain shrink-wrapped until ready for final connection by Plumbing Contractor. Immediately following completion of final connections, K.E.C. shall re-shrink-wrap tubs or provide removable panel to avoid use by construction trades. Post sign on wall above sink tubs in English and Spanish stating: **WARNING! NOT TO BE USED BY CONSTRUCTION TRADES. FAILURE TO COMPLY WILL RESULT IN \$500.00 FINE AND ALL COSTS TO REPLACE ITEM WITH NEW.**

ITEM #16: POT & PAN SHELVING, MOBILE

QUANTITY: One (1)
 MANUFACTURER: InterMetro Industries Corporation
 MODEL NO.: MetroMax i (N058)
 PERTINENT DATA: Four-Tier High, Polymer, Open Grid Mat Shelf
 UTILITIES REQ'D: ----
 ALTERNATE MFR.: None

ITEM #16: (Continued)

Furnish and set-in-place per Equipment Plan, Sheet QF101, Manufacturer's Instructions and the following:

1. One (1) #MX2448G section; 24" W x 48" L x 4-tier high.
2. Four (4) #MX63UP polymer posts for stem casters, 63" high.
3. Two (2) #5MPX polyurethane swivel casters with donut bumpers.
4. Two (2) #5MPBX polyurethane swivel casters with brakes and donut bumpers.
5. Plastic wedge lock connectors, quantity as required.
6. Locate bottom shelf @ 12" A.F.F., space remaining shelves equally.
7. Accessories:
 - Two (2) #MTR2448XE tray drying racks.
 - Ten (10) #MXD24-8 shelf dividers.

ITEM #17: WASHER/DRYER, STACKED – (N.I.K.E.C. - SPECIFIED BY ARCHITECT)

QUANTITY: One (1)

ITEM #18: ICE MACHINE/BIN

QUANTITY: One (1)
 MANUFACTURER: Manitowoc Equipment Works
 MODEL NO.: ID-0322A/B-420 (N058)
 PERTINENT DATA: Air-Cooled, 350-LB. Maker, 310-LB. Bin, Dice Size Cubes
 UTILITIES REQ'D: 11.5A, 120V, 1PH; 1/2" CW, 1/2" IW (Maker Drain), 3/4" IW (Bin Drain)
 ALTERNATE MFRS.: Scotsman; Ice-O-Matic

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Stainless steel exterior finish, ice machine and bin.
2. Accessories:
 - One (1) Everpure Model EV9324-21 InsurIce 2000 single water filter system with 20" Coarse Filter factory assembled to common wall mounting rack.
 - 6" high stainless steel leg set with adjustable bullet feet.
 - Custom fabricated stainless steel ice scoop holder bracket mounted to right-side of bin per Detail, Sheet QF501.

ITEM #19: WORKTABLE WITH SINK

QUANTITY: One (1)
 MANUFACTURER: Custom Fabricated
 MODEL NO.: #14 GA Stainless Steel
 PERTINENT DATA: 12'-0" Long x 2'-6" Wide x 3'-0" High
 UTILITIES REQ'D: 1/2" HW, 1/2" CW, 1-1/2" IW
 ALTERNATE MFR.: None

ITEM #19: (Continued)

Fabricate and set-in-place per Equipment Plan, Sheet QF101; Fabrication Detail, Sheet QF501 and the following:

1. Perimeter edge roll per Detail 1.02M.
2. Framework per Detail 1.05.
4. Legs per Detail 1.07.
5. Crossbracing per Detail 1.10.
6. Stainless steel undershelf per Detail 1.11.
6. Two (2) stainless steel drawer assemblies per Detail 1.14, Type I, with locks.
7. Worktable per Detail 2.01.
8. 18" x 18" x 10" deep utility sink per Detail 3.04 with waste lever angle bracket welded to underside of sink.
9. Sound-deaden underside of tabletop and sink with NSF-approved sound dampening material.
10. Accessories:
 - One (1) T&S #B-325 deck-mounted swivel gooseneck faucet with #B-199-1 aerator.
 - One (1) T&S #B-3950-01 twist waste valve with overflow assembly and #010387-45 basket strainer.

ITEM #20: CONVECTION OVEN

QUANTITY: One (1)
 MANUFACTURER: Blodgett Oven Company, Inc.
 MODEL NO.: HV-100G-DOUBLE (N058)
 PERTINENT DATA: Double Section, Standard Depth, HydroVection™
 UTILITIES REQ'D: (2)20.0, 120V, 1PH; (2)3/4" CW, (2)1" IW; 3/4" Natural Gas @ 120 MBH
 ALTERNATE MFRS: None

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Natural gas fired, pressure regulator as required. Manifold rear gas connection of each oven compartment for single connection point ready for quick disconnect assembly furnished with Item #22.
2. Standard compliment of wire racks, five (5) per section.
3. Accessories:
 - 11" adjustable legs.
 - MenuSelect control with core probe.
 - Stacking kit.
 - Ten (10) multi-purpose fry pans.
 - Five (5) additional stainless steel wire racks.
 - One (1) Everpure #EV9797-21 KleenSteam II Single System Water Filter. Ship to Utility Raceway manufacturer for factory installation.
4. Approved backflow preventor furnished and installed by Plumbing Contractor.
5. Mechanical and electrical service supplied through Utility Raceway, Item #22.

ITEM #21: EXHAUST CANOPY

QUANTITY: One (1)
 MANUFACTURER: Captive-Aire Systems, Inc.
 MODEL NO.: 6030VHB-ND (N058)
 PERTINENT DATA: Stainless Steel, Non-Grease, Heat/Vapor Removal Only Type
 UTILITIES REQ'D: 1,800 CFM Exhaust; 350W, 120V, 1PH (Lights)
 ALTERNATE MFR.: Avtec; Gaylord

Furnish and install per Equipment Plan, Sheet QF101; Exhaust Canopy Details, Sheet QF503; Manufacturer's Instructions and the following:

1. 5'-0" Wide x 12'-0" Long x 2'-6" High with bottom edge mounted at 6'-8" A.F.F. Length comprised of one (1) 12'-0" section. Entire unit constructed of 18 GA stainless steel type 304 with #4 finish on all exposed surfaces with liquid tight all welded external continuous seams and joints per N.F.P.A. 96,U.L. and State of Delaware Codes.
2. Three (3) U.L. Listed, NSF-Approved, 36" long twin-tube recessed LED light fixtures, equally spaced. Bulbs furnished and installed by K.E.C.
3. Matching stainless steel perimeter closure panels to finished ceiling; K.E.C. to verify ceiling height.
4. On/Off fan and light switches factory mounted in Item #22: Utility Raceway.
5. Hanger rods and support system from structure above by Contractor. K.E.C. to coordinate method and location with other trades.
6. Integral stainless steel hanger brackets.
7. 8" wide stainless steel angle framing and closure panels @ rear to accommodate Utility Raceway, Item #22.
8. Exhaust hood shall be of same manufacturer as Utility Raceway, Item #22.

ITEM #22: UTILITY RACEWAY

QUANTITY: One (1)
 MANUFACTURER: Captive-Aire Systems, Inc.
 MODEL NO.: UDW (N058)
 PERTINENT DATA: Wall-Mounted
 UTILITIES REQ'D: 14.4KW, 120/208V, 3PH; 3/4"CW; 1-1/4" Natural Gas @ 960MBH (Looped Service)
 ALTERNATE MFRS.: Avtec; Gaylord

Furnish and install per Equipment Plan, Sheet QF101; Utility Raceway Details, Sheet QF502; Manufacturer's Instructions and the following:

1. All components and labor necessary for a complete system manufactured in accordance with NEC latest edition, NEMA, NFPA No. 96 and No. 54, Uniform Plumbing Code, ASME, OSHA using only U.L. Listed certified components.
2. 12'-0" long x 8" wide x 6'-10" high with risers, completely pre-wired and pre-plumbed to one final connection point for electric, cold water and gas. All connections shall face down on horizontal member.
3. System shall extend up to bottom edge of Exhaust Canopy, Item #21.
4. 54" overall height less risers with peaked top.
5. 36" wide x 6'-10" high risers on each end with 2" penetration into ventilator at 6'-8" A.F.F.

ITEM #22: (Continued)

6. Entire raceway shall be constructed of #16 gauge Type 304 stainless steel with a #4 mill finish.
7. Removable link plates constructed of #16 gauge stainless steel.
8. Electrical compartment shall be completely enclosed with stainless steel housing accessible by the removal of link plates. Internal electrical feeder shall be cable wireway having balanced load and phases and with connection lugs for main service. Branch circuit wiring for each electrical connection shall be phase identified and sized in accordance with circuit breaker rated capacity. Raceway shall provide electrical, gas and water service for items #20, #23 and #24.
9. Provide 12" long interchangeable 16 gauge stainless steel link connection plate for each electrical connection equipped with individual circuit breaker(s) installed in breaker panel mounted in right-hand riser, and grounding type receptacle with twist-lock feature or pre-wired flexible sealtite conduit.
10. On each connection plate provide U.L. listed GFIC ground fault interrupter circuits and matching power supply cords on each 120-volt single-phase connection.
11. Cold water plumbing compartment shall be isolated from electrical compartment. All piping and disconnects in system shall be color coded.
12. At each individual gas branch connection, provide 1/4-turn ball valve and 48" long Dormont PVC coated AGA and NSF approved flexible hose with SnapFast quick-disconnect device and double SwivelMAX gas connectors.
13. Provide fire/fuel shut-off for electric equipment per NFPA No. 96. System shall require one final connection by Contractor from fire protection system.
14. All cold water piping, including individual branch pipe connection, shall be hard temper type "L" copper tubing with copper sweat type solder fittings. At each individual connection, provide A.G.A approved flexible hose(s) with two wall brass and stainless steel construction with quick-disconnect fittings.
15. Provide matching cord sets for all electric equipment, five (5) total.
16. Neoprene bumper strips, full length.
17. U.L. listed, solid-state control panel mounted in right-hand riser end, with the following integral accessories:
 - Ventilator start/stop station with adjustable time-delay to exhaust residual heat.
 - Ventilator light switch, pre-wired in 10ft. flexible conduit ready for connection to light junction box in ventilator by Electrical Contractor.
18. Accessories:
 - One (1) Everpure #EV9797-21 KleenSteam II water filter system factory-installed and housed within left-hand riser. Provide one (1) independent pre-piped water line to service point for Item #20: Convection Oven. Fabricate 18"x18" lexan viewport in riser panel to monitor pressure gauge and filter bowl.
19. Fabricated in three (3) sections, assembled in field to present integral one-piece appearance.
20. Main electrical shunt-type circuit breakers mounted in left-hand riser for 50A, 120/208V, 3PH service.
21. Factory supervision of installation and start-up.
22. Raceway shall be of same manufacturer as Exhaust Canopy, Item #21.

ITEM #23: CONVECTION STEAMER

QUANTITY: One (1)
 MANUFACTURER: AccuTemp Products, Inc.
 MODEL NO.: N61201E060 DBL (N058)
 PERTINENT DATA: (2) Double Stacked, Stand-Mounted 6-Pan, Connected Boilerless, Evolution Series
 UTILITIES REQ'D: (2)1.0A, 120V, 1PH; (2) 3/4" CW, (2) 3/4" IW; (2)1/2" Natural Gas @ 60 MBH
 ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Accessories:
 - #SNH-20-00 heavy-duty stainless steel support stand with adjustable bullet feet.
2. Electrical and mechanical services provided thru Utility Raceway, Item #22.

ITEM #24: CONVECTION OVEN, MOBILE

QUANTITY: One (1)
 MANUFACTURER: Blodgett Oven Company, Inc.
 MODEL NO.: DFG-100-SINGLE (N058)
 PERTINENT DATA: Single-Deck, Standard Depth
 UTILITIES REQ'D: 1/3 HP, 120V, 1PV; 3/4" Natural Gas @ 55 MBH
 ALTERNATE MFRS.: None

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Natural gas fired, pressure regulator as required.
2. Standard compliment of wire racks, five (5) per section.
3. Doors with dual pane thermal windows and interior light package.
4. Accessories:
 - Stainless steel front, both sides, top and solid back panels.
 - Four (4) heavy-duty 5" diameter polyurethane swivel casters, front two (2) with brakes.
 - Blower fan guard.
5. Cord and plug sets.
6. Electrical and mechanical services supplied through Utility Raceway, Item #22.

ITEM #25: PAN RACK CART, MOBILE

QUANTITY: Two (2)
 MANUFACTURER: CresCor
 MODEL NO.: 207-UA-13A (N058)
 PERTINENT DATA: Universal Angles, Channel Posts, (18) 22x20 Pan Capacity
 UTILITIES REQ'D: ----
 ALTERNATE MFR: InterMetro; Lakeside

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Accessories:
 - Full perimeter non-marking wrap-around vinyl bumper.

ITEM #26: PASS-THRU REFRIGERATOR, MOBILE

QUANTITY: Two (2)
 MANUFACTURER: Continental Refrigerator
 MODEL NO.: DL1R-SS-PT-HD (N058)
 PERTINENT DATA: Designer Line Series, Two-Section, Self-Contained, Stainless Steel Exterior/Interior
 UTILITIES REQ'D: 7.2A, 120V, 1PH
 ALTERNATE MFRS.: True

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Half-height doors hinged per Equipment Plan. Glass doors on kitchen side, solid doors on serving side.
2. Cylinder door locks, keyed-alike.
3. #16 gauge stainless steel, angle type, bottom support tray slides for 18"x26" pans in lieu of wire shelves installed on 3" centers, nine (9) pair per compartment, eighteen (18) total, each unit.
4. Exterior mounted digital thermometer installed on kitchen side.
5. Plastic laminate finish factory applied to door fronts on serving side only; color as selected by Architect, K.E.C. to verify.
6. Set of four (4), 5" diameter heavy-duty swivel-type locking casters with brakes.
7. Cord and plug set.

ITEM #27: PASS-THRU HEATED CABINET, MOBILE

QUANTITY: Two (2)
 MANUFACTURER: Piper Products
 MODEL NO.: 1016-SS-D (N058)
 PERTINENT DATA: Double Unit, Insulated, Stainless Steel Exterior/Interior
 UTILITIES REQ'D: 33.3A, 120V, 1PH
 ALTERNATE MFRS.: CresCor; InterMetro

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Half-height doors hinged per Equipment Plan. Glass doors on kitchen side, solid doors on serving side.
2. Cylinder door locks, keyed-alike.
3. Accessories:
 -- Full-perimeter wrap-around non-marking vinyl bumper.
4. Cord and plug set.

ITEM #28: MILK COOLER, MOBILE

QUANTITY: Two (2)
 MANUFACTURER: Continental Refrigerator
 MODEL NO.: MC3-SS-S (N058)
 PERTINENT DATA: 34" Wide, Single Access, Forced-Air, 8 Cu. Ft. Capacity
 UTILITIES REQ'D: 1/4HP, 120V, 1PH
 ALTERNATE MFR.: True

ITEM #28: (Continued)

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Instructions and the following:

1. Stainless steel exterior and interior.
2. Cord and plug set.
3. Cylinder lid lock.
4. Swivel casters with brakes.
5. Accessories:
 - #5-223 corner bumpers.

ITEM #29: SERVING COUNTER

QUANTITY: One (1)
 MANUFACTURER: Elite 500 by Piper Products
 MODEL NO.: Modular Interlocking Sections
 PERTINENT DATA: T-Shaped Configuration, #14 Gauge S/S Tops
 UTILITIES REQ'D: ---
 ALTERNATE MFRS.: Director's Choice by Eagle Group; Shelleysteel by The Delfield Co.

Refer to individual counter components listed under alpha headings for specification.

ITEM #29A: HOT FOOD COUNTER

QUANTITY: Two (2)
 MANUFACTURER: Elite 500 by Piper Products
 MODEL NO.: 5-HF-MOD (N058)
 PERTINENT DATA: Electrically Heated, Open Base, Five (5) Wells
 UTILITIES REQ'D: 24.0A, 208V, 1PH
 ALTERNATE MFRS.: Director's Choice by Eagle Group; Shelleysteel by The Delfield Co.

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Shop Drawing and the following:

1. (SRTS-74) - 10" wide full-length solid stainless steel tray slide with mitered end mounted on rigid brackets @ 29" A.F.F..
2. (SCB-74) - 8" wide full-length fold-down stainless steel work shelf on server's side.
3. (CPGL-74) – Cafeteria-style food protector with tempered glass front, ends and lights.
4. Line-up interlocks for counter body and tray slide.
5. Cord and plug set.
6. (SSL) - 6" high stainless steel legs with adjustable bullet feet.
7. (SD-74) – Sliding doors with lock on server's side.
8. Standard counter height of 36" A.F.F. turn end down to align and interlock with adjacent cold food counter.
9. Laminate front and ends, color as selected by Architect; K.E.C. to verify.

ITEM #29B: COLD FOOD COUNTER

QUANTITY: Two (2)
 MANUFACTURER: Elite 500 by Piper Products
 MODEL NO.: 4CM-MOD (N058)
 PERTINENT DATA: Mechanically-Refrigerated Cold Pan, Open Base, NSF 7
 UTILITIES REQ'D: 6.3A, 120V, 1PH; 3/4" IW
 ALTERNATE MFRS.: Director's Choice by Eagle Group; Shelleysteel by The Delfield Co.

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Shop Drawing and the following:

1. (SRTS-74) - 10" wide full-length solid stainless steel tray slide with mitered end mounted on rigid brackets @ 29" A.F.F..
2. (CDDL) – Cafeteria style two-tier display with tempered glass front, ends and lights.
3. Line-up interlocks for counter body and tray slide.
4. Cord and plug set.
5. (SSL) – 6" high stainless steel legs with adjustable bullet feet.
6. (FB) - False bottom.
7. Modified counter height of 30" A.F.F.
8. Modify length of cold pan and display case to allow adequate passage for 10"x14" compartmented tray between cold pan and adjacent hot food counter.
9. Laminate front and ends, color as selected by Architect; K.E.C. to verify.

ITEM #29C: CORNER SOLID TOP COUNTER

QUANTITY: Two (2)
 MANUFACTURER: Elite 500 by Piper Products
 MODEL NO.: R2-ST-MOD (N058)
 PERTINENT DATA: 36" Wide, Open Base
 UTILITIES REQ'D: ----
 ALTERNATE MFRS.: Director's Choice by Eagle Group; Shelleysteel by The Delfield Co.

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Shop Drawing and the following:

1. Line-up interlocks for counter body.
2. (SSL) – 6" high stainless steel legs with adjustable bullet feet.
3. (SD-36) – Sliding doors with lock on server's side.
4. (DOUT) - 15-amp duplex convenience receptacle mounted in counter apron, server's side.
5. Cord and plug set.
6. Modified counter height of 30" A.F.F.
7. Laminate front and ends, color as selected by Architect; K.E.C. to verify.

ITEM #29D: CASHIER STAND

QUANTITY: Two (2)
 MANUFACTURER: Elite 500 by Piper Products
 MODEL NO.: 2-CD-MOD (N058)
 PERTINENT DATA: 30" Long
 UTILITIES REQ'D: 15A, 120V, 1PH (Dedicated Circuit)
 ALTERNATE MFRS.: Director's Choice by Eagle Group; Shelleysteel by The Delfield Co.

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Shop Drawing and the following:

1. (SRTS-30) - 10" wide full-length solid stainless steel tray slide with mitered end mounted on rigid brackets@ 29" A.F.F. Extend tray slide to span length of Item #29C: Solid Top Counter and interlock with cold food counter.
2. Line-up interlocks for countertop and tray slide.
3. (DOUT) - 15-amp convenience outlet mounted below top in counter body. Provide die-raised opening in top for power cord access.
4. Cashier's utility drawer with locking provision mounted on end.
5. (SSL) – 6" high stainless steel legs with adjustable bullet feet.
6. Cord and plug set.
7. Standard counter working height of 36" A.F.F. Turn top down to align & interlock with adjacent solid top counter.
8. Laminate front and ends, color as selected by Architect; K.E.C. to verify.

ITEM #30: WORKCOUNTER

QUANTITY: Two (2)
 MANUFACTURER: Custom Fabricated
 MODEL NO.: #14 GA Stainless Steel
 PERTINENT DATA: 5'-0" Long x 2'-6" Wide x 3'-0" High
 UTILITIES REQ'D: ----
 ALTERNATE MFRS.: None

Fabricate and set-in-place per Equipment Plan, Sheet QF101; Fabrication Detail, Sheet QF501; and the following:

1. Front and end edge roll per Detail 1.02M.
2. 6" high backsplash per Detail 1.04A.
3. Counter framework per Detail 1.06.
4. Heavy-duty counter legs per Detail 1.08.
5. Workcounter per Detail 4.01.
6. Stainless steel hinged doors per Detail 4.26, with locks and laminate finish, color as selected by Architect; K.E.C. to verify.
7. Sound-deaden underside of tabletop with NSF-approved sound dampening material.

ITEM #31: CASH REGISTER -- (N.I.K.E.C. – FURNISHED BY OWNER)

QUANTITY: Two (2)

ITEM #32: CONDIMENT COUNTER, MOBILE

QUANTITY: One (1)
MANUFACTURER: Elite 500 by Piper Products
MODEL NO.: 2TSL-MOD (N058)
PERTINENT DATA: 50" Long, With Storage Base
UTILITIES REQ'D: ----
ALTERNATE MFRS.: Director's Choice by Eagle Group; Shelleysteel by The Delfield Co.

Furnish and set-in-place per Equipment Plan, Sheet QF101; Manufacturer's Shop Drawing and the following:

1. (SRTS-50) - 10" wide full-length solid tray slides mounted on fold-down brackets, on both sides.
2. Enclosed understorage base with bottom and intermediate stainless steel shelf and stainless steel sliding doors with lock.
3. 5" diameter heavy-duty swivel casters, all four (4) with brakes.
4. Modified counter height of 30" A.F.F.
5. Laminate front, back and ends, color as selected by Architect; K.E.C. to verify.

ITEM #33: MOP SINK & RACK -- (N.I.K.E.C. – SPECIFIED UNDER MECHANICAL DIVISION)

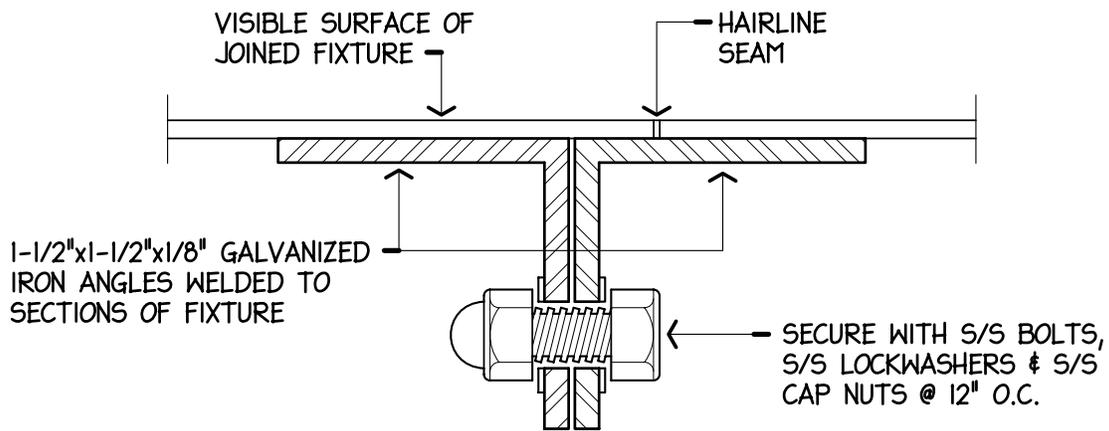
QUANTITY: One (1)

ITEM #34: SHELVING -- (N.I.K.E.C. – SPECIFIED BY ARCHITECT)

QUANTITY: One (1)

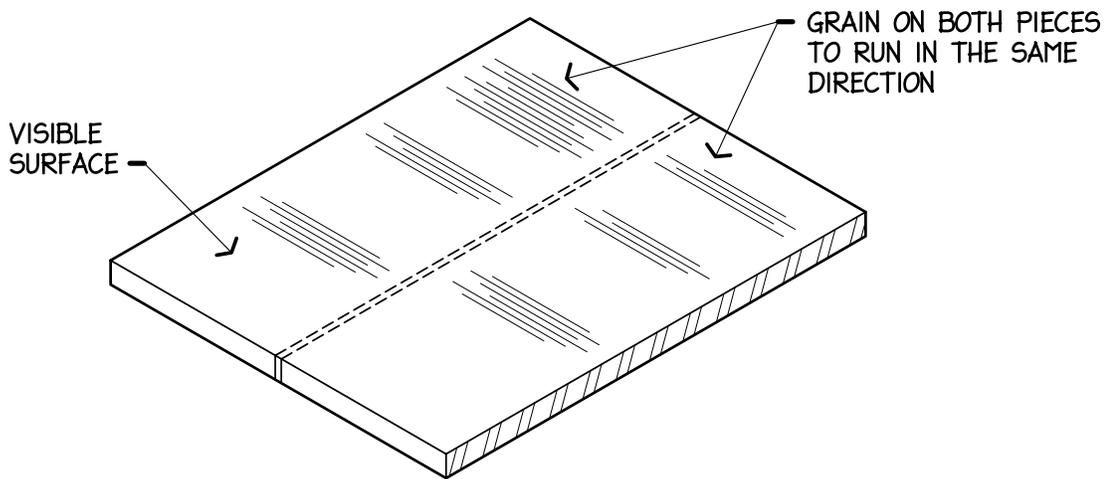
(END OF FOODSERVICE ITEMIZED SPECIFICATIONS)

STANDARD DETAILS



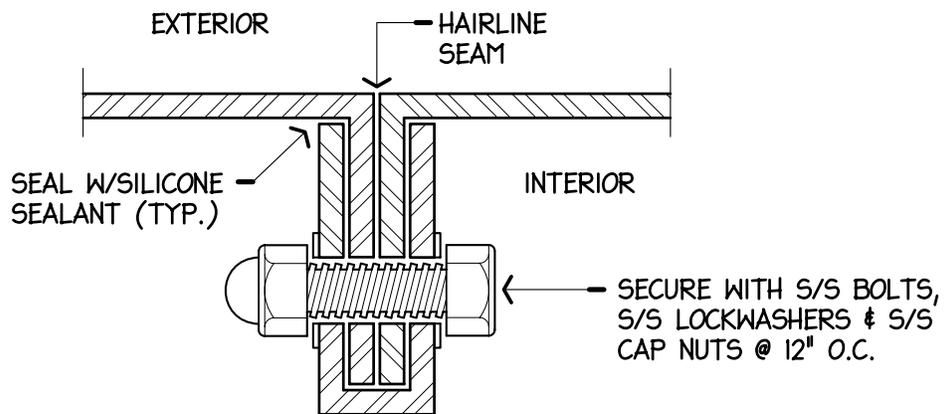
NOTE! JOINED SECTIONS SHALL BE DRAWN TOGETHER LEAVING ONLY A HAIRLINE SEAM.

A. BOLT DRAWN JOINT



NOTE! ON FIXTURES SPECIFIED WITH WELDED FIELD JOINTS, WELDS SHALL BE CONTINUOUS, GROUND & POLISHED LEAVING NO VISIBLE EVIDENCE OF WELD.

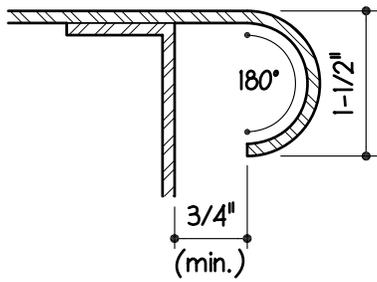
B. WELDED BUTT JOINT



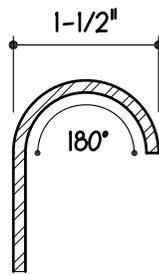
NOTE! JOINED SECTIONS SHALL BE DRAWN TOGETHER LEAVING ONLY A HAIRLINE SEAM.

C. RAISED CAP SEAM - KNUCKLE JOINT

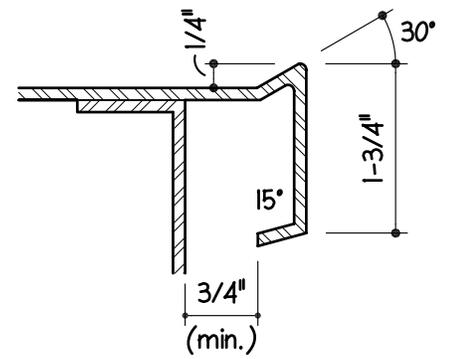
 <p>NYIKOS ASSOCIATES, INC. Food Facilities Design/Consulting</p>	DESCRIPTION:	STANDARD DTL:
	FIELD JOINTS & ASSEMBLY	1.01
		PAGE:
		114000-40



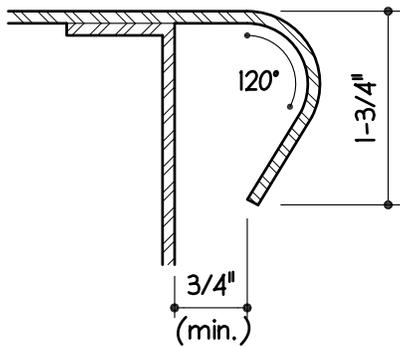
ROLLED A.



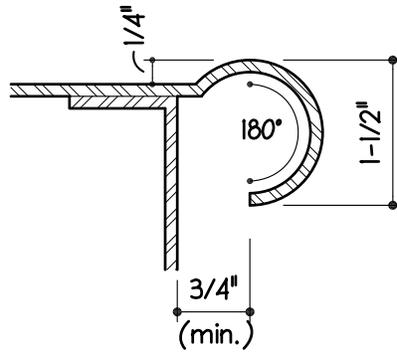
RAISED ROLLED B.



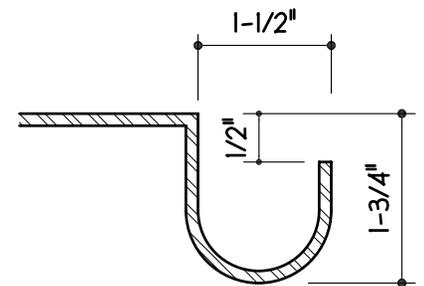
INVERTED "V" EDGE C.



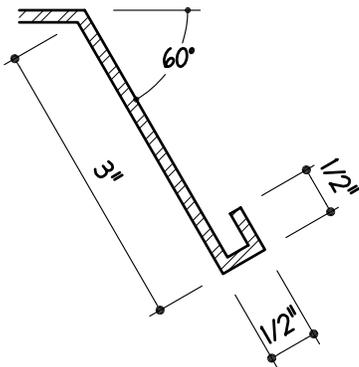
BULL NOSE ROLLED D.



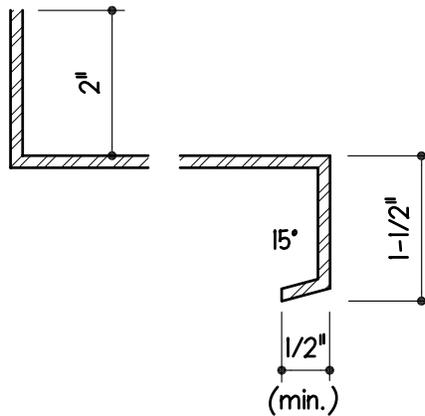
MARINE EDGE E.



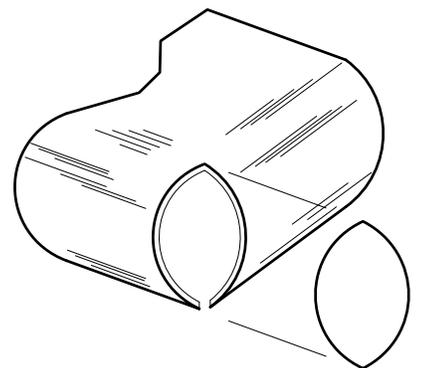
FLOUR GUTTER F.



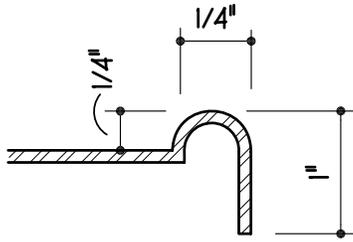
RECIPE CARD HOLDER G.



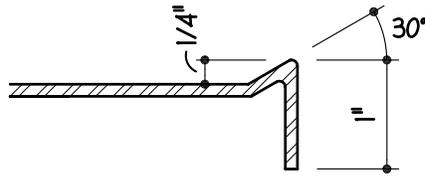
UNDERSHELF EDGE H.



BULL NOSE CORNER I.

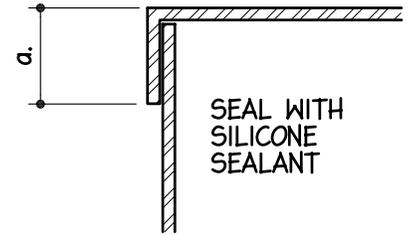


RAISED OPENING EDGE J.

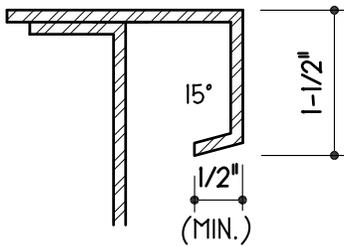


RAISED OPENING EDGE K.

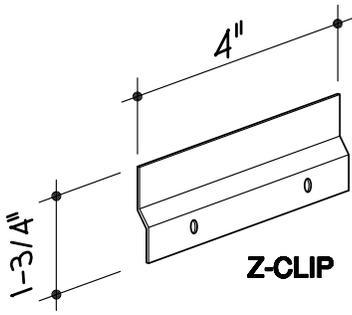
a. AS SPECIFIED, TO MATCH ADJACENT ROLLED EDGES



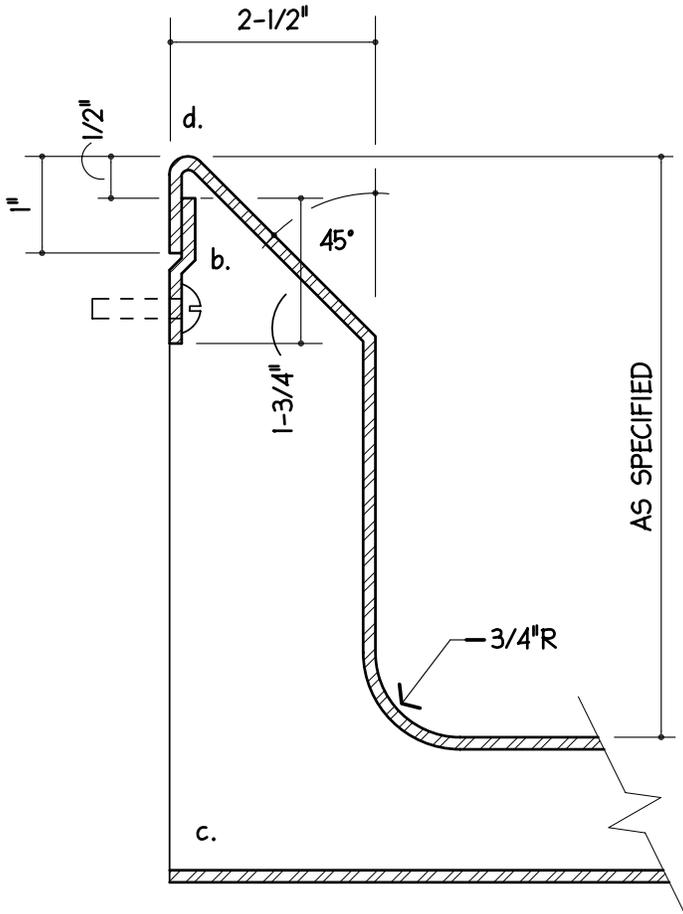
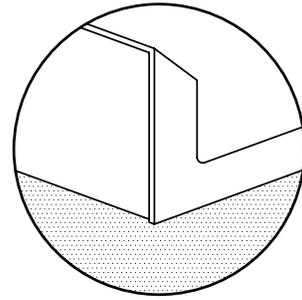
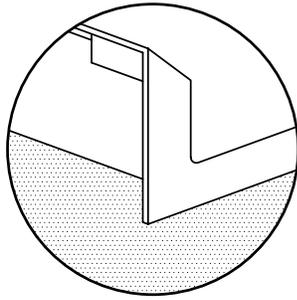
STRAIGHT TURN DOWN L.



TURNED DOWN EDGE M.



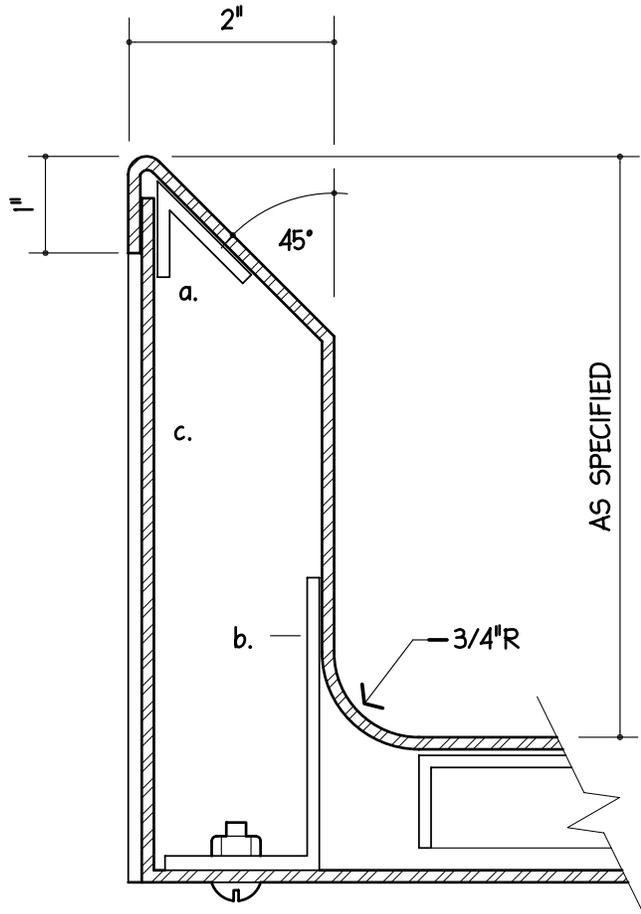
Z-CLIP



WALL UNIT

DETAIL A

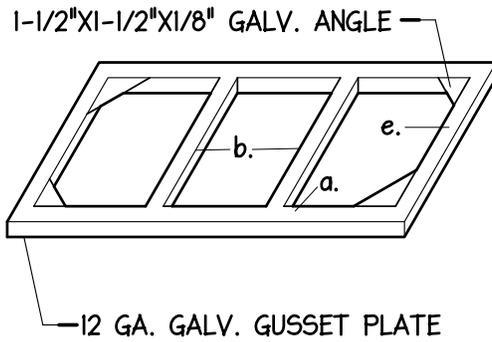
- a. 2-1/2" AT SINK TO ALLOW FOR CONNECTED OVERFLOW
- b. 12 GA. S/S CLIPS, 4" LONG, FASTENED TO EACH WALL END OF EACH UNIT & 4'-0" ON CENTER. SECURE TO WALL W/A MINIMUM OF TWO 1/4"x20 S/S TOGGLE BOLTS OR EXPANSION SHIELDS.
- c. EXPOSED ENDS TO BE FULLY WELDED CLOSED.
- d. SEAL ALL AROUND TO WALL WITH SILICONE SEALANT.



FREE STANDING UNIT

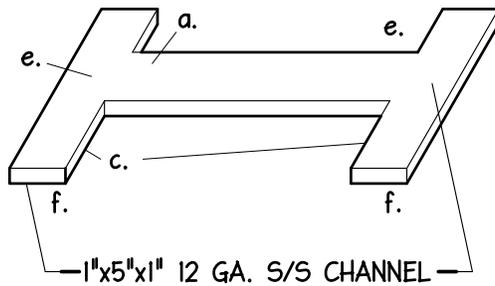
DETAIL B

- a. 1"x1"x14 GA. S/S x1-1/2" LONG RETAINING CLIP WELDED IN PLACE. ONE AT EACH END OF UNIT AND 12" ON CENTER.
- b. 2-1/2"x1-1/2"x1-1/2" 14 GA.S/S CLIP WELDED TO SPLASH. ONE AT OF EACH UNIT & 12" ON CENTER.
- c. 14 GA S/S PANEL SECURED TO CLIPS W/ S/S OVALHEAD BOLT. WELD NUT TO CLIP.
- d. EXPOSED ENDS TO BE FULLY WELDED.



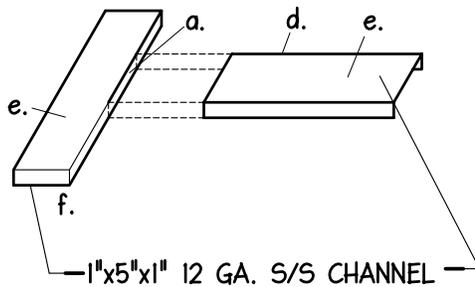
TABLES

A.



DISHTABLES

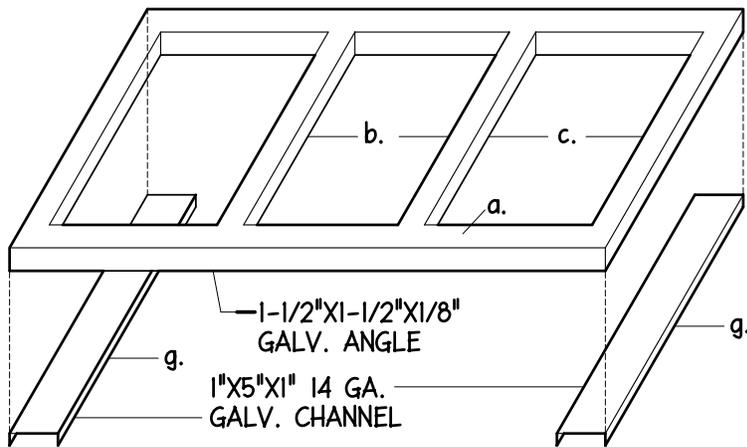
B.



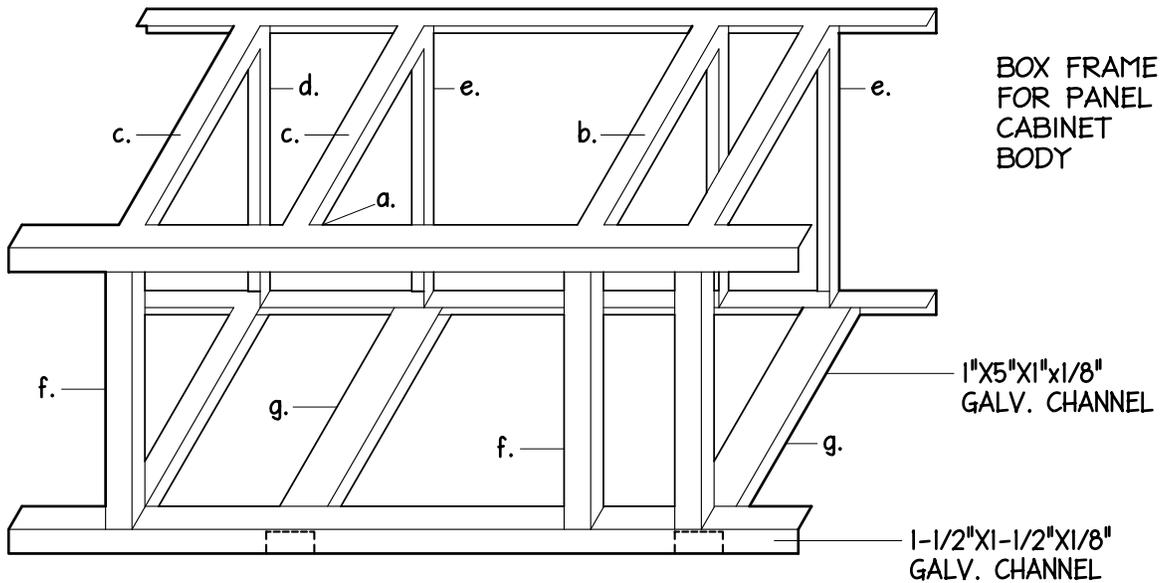
**SINK
DRAINBOARDS**

C.

- a. FULLY WELDED CONSTRUCTION.
- b. ANGLE LOCATION - ENDS; SIDES OF TOP INSETS; INTERMEDIATES
24" ON CENTER.
- c. CHANNEL LOCATION - ENDS AND INTERMEDIATE MAXIMUM 6'-6" O.C.
- d. ADD CENTER CHANNEL WHEN DRAINBOARD LENGHT EXCEEDS 5'-6".
- e. SECURE TOP TO FRAMEWORK WITH WELDED STUDS, S/S LOCKWASHERS
AND CAP NUTS.
- f. CLOSE CHANNEL AT FRONT ONLY.

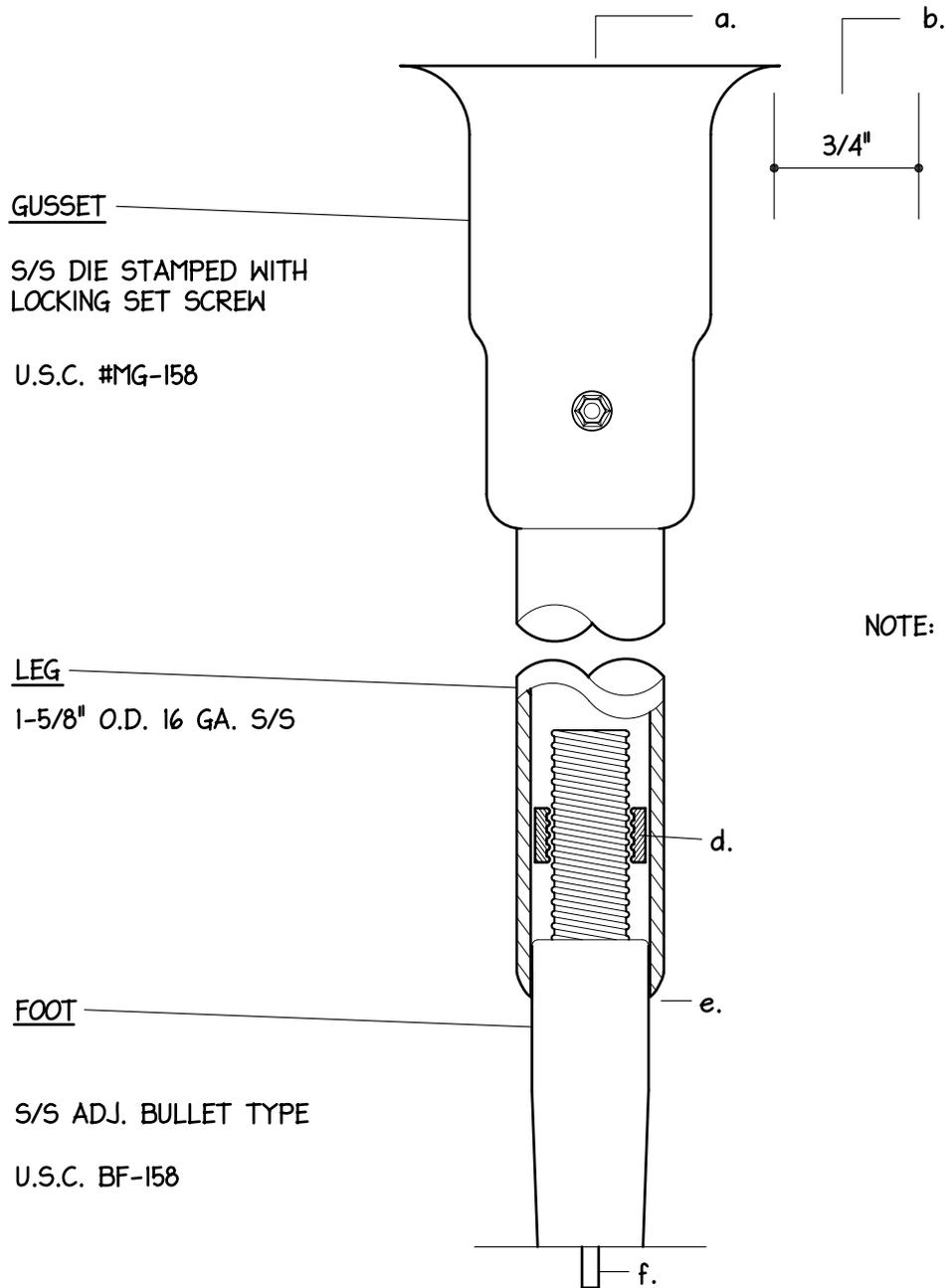


FRAME FOR
STRUCTURALLY
FORMED
CABINET BODY



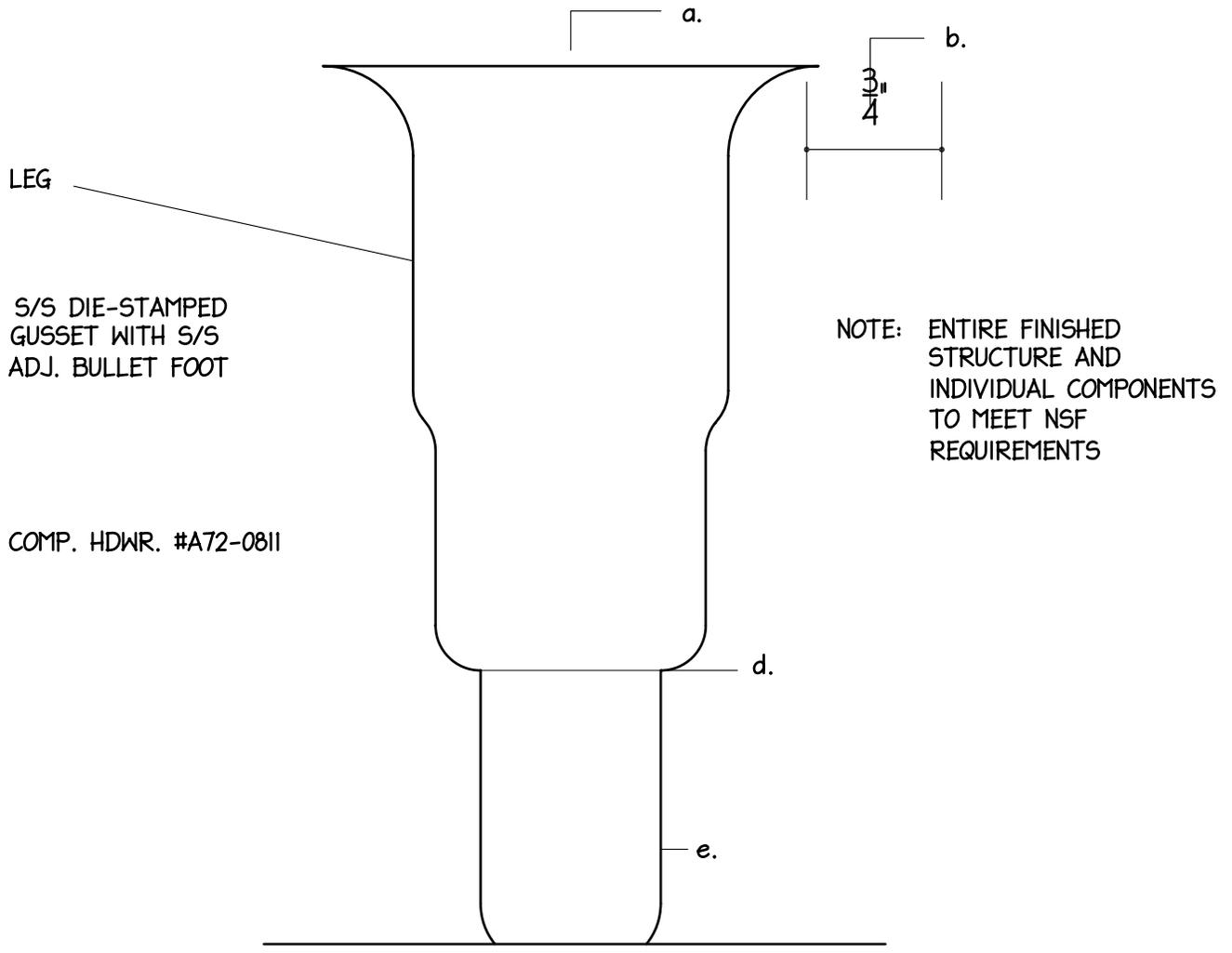
BOX FRAME
FOR PANEL
CABINET
BODY

- a. FULLY WELDED CONSTRUCTION.
- b. SECURE TOP TO FRAMEWORK WITH WELDED STUDS, S/S LOCKWASHERS, AND CAP UNITS. MAXIMUM 15" ON CENTER.
- c. TOP ANGLE LOCATION - ENDS; SIDES OF TOP INSETS; UNDER HEAVY EQUIPMENT LEGS; INTERMEDIATES 24" ON CENTER.
- d. BACK ANGLE LOCATION - ENDS; INTERMEDIATE MAXIMUM 5'-6" ON CENTER.
- e. CAFETERIA FRONT ANGLE (CHANNEL) LOCATION - ENDS; INTERMEDIATES TO CORRESPOND TO PILASTERS, SLIDE BRACKETS, PANEL SPACING, MAXIMUM 4'-0" ON CENTER. RE: STDS.-4.01 THRU 4.04.
- f. WORK SIDE ANGLE LOCATION - ENDS; SIDE OF OPENINGS; INTERMEDIATES MAXIMUM 5'-6" ON CENTER.
- g. BOTTOM LEG CHANNEL LOCATION - ENDS; INTERMEDIATES CORRESPOND TO FRONT PANEL SPACING; PILASTERS, SLIDE BRACKETS. MAXIMUM 5'-6" ON CENTER.



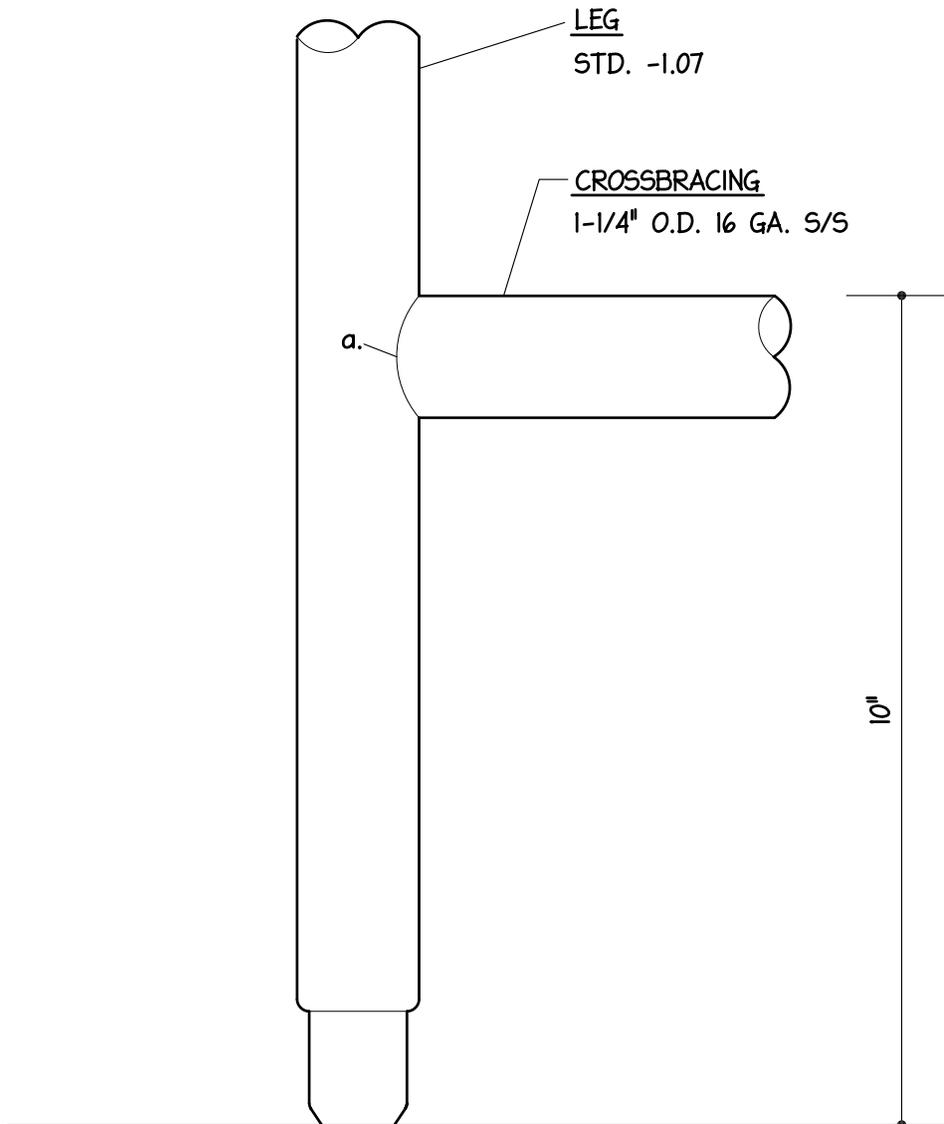
NOTE: ENTIRE FINISHED STRUCTURE AND INDIVIDUAL COMPONENTS TO MEET NSF REQUIREMENTS

- a. FULLY WELD GUSSET TO FRAMEWORK OR SINK
- b. 3/4" MINIMUM CLEARANCE ALL AROUND
- c. SET SCREW NOT VISIBLE TO WORKING SIDE OF EQUIPMENT.
- d. MAXIMUM 1/32" CLEARANCE BETWEEN LEG AND FOOT
- e. FOOT SET AT MIDPOINT TO ALLOW 1" ADJUSTMENT UP AND 1" DOWN. WITHOUT THREAD EXPOSURE.
- f. LEGS UNSUPPORTED Laterally BY CROSSBACKING OR UNDERSHELVES SHALL BE PINNED TO FLOOR USING 1/4" DIA. X 1/2" PINS WELDED TO FOOT AND SET IN MATCHING HOLES IN THE FLOOR.



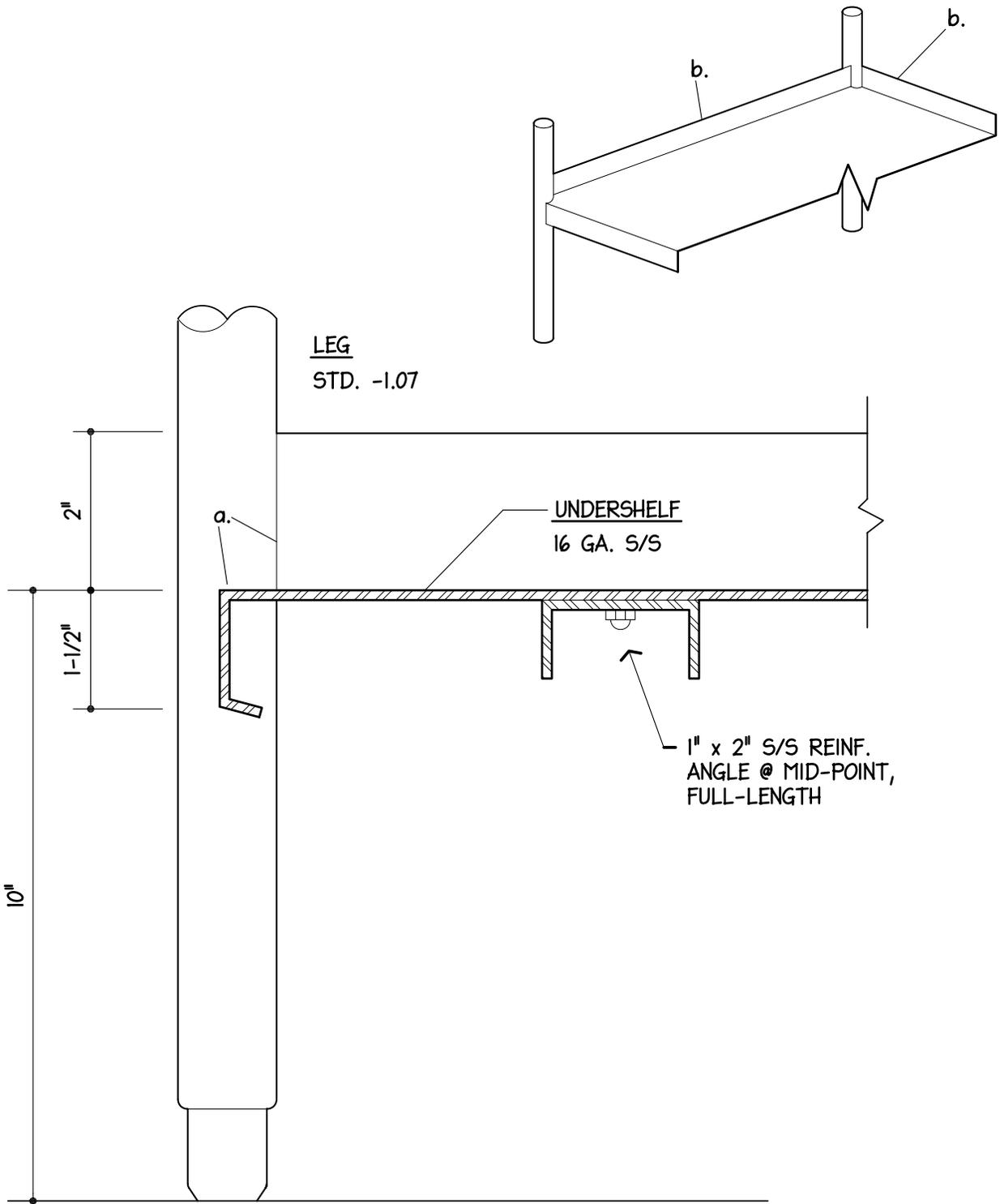
- a. FULLY WELD TO FRAMEWORK CHANNEL
- b. 3/4" MINIMUM CLEARANCE ALL AROUND
- d. MAXIMUM 1/32" CLEARANCE BETWEEN LEG AND FOOT
- e. FOOT SET AT MIDPOINT TO ALLOW 1" ADJUSTMENT UP AND 1" DOWN. WITHOUT THREAD EXPOSURE.

 NYIKOS ASSOCIATES, INC. <i>Food Facilities Design/Consulting</i>	DESCRIPTION: <p style="text-align: center;">COUNTER LEGS</p>	STANDARD DTL: <p style="text-align: center;">1.08</p>
		PAGE: <p style="text-align: center;">114000-47</p>

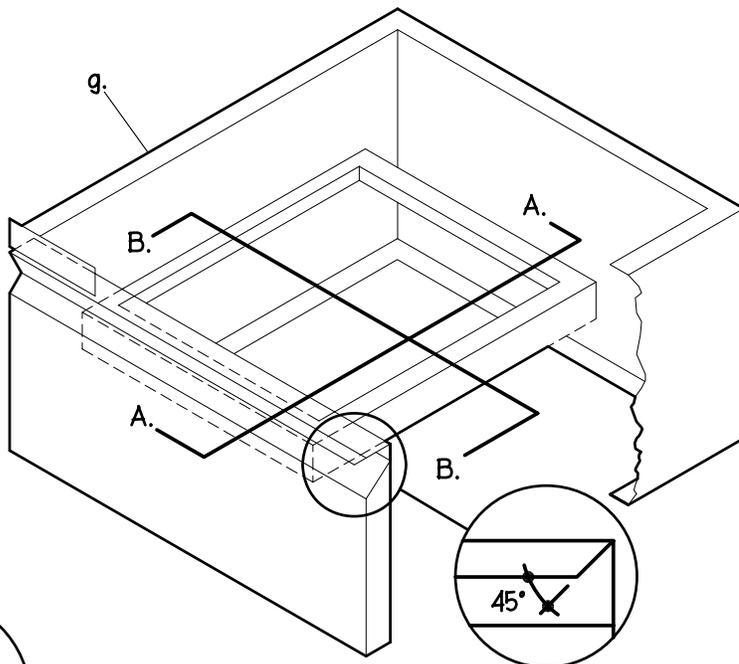


a. FULLY WELD, GRIND SMOOTH AND POLISH.

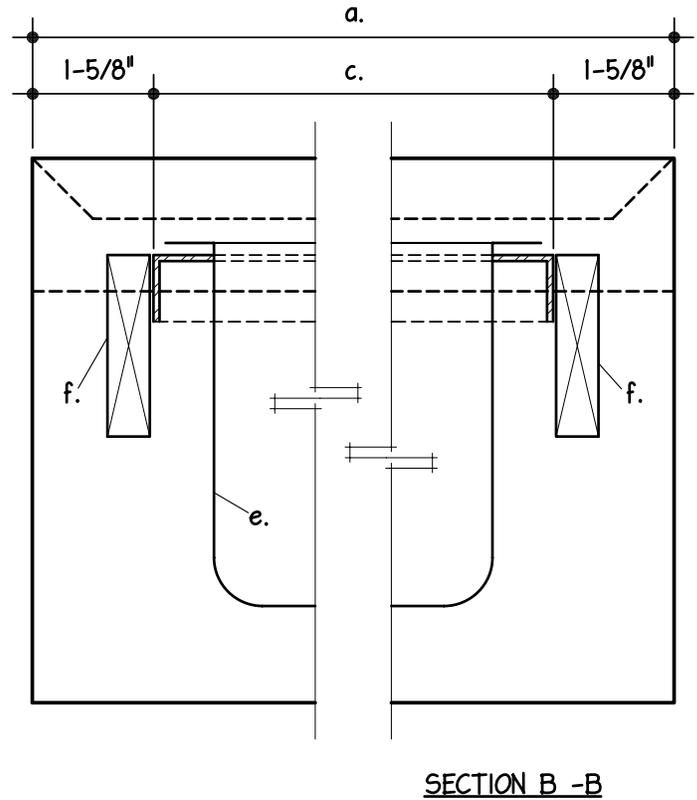
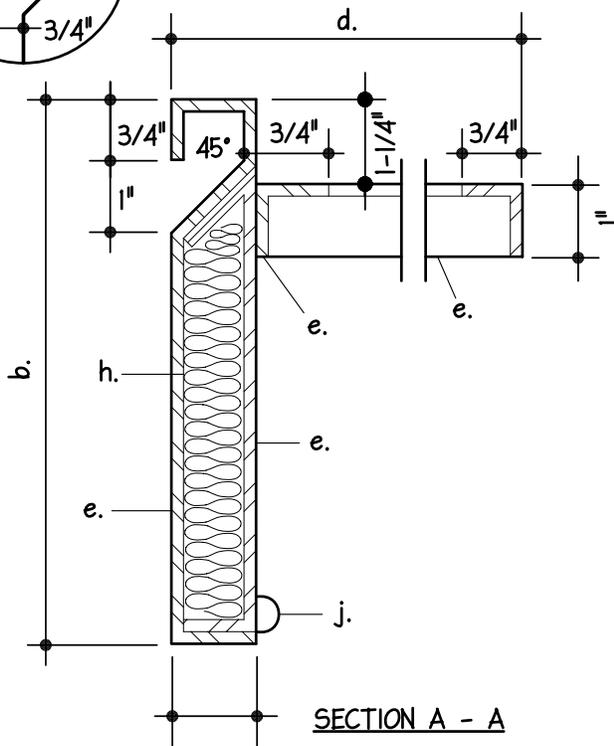
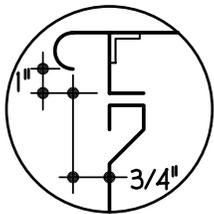
 NYIKOS ASSOCIATES, INC. <i>Food Facilities Design/Consulting</i>	DESCRIPTION:	STANDARD DTL:
	CROSSBRACING	1.10
		PAGE:
		114000-48



- a. FULLY WELD, GRIND SMOOTH AND POLISH.
- b. WHEN SPECIFIED, TURN REAR AND ENDS UP 2".

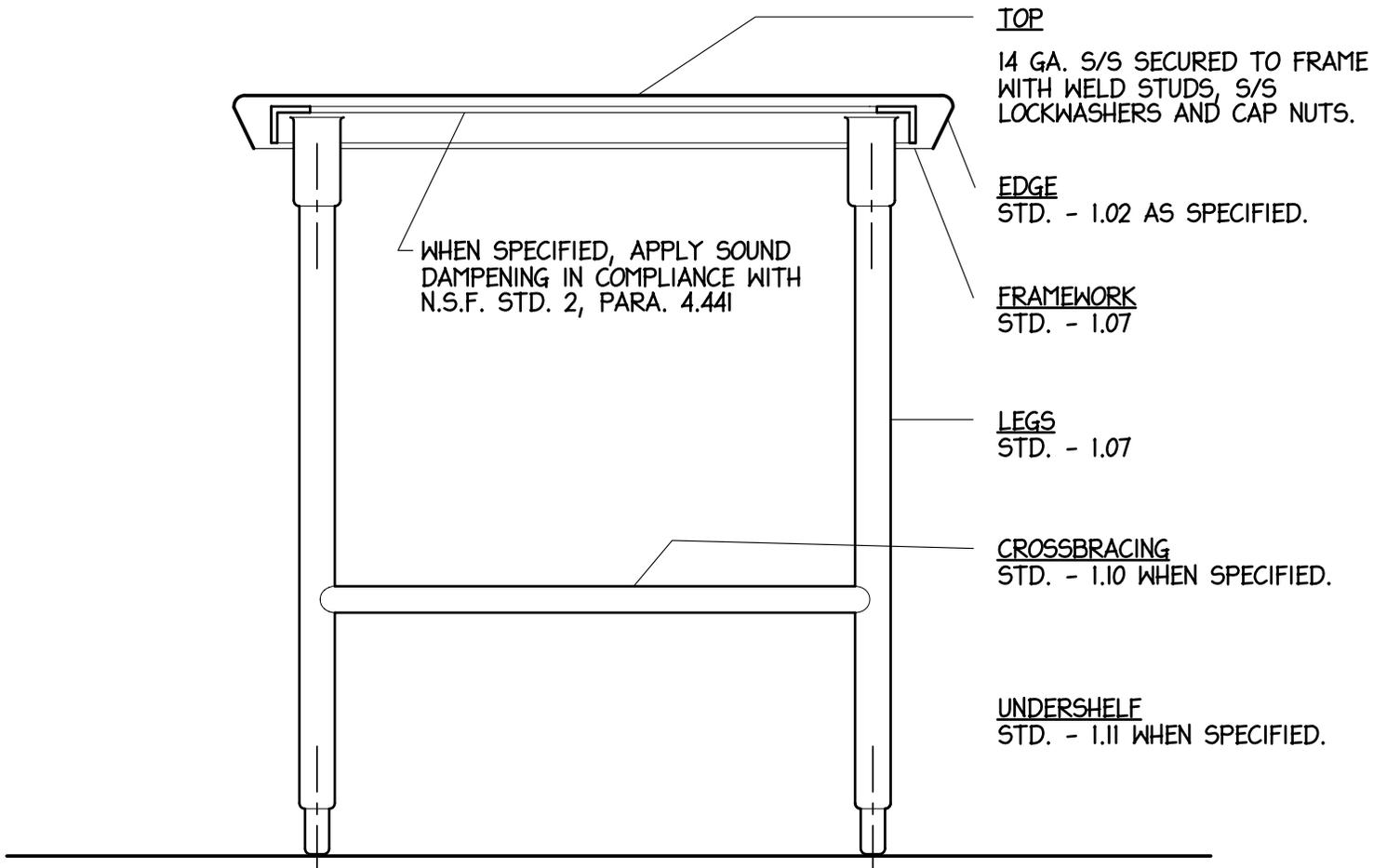
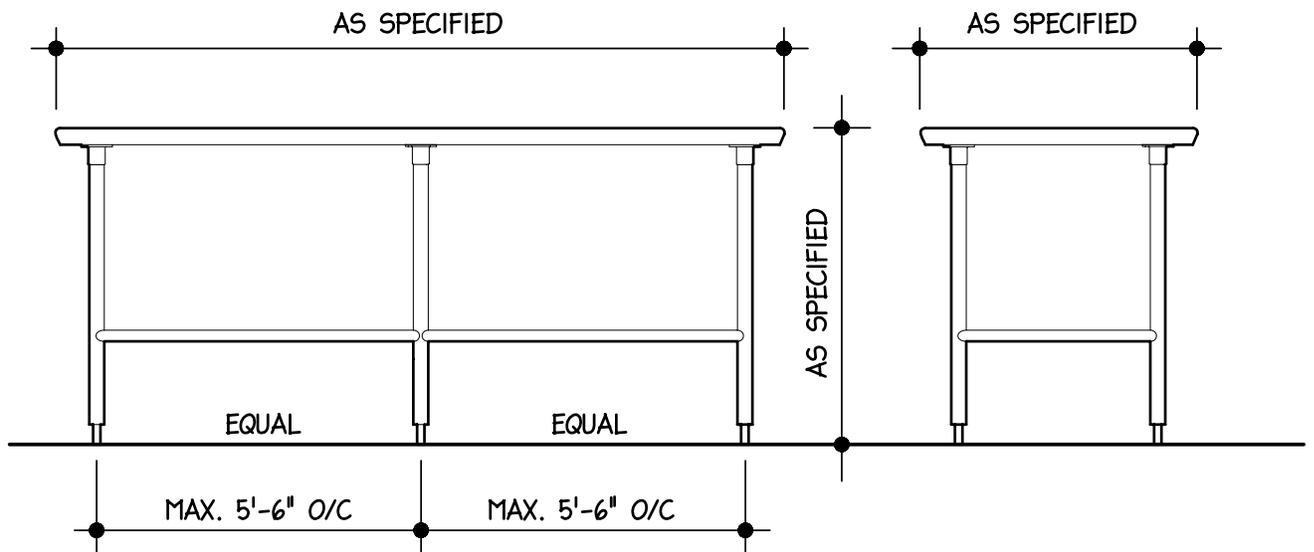


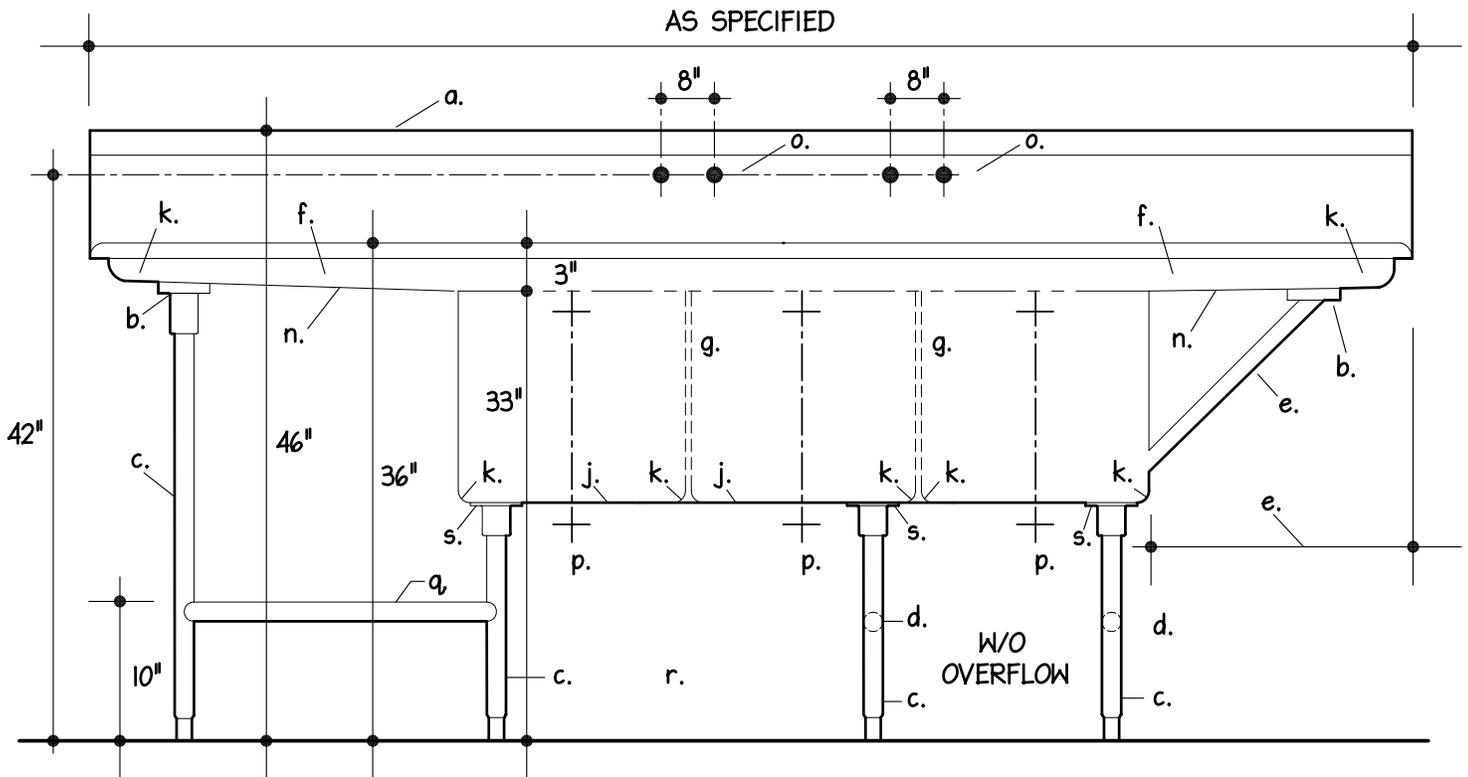
- e. 16 GA. S/S ALL WELDED.
- f. 3 PIECE SELF CLOSING DWR. SLIDE AS MFD. BY COMPONENT HARDWARE, S52 SERIES WITH S/S ROLLER BEARINGS. PITCH SLIDE DOWNWARD 3/8" PER FOOT FOR SELF-CLOSING ACTION.
- g. 18 GA. S/S DWR. ENCLOSURE. ALL WELDED.
- h. SEMI - RIGID FIBERGLASS SOUND DAMPENING.
- j. HARD RUBBER DRAWER BUMPER EACH CORNER.



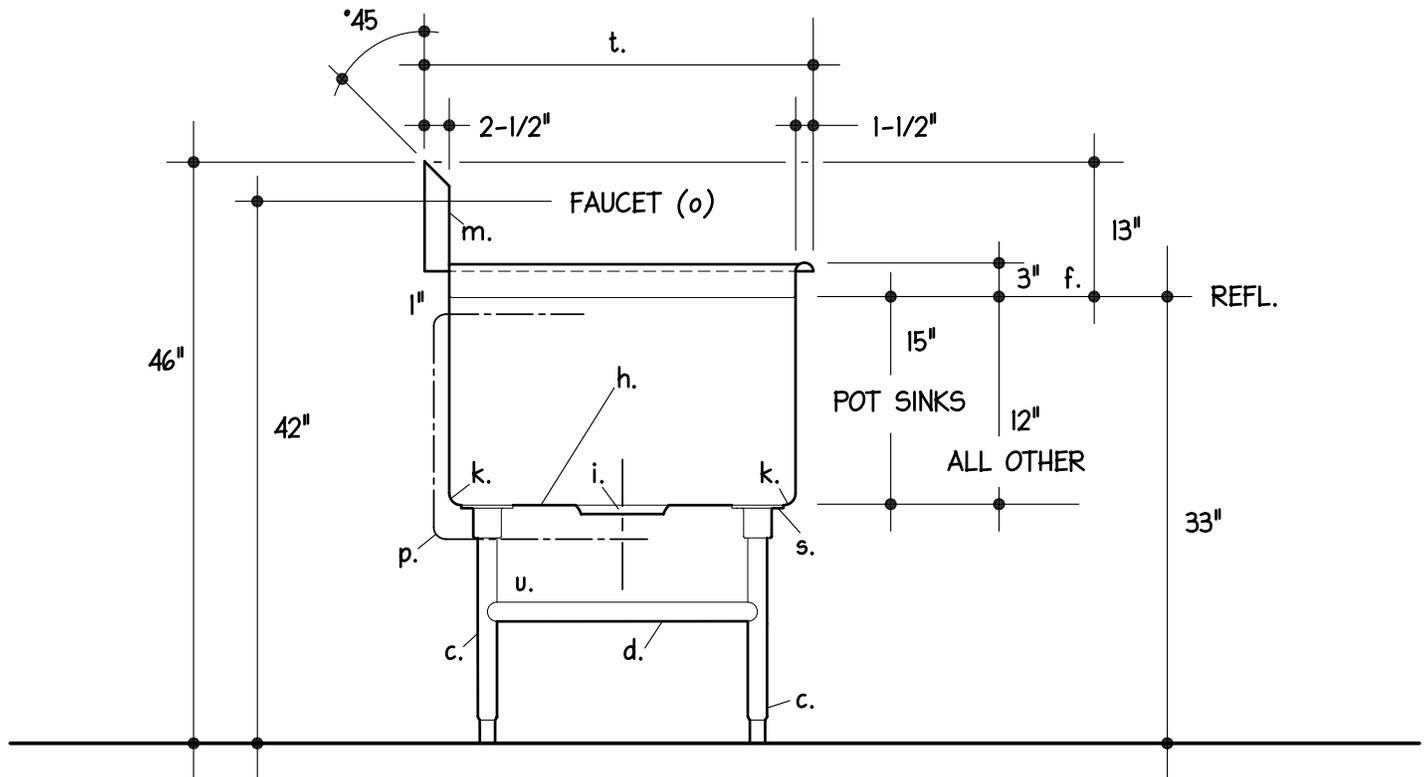
i. PROVIDE DIE - STAMPED #18 GA. S/S DWR. PANS AS FOLLOWS:

TYPE	NO.	PANS	a.	b.	c.	d.
I	1	20x20x5 DP.	25	7-1/2	21-3/4	22-3/4
II	1	20x20x8 DP.	25	10-1/2	21-3/4	22-3/4
III	1	12x20x4 DP.	25	6-1/2	21-3/4	14-1/2
IV	2	12x20x4 DP.	28	6-1/2	26-1/4	22-1/2
V	1	12x20x4 DP.	17	13-1/2	13-1/2	22-1/2





ELEVATION



TYPICAL SECTION

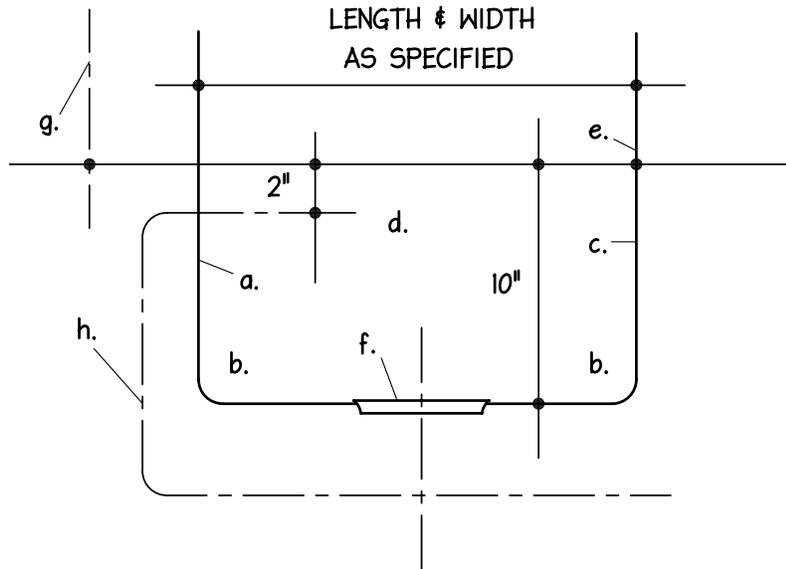
- a. MATERIAL - 14 GA. S/S.
- b. STD. - 1.05c.
- c. STD. - 1.07
- d. STD. - 1.10

CONTINUED ON STD.- 3.01.1

<p style="margin: 0;">NYIKOS ASSOCIATES, INC. Food Facilities Design/Consulting</p>	<p>DESCRIPTION:</p> <p style="font-size: 1.2em;">SINKS AND DRAINBOARDS</p>	<p>STANDARD DTL:</p> <p style="font-size: 1.5em;">3.01</p>
	<p>PAGE:</p> <p style="font-weight: bold;">114000-52</p>	

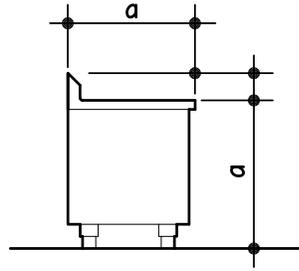
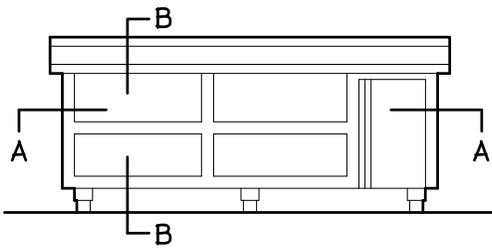
- e. DRAINBOARDS UP TO 24" IN LENGTH REQUIRE NO LEGS OR BRACES. DRAINBOARDS 25" TO 30" REQUIRE 1" O.D. 16 GA. S/S BRACE. DRAINBOARDS OVER 30" REQUIRE LEGS AND CHANNEL FRAMEWORK.
- f. DRAINBOARDS SHALL PITCH TO SINK 1/8" PER FOOT OF LENGTH TO PROVIDE COMPLETE DRAINING WITHOUT POOLING. THE 3" HIGH RAISED ROLLED RIM AT THE SINK SHALL DECREASE IN HEIGHT TOWARD THE OUTER ENDS OF THE DRAINBOARD.
- g. PARTITIONS BETWEEN COMPARTMENTS TO BE DOUBLE WALLED CONSTRUCTION WITH ROUNDED TOP, ALL WELDED INTEGRAL WITH SINK BODY.
- h. BACK, BOTTOM, AND FRONT SHALL BE ONE CONTINUOUS PIECE WITH ENDS WELDED INTEGRAL, WITHOUT OVERLAPPING JOINTS OR OPEN SPACES, BETWEEN COMPARTMENTS.
- i. WASTES SHALL BE SEATED IN DIE STAMPED DEPRESSIONS WITHOUT USE OF SOLDER, RIVETS OR WELDING. INSTALLED COMPONENTS SHALL BE FLUSH WITH SURROUNDING SURFACE.
- j. EACH SINK COMPARTMENT TO BE PITCHED AND CREASED TO WASTE TO ASSURE COMPLETE DRAINING WITHOUT POOLING.
- k. ENTIRE UNIT SHALL BE ALL WELDED COVE CORNERED CONSTRUCTION WITH VERTICAL AND HORIZONTAL AND INTERIOR CORNERS HAVING A 3/4" RADIUS.
- l. STD.- 1.02 b EDGE.
- m. STD. - 1.04a. BACKSPLASH.
- n. UNDERSIDE OF DRAINBOARDS AND SINKS TO BE SPRAYED WITH SOUND DAMPENING IN COMPLIANCE WITH N.S.F. STD. 2 PARA 4.44I WHEN SPECIFIED.
- o. FAUCETS - T&S MODEL B-232 WITH AERATOR B-199, REMOVABLE MONEL SEATS AND 1/2" I.P.S. MALE INLETS.
- p. WASTES - 2" NICKEL PLATED BRONZE ROTARY HANDLE WASTE S/S STRAINER PLATE WITH CHROME WITH CHROME PLATED BRASS CONNECTED OVERFLOW, STANDARD- KIEL HARDWARE MFG. CO. #1770-1015-1000.
- q. REAR CROSS BRACING ONLY.
- r. OMIT FRONT AND REAR LENGTHWISE CROSSBRACIG UNDER SINKS.
- s. 12 GAUGE STAINLESS STEEL 6"x 6" TRIANGULAR SUPPORT PLATE WELDED TO UNDERSIDE OF SINKS.
- t. WIDTH AS SPECIFIED.

 <p>NYIKOS ASSOCIATES, INC. Food Facilities Design/Consulting</p>	DESCRIPTION:	STANDARD DTL:
	SINK AND DRAINBOARDS	3.01.1
		PAGE: 114000-53

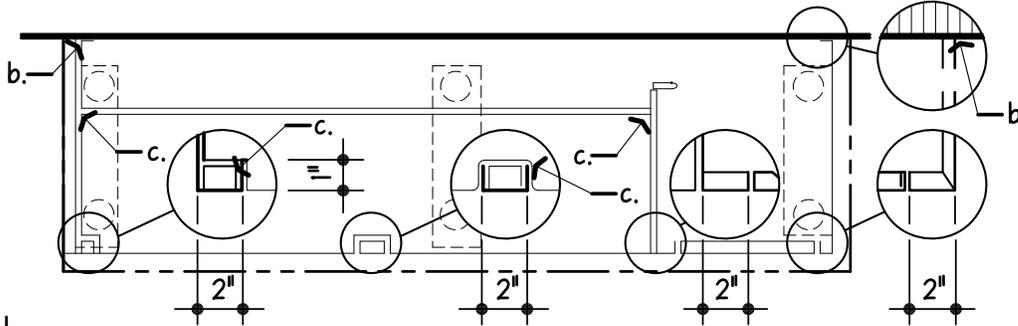


TYPICAL SECTION

- a. MATERIAL - 14 GA. S/S
- b. ENTIRE UNIT SHALL BE ALL WELDED COVE CORNERED CONSTRUCTION WITH VERTICAL AND HORIZONTAL AND INTERIOR CORNERS HAVING A 3/4" RADIUS.
- c. TWO SIDES AND BOTTOM SHELL BE ONE CONTINUOUS PIECE WITH ENDS WELDED INTEGRAL WITHOUT OVERLAPPING JOINTS.
- d. PARTITIONS BETWEEN COMPARTMENTS TO BE DOUBLE WALLED CONSTRUCTION WITH ROUNDED TOP, ALL WELDED INTEGRAL WITH SINK.
- e. FULLY WELD SINK TO TOP WITHOUT OVERLAPPING JOINTS.
- f. WASTES SHALL BE SEATED IN DIE STAMPED DEPRESSIONS WITHOUT USE OF SOLDER RIVETS OR WELDING . INSTALLED COMPONENTS SHALL BE FLUSH WITH SURROUNDING SURFACE.
- g. FAUCET - T&S MODEL B-222 FAUCET WITH B-199 AERATOR, REMOVABLE MONEL SEATS AND 1/2" IPS MALE INLETS.
- h. WASTES - 1-1/2" NICKEL PLATED BRONZE ROTARY HANDLE WASTE AND S/S STRAINER PLATE WITH CHROME PLATED BRASS CONNECTED OVERFLOW, STANDARD-KEIL HARDWARE COMPANY NO. #1770-1015-1000.

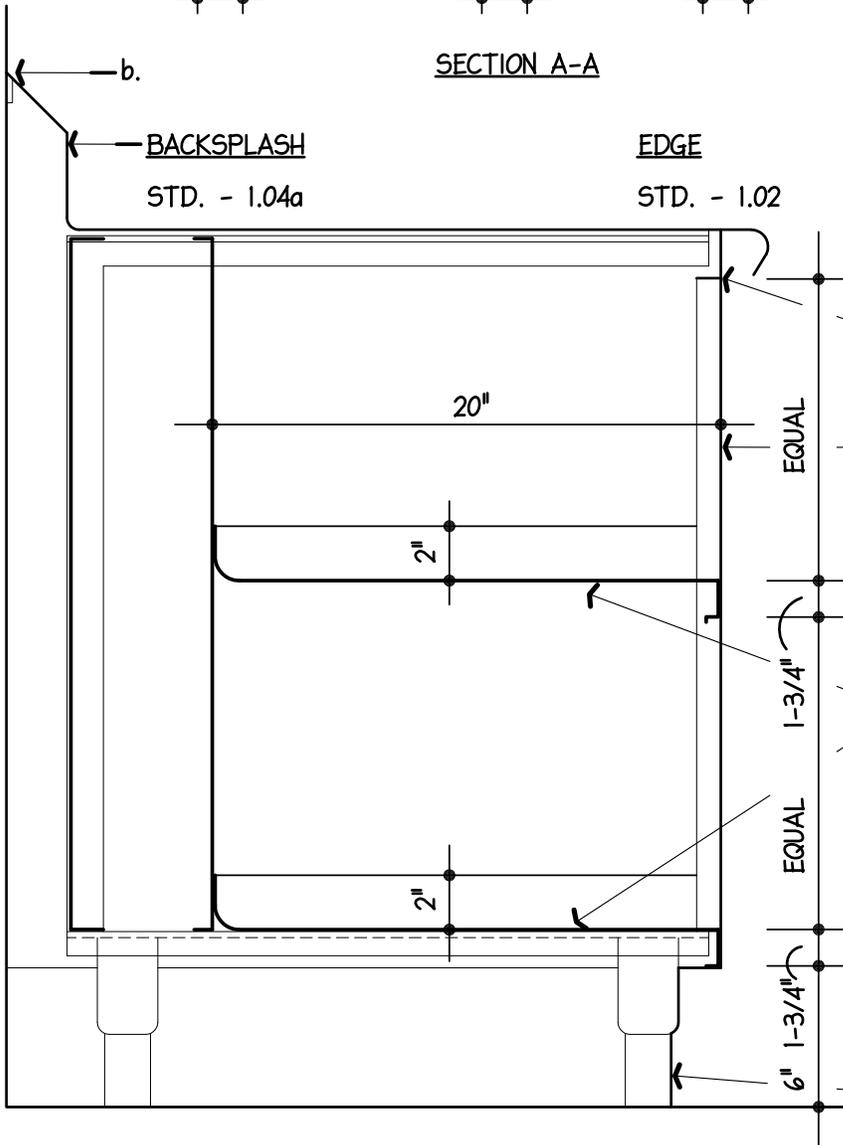


- a. AS SPECIFIED
- b. SEAL WITH SILICONE SEALANT
- c. TIGHT JOINT. CLOSED BOTTOM.



NOTE:
POP RIVETS &
EXPOSED STUDS &
CAP NUTS NOT
ACCEPTABLE.

SECTION A-A



TOP

14 GA. S/S SECURED TO FRAMEWORK WITH WELDED STUDS, S/S L.W. AND CAP NUTS.

FRAMEWORK

STD. - 1.06

BODY

18 GA. S/S WITH INTEGRALLY FORMED STRUCTURAL ANGLES AND CHANNELS TACK WELDED.

SHELVES

16 GA. S/S SECURED TO LINER WITH TACK WELLS 1/2" LONG, 12" O/C.

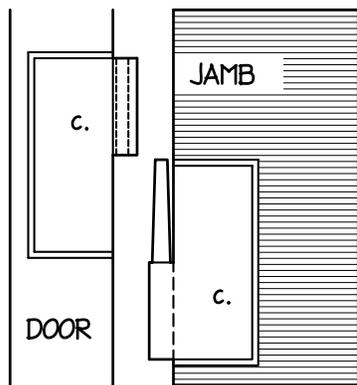
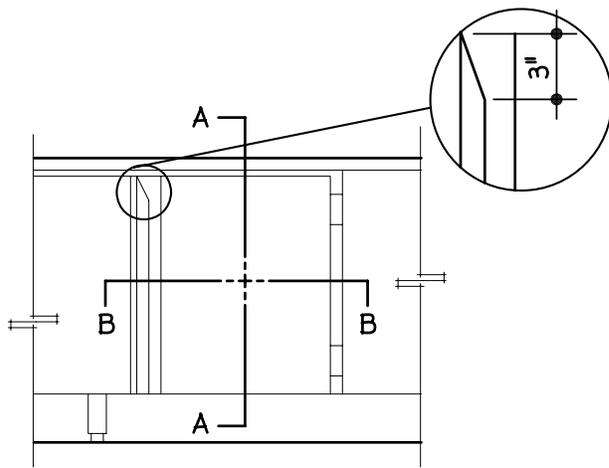
DOOR

- STD. - 4.25
- 4.26
- 4.27
- 4.28

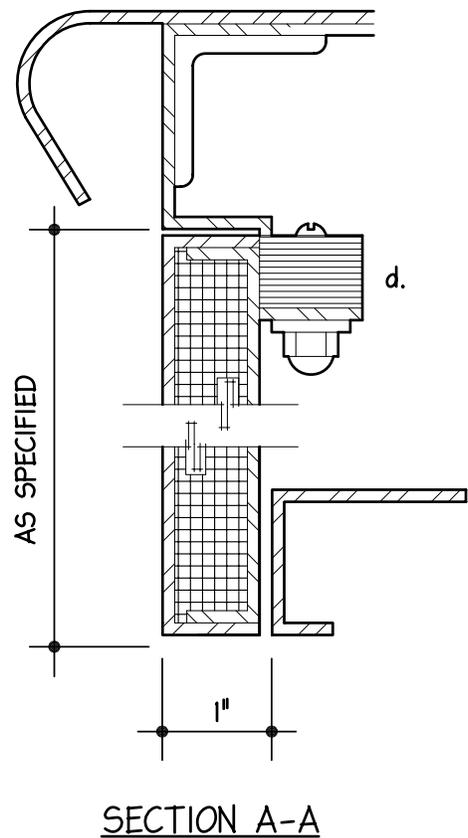
LEGS

STD. - 1.08

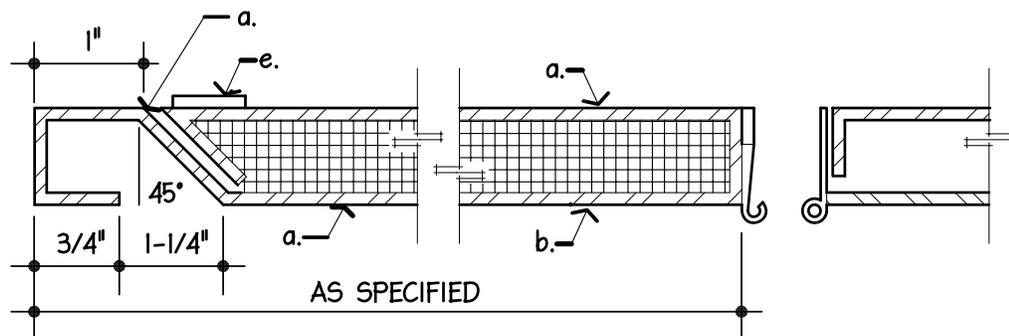
SECTION B-B



HINGE DETAIL



SECTION A-A



SECTION B-B

- a. PANELING - 18 GA. S/S GA. EXTERIOR AND INTERIOR PANS TACK WELDED.
- b. SEMI-RIGID FIBERGLASS SOUND DAMPENING.
- c. HEAVY-DUTY S/S CLIP JOINT HINGE AS MFD. BY STANDARD-KEIL. SET IN FLUSH WITH SURFACE OF DOOR AND JAMB AND WELDED IN PLACE.
- d. STANDARD-KEIL #2932-1010-3000 MAGNETIC CATCH MOUNTED FLUSH IN CUT OUT ON 1" TURN DOWN.
- e. STEEL PLATE FOR MAGNETIC CATCH TACK WELDED TO INTERIOR DOOR PAN.

(END OF SECTION 114000)

SECTION 116143 - STAGE CURTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes stage curtains, draw-curtain tracks, and rigging accessories.
- B. Related Sections:
 - 1. Section 055000 "Metal Fabrications" for steel framing and supports for stage-curtain systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. For draw-curtain machines, include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: Show fabrication and installation details for stage curtains. Include plans, elevations, sections, details, attachments to other work, and the following:
 - 1. Operating clearances.
 - 2. Requirements for supporting curtains, track, and equipment. Verify capacity of each track and rigging component to support loads.
 - 3. Locations of equipment components, switches, and controls. Differentiate between manufacturer-installed and field-installed wiring.
 - 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of stage curtain indicated. Include color charts showing the full range of colors, textures, and patterns available, together with a 12-inch- (300-mm-) square Sample (any color) of each type of fabric.
- D. Curtain Fabric Samples for Verification: Full width by 36-inch- (900-mm-) long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.
- E. Delegated-Design Submittal: For rigging indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed in Delaware responsible for their preparation.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For stage curtains and rigging to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of stage curtains.
- B. Fire-Test-Response Characteristics: Provide stage curtains with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
 - a. Permanently attach label to each fabric of curtain assembly indicating whether fabric is inherently and permanently flame resistant or treated with flame-retardant chemicals, and whether it requires retreatment after designated time period or cleaning.
- 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.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings and construction contiguous with stage curtains and rigging by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of rigging equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, faulty operation of rigging equipment.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CURTAIN FABRICS

- A. General: Provide fabrics inherently and permanently flame resistant or chemically flame resistant by immersion treatment to comply with requirements indicated. Provide fabrics of each type and color from same dye lot.
- B. Polyester Velour: Napped fabric of 100 percent polyester weighing not less than 22 oz./linear yd. (683 g/linear m), with pile height approximately 75 mils (1.9 mm); inherently and permanently flame resistant; 54-inch (1372-mm) minimum width.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dazian LLC; Angelo.
 - b. JB Martin Company; Dante.
 - c. J. L. de Ball America, Inc.; Diablo.
 - d. KM Fabrics, Inc.; Prestige.
 - e. Rose Brand; Encore.

2. Color: As selected by Architect from manufacturer's full range.

C. Muslin: Sheer, plain-woven fabric.

1. Fabric: 100 percent polyester weighing not less than 11.75 oz. /linear yd. (364 g/linear m); inherently and permanently flame resistant; 106-inch (2692-mm) minimum width.
2. Color: White.

2.2 CURTAIN FABRICATION

- A. A. Description and Sizes: New draperies shall be as made in accordance with the following schedule and as shown in the drawings, proscenium opening size (28'-0" wide by 14'-0" high):

Description	Qty	Width	Height	Fullness	Fabric Type	Lining
Main Valance	1	38'-0"	5'-0"	100%	1	No
Main Curtain	2	20'-0"	15'-0"	100%	1	No

- B. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction, in accessible location on curtain not visible to audience. Provide vertical seams unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width.

1. Vertical Hems: Provide vertical hems not less than 2 inches (50 mm) wide, and not less than 4 inches (102 mm) wide at borders, valance, teasers, and tormentors, with not less than a 1-inch (25-mm) tuck, and machine sew with no selvage material visible from front of curtain. Sew open ends of hems closed.
2. Leading Edge Turnbacks: Provide turnbacks formed by folding back not less than 12 inches (300 mm) of face fabric, with not less than a 1-inch (25-mm) tuck, and secure by sewing turnbacks vertically.
3. Top Hems: Reinforce top hems by double-stitching 3-1/2-inch- (89-mm-) wide, heavy jute webbing to top edge on back side of curtain with not less than 2 inches (50 mm) of face fabric turned under.
4. Pleats: Provide 100 percent fullness in curtains, exclusive of turnbacks and hems, by sewing additional material into 3-inch (75-mm) double-stitched box pleats sewn flat and spaced at 12 inches (300 mm) o.c. along top hem reinforcement.
5. Grommets: Brass No. 4.
 - a. Pleated Curtains: Centered on each box pleat and 1 inch (25 mm) from corner of curtain; for snap hooks or S-hooks.
6. Bottom Hems: For curtains with fullness.
 - a. For floor-length curtains, provide hems not less than 6 inches (150 mm) deep with separate, interior, 100 percent cotton, heavy canvas chain pockets equipped with proof coil chain. Stitch chain pockets so chain rides 2 inches (50 mm) above finished bottom edge of curtain. Sew open ends of hems closed.

- 1) Proof Coil Chain: Grade 30, No. 8, zinc plated, 3/16 inch (4.7 mm), ASTM A 413/A 413M.

- C. Scrim: Fabricate from scrim curtain fabric, sewn flat. Provide a continuous 6-inch (150-mm) pipe pocket at bottom with a 6-inch (150-mm) flap of same fabric in front of pocket. Provide double-stitched, 3-1/2-inch (89-mm) jute webbing at top with not less than No. 2 brass grommets spaced at 12 inches (300 mm) o.c. and 1 inch (25 mm) from corner of curtain. Provide not less than a 2-inch (50-mm) double-folded side hem and a 4-inch (100-mm) bottom hem.

- D. Drop: Fabricate from muslin fabric, sewn flat, with either horizontal or vertical seams to suit Project and selvage to the rear. Provide 6-inch (150-mm) pipe pocket at bottom with a 6-inch (150-mm) flap of same fabric in front of pocket. Provide double-stitched, 3-1/2-inch (89-mm) jute webbing at top with not less than No. 2 brass grommets spaced at 12 inches (300 mm) o.c. and 1 inch (25 mm) from corner of curtain. Provide not less than a 2-inch (50-mm) double-folded side hem and a 4-inch (100-mm) bottom hem.
- E. Snap Hooks: Track manufacturer's standard heavy-duty hooks, blind sewn to top hem of curtain.

2.3 STEEL-CURTAIN TRACK

- A. Steel Track: Fabricate of roll-formed, galvanized, commercial-quality, zinc-coated steel sheet; complying with ASTM A 653/A 653M; G60 (Z180) coating designation with continuous bottom slot and with each half of track in one continuous piece; black paint finish.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Automatic Devices Company; Besteel 170 series.
 - b. H & H Specialties Inc.; 200 series.
 - 2. Thickness: 0.064 inch (1.63 mm).
- B. Suspended Track: NPS 1-1/2 (DN 40) steel pipe stiffener for supporting both sections of suspended curved tracks.
- C. Clamp and Bracket Hangers: Manufacturer's steel clamps and brackets of sufficient strength required to support loads for attaching track to overhead support.
- D. Track Lap Clamp: Metal to match track channel for attaching double-sectioned track at center overlap.
- E. Fold Guide: Equip carriers with rear-fold or backpack guide and rubber spacers to permit offstage curtain folding; sized for use with operating line if any.
- F. Heavy-Duty Track System: Equip track with heavy-duty components. Provide end stops for track.
 - 1. Curtain Carriers: Standard carriers of plated steel with a pair of nylon-tired ball-bearing wheels riveted parallel to body. Equip carriers with rubber or neoprene bumpers to reduce noise, and heavy-duty, plated-steel swivel eye and manufacturer's standard trim chain for attaching curtain snap or S-hook. Provide quantity of curtain carriers sufficient for track length, to suit curtain fabrication.
 - a. Master Curtain Carriers: One master carrier, for each leading curtain edge, of plated steel with two pairs of nylon-tired ball-bearing wheels and with two line guides per carrier.
 - 2. End Pulleys and Floor Block: One dead-end, single-wheel pulley; one live-end, double-wheel pulley; and one adjustable, floor block; each with not less than 5-inch (125-mm) molded-nylon- or glass-filled-nylon-tired ball-bearing sheaves enclosed in steel housings. Provide pulleys with steel housing finished to match track and with bracket for securing off-stage curtain end. Provide an adjustable floor block to maintain proper tension on operating line with steel housing painted black.

2.4 DRAW-CURTAIN MACHINE

- A. General: Provide operating machine of size and capacity recommended and provided by track manufacturer for curtain specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Automatic Devices Company; Autodrape Model No. 1454.
 - b. H & H Specialties Inc.; Atlas Silk Model No. 454.
 - B. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
 - C. Operator Type: Traction drive.
 - D. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds within installed environment and with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:
 1. Voltage: 115 V.
 2. Horsepower: 1/2.
 3. Enclosure: Manufacturer's standard.
 4. Duty: Continuous duty at ambient temperature of 105 deg F (40 deg C) and at altitude of 3300 feet (1005 m) above sea level.
 5. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
 6. Phase: One.
 - E. Limit Switches: Fully closed and fully opened preset stops.

2.5 CURTAIN RIGGING

- A. Curtain Battens: Fabricate battens from steel pipe with a minimum number of joints. As necessary for required lengths, connect pipe with a drive-fit pipe sleeve not less than 18 inches (450 mm) long, and secure with four flush rivets, plug welds, threaded couplings, or another equally secure method. Shop-paint completed pipe battens with black paint and with a 1-inch- (25-mm-) wide yellow stripe at the center of each.
1. Steel Pipe: ASTM A 53/A 53M, Grade A, standard weight (Schedule 40), black, NPS 1-1/2 (DN 40) nominal diameter unless otherwise indicated.
- B. Supports, Clamps, and Anchors: Sheet steel in manufacturer's standard thicknesses, galvanized after fabrication according to ASTM A 153/A 153M, Class B.
- C. Trim and Support Cable: 1/4-inch- (6-mm-) diameter, 7x19 galvanized-steel cable with a breaking strength of 7000 lb (3175 kg). Provide fittings complying with cable manufacturer's written recommendations for size, number, and method of installation, including a drop-forged galvanized turnbuckle to allow for leveling.
- D. Inserts, Bolts, Rivets, and Fasteners: Manufacturer's standard corrosion-resistant units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for supporting members, blocking, installation tolerances, clearances, and other conditions affecting performance of stage-curtain work. Examine inserts, clips, blocking, or other supports required to be installed by others to support tracks and battens.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install stage-curtain system according to track manufacturer's and curtain fabricator's written instructions.

3.3 TRACK INSTALLATION

- A. Ceiling-Mounted Tracks: Drill track at intervals not greater than manufacturer's written instructions for spacing, and fasten directly to structure.
- B. Beam-Mounted Tracks: Install tracks by suspending from manufacturer's special beam clamps securely mounted to I-beam structure at spacing, according to manufacturer's written instructions.
- C. Wall-Mounted Tracks: Install tracks by suspending from manufacturer's special bracket clamps securely mounted to wall construction at spacing, according to manufacturer's written instructions.
- D. Spacing: Do not exceed the following dimensions between supports:
 - 1. Heavy-Duty Track: 72 inches (1829 mm).
- E. Install track for center-parting curtains with not less than 24-inch (600-mm) overlap of track sections at center, supported by special lap clamps.

3.4 CURTAIN INSTALLATION

- A. Track Hung: Secure curtains to track carriers with snap hooks.

3.5 DRAW-CURTAIN-MACHINE INSTALLATION

- A. Install draw-curtain machines by securely mounting to wall construction, according to manufacturer's written instructions.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain stage curtains, draw-curtain machines, and tracks.

END OF SECTION 116143

SECTION 116623 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Basketball equipment.
2. Volleyball equipment.
3. Wall and column safety pads.

B. Related Requirements:

1. Division 3 Section "Cast-in-Place Concrete" for installation of floor insert sleeves or oversized recessed voids to be cast in concrete subfloors and footings.
2. Division 5 Section "Structural Steel" for structural supports not provided by gymnasium equipment manufacturer for supporting gymnasium equipment to building structure.
3. Division 9 Section "Resilient Athletic Flooring" for related floor finish.

1.3 DEFINITIONS

- A. NFHS: National Federation of State High School Associations.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: For gymnasium equipment.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For the following products:

1. Pad Fabric: Wall padding not less than 3 inches (76 mm) square, with specified treatments applied. Mark face of material.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.8 COORDINATION

- A. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension-system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Basketball backboard failures including glass breakage.
 - b. Faulty operation of basketball backstops.
 - 2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

- A. Source Limitations: Obtain gymnasium equipment from single source from single manufacturer.

2.2 BASKETBALL EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Performance Sports Systems, Inc. (Basis-of-Design).
 - 2. AALCO Manufacturing
 - 3. Bison, Inc.
 - 4. Jaypro Sports Construction Group.
 - 5. Porter Athletic, Inc.
- B. General: Provide equipment complying with requirements in NFHS's "NFHS Basketball Rules Book."

- C. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
- D. Provide manufacturer's recommended connections complying with Section 055000 "Metal Fabrications" of size and type required to transfer loads to building structure.
- E. Overhead-Supported Backstops:
1. Folding Type: Provide manufacturer's standard assembly for forward-folding, front-braced backstop, with hardware and fittings to permit folding.
 - a. Basis of Design: Performance Sports Systems No. 3107
 2. Framing: Steel pipe, tubing, and shapes. Design framing to minimize vibration during play.
 - a. Center-Mast Frame: Welded and bolted or clamped with side sway bracing.
 - b. Finish: Manufacturer's standard polyester powder-coat finish.
 3. Goal Height Adjuster: Adjustable from 8 to 10 feet (2.4 to 3 m) with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.
 - a. Operation: Manual Height Adjuster with Power Wand
 - 1) Basis of Design: Performance Sports Systems No. 1130 with No. 1159
- F. Backstop Safety Device: Designed to limit free fall if support cable, chains, pulleys, fittings, winch, or related components fail; with mechanical automatic reset; 6000-lb (2722-kg) load capacity; one per folding backstop.
1. Retractor Device: Manufacturer's standard device designed to retract both support and safety cables, chains, and straps away from play of the basketball when backstop is in playing position; one per folding backstop.
- G. Basketball Backboards:
1. Shape and Size:
 - a. Rectangular, 72 by 42 inches (1800 by 1067 mm) width by height.
 2. Backboard Material: With predrilled holes or preset inserts for mounting goals, and as follows:
 - a. Glass: Not less than 1/2-inch- (13-mm-) thick, transparent tempered glass complying with ASTM C 1048 Kind FT (fully tempered) and with impact testing requirements in 16 CFR 1201 Category II or ANSI Z97.1 Class A for safety glazing. Provide glass with impact-absorbing resilient rubber or PVC gasket around perimeter in a fully welded, brushed-natural-finish, extruded-aluminum frame, with steel subframe, reinforcement, bracing, and mounting slots for mounting backboard frame to backboard support framing.
 - 1) Standard Mount: Provide steel corner reinforcement with mounting slots for mounting backboard frame to backstop support framing at standard mounting centers.
 - 2) Rim-Restraining Device: Complying with NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.
 3. Target Area and Border Markings: Marked in white, with manufacturer's standard pattern and stripe width.
- H. Goal Mounting Assembly: Compatible with goal, backboard, and support framing; with hole pattern that is manufacturer's standard for goal attachment.

1. Glass Backboard Goal Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backboard frame and to minimize stresses on glass backboard.
- I. Basketball Goals: Complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
1. Single-Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication per manufacturer's standard design.
 2. Type: Movable, breakaway design with manufacturer's standard breakaway mechanism and rebound characteristics identical to those of fixed, nonmovable ring.
 3. Breakaway Characteristics: Positive-lock movable breakaway design, with manufacturer's standard breakaway mechanism including preset pressure release, set to release at **230-lb (105-kg)** load, and automatic reset. Provide movable ring with rebound characteristics identical to those of fixed, nonmovable ring.
 4. Field Adjustment: Provide rim that is field-adjustable for rebound elasticity without being removed from the backboard.
 5. Mount: Front.
 6. Net Attachment: No-tie loops for attaching net to rim without tying.
 7. Finish: Polyester powder-coat finish.
- J. Basketball Nets: 12-loop-mesh net, between **15 and 18 inches (380 to 460 mm)** long, sized to fit rim diameter, and as follows:
1. Cord: Made from white nylon.
- K. Backboard Safety Pads: Designed for backboard thickness indicated and extending continuously along bottom and up sides of backboard and over goal mounting and backboard supports per manufacturer's standard design.
1. Attachment: Bolt on.
 2. Color: As selected by Architect from manufacturer's full range.

2.3 VOLLEYBALL EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Performance Sports Systems, Inc. (Basis-of-Design).
 2. **AALCO Manufacturing**
 3. **Bison, Inc.**
 4. **Jaypro Sports Construction Group.**
 5. **Porter Athletic, Inc.**
- B. General: Provide equipment complying with requirements in "NFHS Volleyball Rule Book."
- C. Floor Insert: Chrome-finished steel floor plate; and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, not less than 9 inches (230 mm) long to securely anchor pipe sleeve below finished floor in concrete footing; with anchors designed for securing floor insert to floor substrate indicated; one per post standard.

2.4 SAFETY PADS

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

1. Performance Sports Systems, Inc. (Basis-of-Design).
 2. AALCO Manufacturing
 3. Jaypro Sports Construction Group.
 4. Porter Athletic, Inc.
 5. Mancino Safety Wall Padding
- B. Safety Pad Surface-Burning Characteristics: ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- C. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture- and tear-resistant, PVC-coated polyester or nylon-reinforced PVC fabric, not less than 14-oz./sq. yd (475-g/sq. m) and treated with fungicide for mildew resistance; with surface-burning characteristics indicated[, and lined with fire-retardant liner].
- D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
1. Backer Board: Not less than 3/8-inch- (9.5-mm-) thick fire-retardant-treated plywood according to AWPA U1, UCFA Fire Retardant Interior.
 2. Fire-Resistive Fill: Multiple-impact-resistant foam not less than 2-inch- (50-mm-) thick, fire-resistive neoprene; 6.0-lb/cu. ft. (96-kg/cu. m) density.
 3. Size: Each panel section, 24 inches (610 mm) wide by not less than 60 inches (1524 mm) long.
 4. Number of Modular Panel Sections: As required per drawings.
 5. Installation Method: Concealed mounting Z-clips.
 6. Fabric Covering Color(s): Selected by Architect from Manufacturer's full range of colors.
- E. Column Safety Pads: Pads covering exposed flange of columns to height indicated, consisting of not less than 1-1/4-inch- (32-mm-) thick, multiple-impact-resistant, closed-cell, polyethylene-foam filler, covered on both sides and all edges by fabric covering with backer board and manufacturer's standard anchorage to column.
1. Length: Each pad matching length of wall safety pads.
 2. Fabric Covering Color(s): Match color of wall safety pads.
- F. Cut-out Trim: Provide manufacturer's standard flanged cut-out trim kits for fitting pads around switches, receptacles, and other obstructions.
1. Color: Black.

2.5 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for use and finish type indicated.
1. Extruded Bars, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 2. Cast Aluminum: ASTM B 179.
 3. Flat Sheet: ASTM B 209 (ASTM B 209M).
- B. Steel: Comply with the following:
1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2. Steel Tubing: ASTM A 500/A 500M or ASTM A 513, cold formed.
 3. Steel Sheet: ASTM A 1011/A 1011M.
- C. Support Cable: Manufacturer's standard galvanized-stranded-steel wire rope with a breaking strength of **7000 lb (3175 kg)**. Provide fittings complying with wire rope manufacturer's written instructions for size, number, and installation method.
- D. Castings and Hangers: Malleable iron, complying with ASTM A 47/A 47M; grade required for structural loading.
- E. Equipment Wall-Mounted Board: Wood, transparent finish, size, and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.
- F. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.
- G. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C 1107/C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
1. Verify critical dimensions.
 2. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions. Complete equipment field assembly where required.
- B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, are completed.
- C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.
1. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.
- D. Floor Insert Setting: Grout sleeve for post standards in oversized, recessed voids in concrete slabs. Clean holes of debris. Position sleeve and fill void around sleeves with grout, mixed and placed to comply with

grout manufacturer's written instructions. Protect portion of sleeve above subfloor and footing from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.

- E. Wall / Column Safety Pads: Mount with bottom edge at [4 inches (102 mm)] [dimension indicated on Drawings] above finished floor.
- F. Cut-out Trim: Limit cuts in face of padding from trim unit's corner-to-corner outside dimensions. Install with ends of cuts concealed behind trim flange.
- G. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.
- H. Connections: Connect electric operators to building electrical system.

3.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION 116623

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Manually operated roller shades with single rollers.
- 2. Motor-operated roller shades with double rollers.

- B. Related Requirements:

- 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
- 2. Division 26 Sections for electrical service and connection for motor operators, controls, limit switches, and other powered devices and for system disconnect switches for motorized shade operation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

- 1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

- C. Samples for Initial Selection: For each type and color of shadeband material.

- D. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roller shades to include in maintenance manuals.

1.5 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades 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 Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUALLY OPERATED SHADES WITH SINGLE ROLLER (WS-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade Systems – Suburban / 2 or comparable product by one of the following: (if mounting can meet Mecho Shade dimensions)
 1. Draper Inc. – Single Roller Clutch Operated FlexShade
 2. Hunter Douglas Contract. – FR Roller Shades (if mounting can meet Mecho Shade dimension)
- B. Source Limitations: Obtain roller shades from single source from single manufacturer.
- C. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 1. Bead Chains: Nickel-plated metal.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Chain tensioner, sill mounted.
- D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Single-Roller Mounting Configuration: Side by side.
 - a. Drive-End Location: Right side of inside face of shade.
 - b. Direction of Shadeband Roll: Regular, from back of roller.
 - c. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.

- E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

- F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

- G. Shadeband:
 1. Shadeband Material: Light-filtering fabric.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.

- H. Installation Accessories:
 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches (76 mm).
 2. Endcap Covers: To cover exposed endcaps.
 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

- 2.2 **MOTOR-OPERATED, DOUBLE-ROLLER SHADES (WS-2)**
 - A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade Systems – Electro/3 Standard Double Shade #20 or comparable product by one of the following: (if mounting can meet Mecho Shade dimensions)
 1. Draper Inc. – Dual Roller Motorized FlexShade
 2. Hunter Douglas Contract. – FR Roller Shades (if mounting can meet Mecho Shade dimension)

 - B. Source Limitations: Obtain roller shades from single source from single manufacturer.

 - C. Motorized Operating Systems: Provide factory-assembled, shade-operator systems of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
 1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Electric Motor: Manufacturer's standard tubular, enclosed in rollers.

- a. Electrical Characteristics: Single phase, 110 V, 60 Hz.
3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:
 - a. Keyed Control Station: Keyed, maintained-contact, three-position, switch-operated control station with open, close, and off functions. Provide two keys per station.
 - b. Color: As selected by Architect from manufacturer's full range.
4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
5. Limit Switches: Adjustable switches, interlocked with motor controls and set to stop shade movement automatically at fully raised and fully lowered positions.
6. Operating Features:
 - a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 - b. Override switch.
- D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shades for service.
 1. Double-Roller Mounting Configuration: Side by side.
 2. Inside Roller:
 - a. Drive-End Location: Right side of inside face of shade.
 - b. Direction of Shadeband Roll: Regular, from back of roller.
 3. Outside Roller:
 - a. Drive-End Location: Right side of inside face of shade.
 - b. Direction of Shadeband Roll: Regular, from back of roller.
 4. Shadeband-to-Roller Attachment: Removable spline fitting integral channel in tube.
- E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.
- F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- G. Inside Shadebands:
 1. Shadeband Material: Light-filtering fabric.
 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.
- H. Outside Shadebands:
 1. Shadeband Material: Light-blocking fabric.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As selected by Architect from manufacturer's full range.

I. Installation Accessories:

1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
 - a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open, but not less than 4 inches (102 mm).
 - b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
2. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 1. Source: Roller-shade manufacturer.
 2. Basis of Design – Mecho Shade Systems: ThermoVeil Basket Weave 1500
 3. Type: PVC-coated polyester.
 4. Weave: Basketweave.
 5. Roll Width: 96 inches.
 6. Orientation on Shadeband: Up the bolt.
 7. Openness Factor: 3 percent.
 8. Color: As selected by Architect from manufacturer's full range.
- C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
 1. Source: Roller-shade manufacturer.
 2. Basis of Design – Mecho Shade Systems: Midnite Blackout 0200 Series
 3. Type: Acrylic-coated polyester.
 4. Roll Width: 96 inches.
 5. Orientation on Shadeband: Up the bolt.
 6. Openness Factor: 0 percent.
 7. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop 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 deg F (23 deg C):
 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch

(3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).

- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
 - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
- B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123200 - MANUFACTURED WOOD CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Plastic-laminate-faced wood cabinets of stock design.
- 2. Solid-surfacing-material countertops.
- 3. Wall shelving.

B. Related Sections:

- 1. Division 06 Section "Miscellaneous Rough Carpentry" for wood blocking for anchoring manufactured wood casework.
- 2. Division 09 Section "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring manufactured wood casework.

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches (1220 mm) above floor, and surfaces visible in open cabinets.

C. Semiexposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches (1980 mm) or more above floor are defined as semiexposed.

D. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

E. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish complete touchup kit for each type and finish of manufactured wood casework provided. Include scratch fillers, stains, finishes, and other materials necessary to perform permanent repairs to damaged casework finish.

1.6 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 manufactured wood casework from single source from single manufacturer.
- C. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."
 - 1. Provide AWI Quality Certification Program certificate indicating that manufactured wood casework complies with requirements.
- D. Product Designations: Drawings indicate sizes, configurations, and finish material of manufactured wood casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Division 01 Section "Product Requirements."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install manufactured wood casework until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with manufactured wood casework by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate layout and installation of framing and reinforcements in walls and partitions for support of manufactured wood casework.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 - d. Deterioration of finishes.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide TMI Systems or comparable product by one of the following:
 1. Plastic-Laminate-Faced Manufactured Casework:
 - a. Case Systems Inc.
 - b. Fisher Hamilton L.L.C.
 - c. LSI Corporation of America; a Sagas International company.

2.2 MATERIALS, GENERAL

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.
- C. Softwood Plywood: DOC PS 1.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. MDF: ANSI A208.2, Grade 130.
- F. Hardboard: AHA A135.4, Class 1 Tempered.
- G. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Formica Corporation.
 - b. Wilsonart International; Div. of Premark International, Inc.
- H. Edgebanding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.
 1. Select wood edgebanding for grain and color compatible with face veneers.
- I. 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:
 - a. E. I. du Pont de Nemours and Company.
 - b. Meganite Inc.; a division of The Pyrochem Group.

2. Type: Provide Standard type unless Special Purpose type is indicated.

- J. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
- K. Edgebanding for Thermoset Decorative Panels: PVC or polyester edgebanding matching thermoset decorative panels.

2.3 CABINET MATERIALS

A. Exposed Cabinet Materials:

- 1. Plastic Laminate: Grade VGS.
- 2. Unless otherwise indicated, provide specified edgebanding on all exposed edges.

B. Semiexposed Cabinet Materials:

- 1. Plastic Laminate: Grade VGS.
 - a. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.
- 2. Metal for Steel Drawer Pans: Cold-rolled, steel sheet.
- 3. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.

C. Concealed Cabinet Materials:

- 1. Plastic Laminate: Grade BKL.

2.4 DESIGN, COLOR, AND FINISH

A. Design: Provide manufactured wood casework of the following design:

- 1. Flush overlay with wire pulls.

B. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from plastic-laminate manufacturer's full range.

C. PVC Edgebanding Color: As selected from casework manufacturers full range.

D. Solid-Surfacing Material Colors and Patterns: As selected by Architect from manufacturer's full range.

E. Thermoset Decorative Panel Colors, Patterns, and Finishes: As selected by Architect from thermoset decorative panel manufacturer's full range.

2.5 CABINET FABRICATION

A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

- 1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch (19-mm) particleboard, plastic-laminate faced.
- 2. Shelves: 3/4-inch (19-mm) plywood, plastic-laminate faced.
- 3. Backs of Cabinets: 1/2-inch (12.7-mm) particleboard, plastic-laminate faced.

4. Drawer Fronts: 3/4-inch (19-mm) particleboard, plastic-laminate faced.
 5. Drawer Sides and Backs: 1/2-inch (12.7-mm) 1/2-inch (12.7-mm) particleboard or MDF, thermoset decorative panel faced.
 6. Drawer Bottoms: 1/4-inch (6.4-mm) particleboard or MDF, thermoset decorative panel faced glued and dadoed into front, back, and sides of drawers. Use 1/2-inch (12.7-mm) material for drawers more than 24 inches (600 mm) wide.
 7. Doors: 3/4-inch (19-mm) particleboard or MDF, plastic-laminate faced.
- B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.6 CASEWORK HARDWARE AND ACCESSORIES

- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard satin-finish, commercial-quality, heavy-duty hardware.
1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, 135 degrees of opening.
- C. Pulls: Solid stainless-steel wire pulls, fastened from back with two screws. Provide 2 pulls for drawers more than 24 inches (600 mm) wide.
- D. Door Catches: Powder-coated, nylon-roller spring catch. Provide 2 catches on doors more than 48 inches (1220 mm) high.
- E. Drawer Slides: BHMA A156.9, Type B05091.
1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated, steel ball-bearing slides.
 2. Box Drawer Slides: Grade 1, for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
 3. File Drawer Slides: Grade 1HD-200, for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
- F. Drawer and Hinged Door Locks: Cylindrical (cam) type, 5-pin or 5-disc tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
1. Provide a minimum of two keys per lock and six master keys.
 2. Provide locks on all doors and drawers.
- G. Adjustable Shelf Supports: 2-pin locking plastic shelf rests complying with BHMA A156.9, Type B04013.
- H. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

2.7 COUNTERTOPS

- A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch (25 mm) over base cabinets.

- B. Solid-Surfacing-Material Tops: 1/2-inch- (12.7-mm-) thick, solid-surfacing material with front edge built up with same material].
 - 1. Front: Straight, slightly eased at top.
 - a. Edge profile depth: 1 1/2"
 - 2. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid-surfacing material; slightly eased at edge.
- C. Plastic-Laminate Tops: Plastic-laminate sheet, shop bonded with waterproof glue to both sides of 3/4-inch plywood or particleboard. Sand surfaces to which plastic laminate is to be bonded.
 - 1. Plastic-Laminate Type for Flat Tops: HGS.
 - 2. Plastic-Laminate Type for Formed Tops: HGP.
 - 3. Plastic-Laminate Type for Backing: BKL.
 - 4. Provide 3-mm PVC edging on front edge of top, on top edges of backsplashes and end splashes, and on ends of tops and splashes.
 - 5. Construct top and backsplash from one piece of plastic laminate with rolled edges and coved intersection. Where indicated, provide separate end splashes fitted to top.
 - 6. Use exterior plywood or phenolic-resin-bonded particleboard for countertops containing sinks.

2.8 WALL SHELVING

- A. Plastic-Laminate Shelving: Plastic-laminate sheet, Grade HGL or HGP, shop bonded to both sides of plywood. Sand surfaces to which plastic laminate is to be bonded.
 - 1. Shelf Thickness: 3/4 inch (19 mm).
 - 2. Edge Treatment: Finish both edges with rigid PVC extrusion, through color with satin finish, 3 mm thick.
 - 3. Provide 4 shelves at each closet on adjustable tracks full height of closet.
- B. Adjustable Shelf Supports: Powder-coated steel standards and shelf brackets, complying with BHMA A156.9, Types B04102 and B04112, surface mounted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured wood casework.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CASEWORK INSTALLATION

- A. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured wood casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 16 inches (400 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.
- C. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).
1. Fasten through back, near top and bottom, at ends, and not more than 16 inches (400 mm) o.c.
 2. Use toggle bolts at hollow masonry.
 3. Use expansion anchors at solid masonry.
 4. Use No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish at metal-framed partitions.
- D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

- A. Field Jointing: Where possible make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding 24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- B. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.
- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- D. Secure backsplashes and end splashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and walls with adhesive.
- E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.4 INSTALLATION OF SHELVING

- A. Securely fasten shelf standards to masonry, partition framing, wood blocking, or reinforcements in partitions.
1. Fasten shelf standards at ends and not more than 12 inches (300 mm) o.c.
 2. Use toggle bolts at hollow masonry.
 3. Use expansion anchors at solid masonry.
 4. Use self-tapping sheet metal screws in metal framing or metal backing at metal-framed partitions. Do not use wall anchors in gypsum board.

- B. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Space standards not more than 36 inches (900 mm) o.c.
- C. Install shelving level and straight, closely fitted to other work where indicated.

3.5 CLEANING AND PROTECTING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123200

SECTION 123280 – MEDIA SHELVING AND CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Furnishing and installation of steel book stack shelving in Media Center.

1.3 SUBMITTALS

- A. Product Data: Submit applicable reference standards, performance data, and application recommendations and limitations.
- B. Shop Drawings: Submit design and installation drawings showing product components in assembly with adjacent materials and products.
- C. Quality Control Submittals:
 - 1. Manufacturer's installation instructions.
- D. Contract Closeout Submittals:
 - 1. Maintenance recommendations.
 - 2. Warranty.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Pack and ship to avoid damage according to manufacturer's recommendations:
 - 1. Finish and assemble components in factory before shipment.
 - 2. Ship components in individual, sealed, labeled cartons.
 - 3. Deliver components to room designated for installation.
- B. Do not accept or install damaged products at the site.
- C. Store products in heated indoor storage near point of installation. Retain protective packaging until installing.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install cabinets until all mortar, wet and dust producing work is completed.
- B. Field Measurements: Obtain required field measurements from the Contractor and indicate on Shop Drawings.

1.6 WARRANTY

- A. Provide manufacturer's written warranty that products not in accordance with requirements of Contract Documents within three years after commencement of warranties shall be corrected promptly after receipt of written notice from Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products by Montel and Worden Company or equivalent product by one of the following:
 - 1. Brodart Contract Furniture, McElhatten, PA.
 - 2. Library Interiors, Inc., California, MD
 - 3. Russwood Library Furniture, Raleigh, NC.
 - 4. Estey, A Division of Tenssco Corp.
 - 5. Palmeiri Furniture
 - 6. Library Bureau Steel
- B. Manufacturers offering substitute products must obtain approval prior to bidding as required under provisions of Instructions to Bidders.
 - 1. Manufacturer requesting prior approval must submit evidence of minimum 20 years experience manufacturing media education furniture.
 - 2. Manufacturer requesting prior approval must submit samples of materials, construction features and finishes.

2.2 PRODUCTS

- A. Basis of Design: Steel shelving units by Montel and end panels by The Worden Company.

2.3 SYSTEM DESCRIPTION

- A. Type of Book stack:
 - 1. Steel book stacks shall be cantilever, unit construction design with individual welded frame assemblies.
 - 2. The modular construction shall be such that all components of a book stack section may be removed from any range without in any way disturbing the adjacent units, so that any range may be divided for the purpose of rearrangements without the necessity of procuring additional components. Any bracing which prevents insertion of oversize material (past the center line) on any base or adjustable shelf is not acceptable.
- B. Sheet metal is to be cold rolled, Class 1 steel. Gauge thicknesses are U.S. standard with the following minimum requirements:
 - 1. Upright Columns of welded frame: 16 gauge.
 - 2. Top and Bottom Spreaders of welded frame: 16 gauge.
 - 3. Shelves (including Base Shelf): 18 gauge.
 - 4. Shelf End Brackets: 16 gauge.
- C. All shelving shall be carefully adjusted to the floor and leveled. Wall shelving shall be attached to the walls at the most inconspicuous locations.
- D. Shelving Types: As designated on drawings and in schedule.
 - 1. Shelf dimensions are nominal.
 - 2. All components, parts and accessories are to be provided for complete installation.

- E. High Performance Laminate Self-Edged End Panels: Wilsonart Laminate #7953-38 Harvest Maple.
 - 1. All components, parts and accessories are to be provided for complete installation.
- F. Powder-coated steel shelving: Black.
- G. High Performance Laminate Countertops: Formica Multifleck #253-58, Matte Finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation in accordance with manufacturer's instructions.

3.2 ADJUSTING

- A. Adjust all hardware for smooth operation.

3.3 CLEANING

- A. Clean all surfaces of soil and remove all packaging materials and construction debris.

3.4 MEDIA CENTER SHELVING SCHEDULE

- A. Montel Aetnastak Welded Frame Cantilever Shelving with HPL End panels and Counter tops. End panels are 3/4" thick, self-edged, laminated two sides, particle board core. Counter tops are 1-1/8" thick with self-edge, laminated on all sides, particle board core.

SH-1

Double faced closed base, 42"h x 36"w x 24"d with 4 - 12"d adj. divider type shelves and 2 divider type base shelves, self-edged HPL end panels, where required, and HPL counter tops. HPL all sides of end panels and countertops. Provide 2 - 9" high dividers per shelf.

SH-2

Double faced closed base, 42"h x 36"w x 24"d with 4 - 12"d hinged periodical shelves and 2 hinged periodical bases, self-edged HPL end panels, where required, and HPL counter tops. HPL all sides of end panels and countertops.

SH-3

Single faced closed base, 78"h x 36"w x 12"d with 4 - 12"d adj. divider type shelves and divider type base shelf, self-edged HPL end panels and metal canopy top. HPL all sides of end panels. Provide 2 - 9" high dividers per shelf.

SH-4

Single faced

closed base, 78"h x 24"w x 12"d with 4 - 12"d adj. divider type shelves and divider type base shelf, self-edged HPL end panels and metal canopy top. HPL all sides of end panels. Provide 2 - 9" high dividers per shelf.

SH-5

Single faced 42"h x 36"w x 12"d closed base w/ base shelf and 2 - 12"d adj. flat shelves, self-edged HPL end panels and counter tops. HPL all sides of end panels and countertops. Provide 2 - 9" high dividers per shelf.

EP-1

Double faced to fit 42"h x 24"d base.

EP-2

Single faced to fit 78"h x 12"d base.

EP-3

Single faced to fit 42"h x 12"d base.

END OF SECTION 123280

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Bicycle racks
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for installation of pipe sleeves cast and installation of anchor bolts cast in concrete footings.
- C. Products furnished, but not installed under this Section, include pipe sleeves, anchor bolts, to be cast in concrete footings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For units with factory-applied color finishes.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

Size: Not less than 6-inch long linear components and 4-inch square sheet components.
- D. Product Schedule: For site furnishings. Use same designations indicated on Drawings.
- E. Maintenance Data: For site furnishings to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of site furnishing(s) through one source from a single manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or non-corrodible materials; tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.
- B. Non-shrink, Non-metallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107; recommended in writing by manufacturer, for exterior applications.
- C. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring,

patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.2 BICYCLE RACKS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Huntco: BR Series Rack – 15 total as manufactured by Huntco Supply, LLC P.O. Box 10395 Portland, Oregon 97296, (p) 503.224.8700, www.huntco.com or a comparable product by one of the following:
1. American Bicycle Security Company
 2. Canterbury International
 3. Creative Pipe, Inc.
 4. Keystone Ridge Designs, Inc.
 5. Landscape Forms
 6. Landscape Structures Inc.
 7. Maglin Furniture Systems Ltd.
 8. Miracle Recreation Equipment Co.; a division of PlayPower, Inc.
 9. SportsPlay Equipment, Inc.
- B. Color: Thermo Plastic -Black.

2.3 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.4 FINISHES, GENERAL

- 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: 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.

2.5 STEEL AND GALVANIZED STEEL FINISHES

- A. Thermo Plastic Coating: Manufacturer's standard, Thermo Plastic Coating finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored or positioned at locations indicated on Drawings.
- D. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

3.3 CLEANING

- A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION129300

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hydraulic passenger elevators.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
 - 2. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
 - 3. Section 051200 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
 - b. Hoist beams.
 - c. Structural-steel shapes for sills that are part of steel frame.
 - 4. Section 055000 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Divider beams.
 - c. Structural-steel shapes for sills.
 - d. Pit ladders.
 - 5. Section 096519 "Resilient Tile Flooring" for elevator cab flooring.
 - 6. Section 099123 "Interior Painting" for field painting of hoistway walls.
 - 7. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
 - 8. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
 - 9. Section 283111 "Digital, Addressable Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation and for connection to elevator controllers.

1.3 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
 - 2. Include large-scale layout of car-control station.
 - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, 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.
- C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturers.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance sills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: One year from date of Substantial Completion. Warranty will coincide with a 12 month free maintenance service period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS & INSTALLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Controllers - Motion Control Engineering, Elevator Controls, Smart Rise, GAL or Virginia Controls or approved equal. No proprietary equipment will be allowed.
 - 2. Pumping Unit - DEM (Delaware Elevator Manufacturing), MEI Minnesota Elevator or approved equal.
 - 3. Fixtures – Innovation, GAL or Monitor or approved equal.
 - 4. Door Equipment – GAL (No Substitutions)

- B. Approved Installers:
1. Delaware Elevator, Inc. (Contact Keith Mitchell 410-749-3489 Ext. 170)
 2. KONE Elevator
 3. Shindler Elevator
 4. Thyssen-Krupp Elevator
 5. OTIS Elevator

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 2. Provide earthquake equipment required by ASME A17.1/CSA B44.
 3. Provide seismic switch required by ASCE/SEI 7.
 4. Project's Seismic Design Category: Zone 2A = 0.15g

2.3 ELEVATORS

- A. Elevator System, General: Non-Proprietary standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
1. Elevator Number(s): One.
 2. Type: Holeless, beside-the-car, single-acting, dual cylinder.
 3. Rated Load: 3500 lb.
 4. Passenger Elevator (Stretcher Compliant)
 5. Rated Speed: 100 fpm.
 6. Operation System: Single automatic.
 7. Auxiliary Operations:
 - a. Standby power operation.
 - b. Nuisance call cancel.
 8. Security Features: Keyless Entry System
 9. Car Enclosures:
 - a. Inside Height: 94 inches to underside of ceiling.
 - b. Front Walls (Return Panels): Satin stainless steel, No. 4 finish
 - c. Car Fixtures: Satin stainless steel, No. 4 finish.
 - d. Side and Rear Wall Panels: Plastic laminate.
 - e. Reveals: Satin stainless steel, No. 4 finish.
 - f. Door Faces (Interior): Satin stainless steel, No. 4 finish.
 - g. Door Sills: Aluminum
 - h. Ceiling: Satin stainless steel, No. 4 finish.

- i. Handrail: 1/2 by 2 inches (13 by 50 mm) rectangular satin stainless steel, No. 4 finish, at rear of car.
 - j. Floor prepared to receive rubber flooring (specified in Section 096519 "Resilient Tile Flooring").
10. Hoistway Entrances:
- a. Width: 42 inches (1067 mm).
 - b. Height: 84 inches (2134 mm).
 - c. Type: Single-speed side sliding.
 - d. Frames: Satin stainless steel, No. 4 finish.
 - e. Doors: Satin stainless steel, No. 4 finish.
 - f. Sills: Aluminum
11. Hall Fixtures: Satin stainless steel, No. 4 finish.
12. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
 - b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
- 1. Pump shall be submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts or shall be tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
 - 2. Motor shall have solid-state starting.
 - 3. Motor shall have variable-voltage, variable-frequency control.
- B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
- 1. Cylinder units shall be connected with dielectric couplings.
 - 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- D. Hydraulic Fluid: Nontoxic, biodegradable fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives and approved by elevator manufacturer for use with elevator equipment.
- 1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.

- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- F. Car Frame and Platform: Manufacturer's standard.
- G. Guides: Roller guides; polymer-coated, nonlubricated sliding guides.

2.5 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:
 - 1. Single-Car Standby Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at fire command station. Manual operation causes automatic operation to cease.
 - 2. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
- C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.
 - 1. Card-Reader Operation: System uses card readers at hall push-button stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers.
 - a. Security access system equipment is to be from Essex Electronics and will be the responsibility of the elevator contractor.

2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

- A. General: Provide enameled-steel car enclosures to receive removable wall panels, with access doors, power door operators, and ventilation.
 - 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
 2. Floor Finish: Specified in 096519
 3. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 4. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard with manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate manufacturer's full range.
 5. Fabricate car with recesses and cutouts for signal equipment.
 6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 7. Sight Guards: Provide sight guards on car doors.
 8. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 9. Metal Ceiling: Flush panels, with low-voltage downlights in the center of each panel. Align ceiling panel joints with joints between wall panels.
 10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
1. Stainless-Steel Frames: Formed from stainless-steel sheet.
 2. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both inside surfaces of hoistway door frames.
 3. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
 4. Sight Guards: Provide sight guards on doors matching door edges.
 5. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
 6. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 283111 "Digital, Addressable Fire-Alarm System"
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing.
 - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
 - 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
 - 1. Manufacturer's standard wall-mounted units, for recessed mounting above entrance frames.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 - 1. At manufacturer's option, audible signals may be placed on cars.
- I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
 - 1. Integrate ground-floor hall lanterns with hall position indicators.
- J. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.
- K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- E. Stainless-Steel Bars: ASTM A 276, Type 304.
- F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- H. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- 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.

3.2 INSTALLATION

- A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Install piping above the floor, where possible. Install underground piping in casing.
- E. Lubricate operating parts of systems as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

- G. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- I. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
 - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
 - 2. Place hall lanterns either above or beside each hoistway entrance.
 - 3. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: NONE

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).
- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 1. Perform maintenance during normal working hours.
 - 2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 142400

SECTION 21 05 00**COMMON WORK RESULTS FOR FIRE SUPPRESSION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Pipe, fittings, valves, and connections for sprinkler, standpipe and fire hose, and combination sprinkler and standpipe systems.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Preparation and painting of fire protection piping systems.
- B. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Piping identification.
- D. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.
- E. Section 21 12 00 - Fire-Suppression Standpipes: Standpipe design.

1.03 REFERENCE STANDARDS

- A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers.
- C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers.
- D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers (ANSI/ASME B16.5).
- F. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers.
- G. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded; The American Society of Mechanical Engineers.
- H. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers (ANSI B16.18).
- I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- J. ASME B16.25 - Buttwelding Ends; The American Society of Mechanical Engineers.
- K. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers.
- L. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.

- M. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- N. ASTM A135/A135M - Standard Specification for Electric-Resistance Welded Steel Pipe.
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- P. ASTM A536 - Standard Specification for Ductile Iron Castings.
- Q. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- R. ASTM B32 - Standard Specification for Solder Metal.
- S. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.
- T. ASTM B75M - Standard Specification for Seamless Copper Tube (Metric).
- U. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- V. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- W. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- X. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- Y. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
- Z. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- AA. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- AB. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- AC. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association (ANSI/AWWA C105/A21.5).
- AD. AWWA C110/A21.10 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids; American Water Works Association.
- AE. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association (ANSI/AWWA C111/A21.11).
- AF. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association (ANSI/AWWA C151/A21.51).
- AG. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association.
- AH. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; National Fire Protection Association.
- AI. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; National Fire Protection Association.

- AJ. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc..
- AK. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc..
- AL. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. See Gilbane Project Manual.
- B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- C. Project Record Documents: Record actual locations of components and tag numbering.
- D. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years experience. approved by manufacturer.
- C. Conform to UL requirements.
- D. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- E. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.07 EXTRA MATERIALS

- A. See Gilbane Project Manual.
- B. Provide two valve stem packings for each size and type of valve installed.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

- A. Sprinkler Systems: Conform work to NFPA 13.
- B. Standpipe and Hose Systems: Conform to NFPA 14.
- C. Welding Materials and Procedures: Conform to ASME Code.

2.02 BURIED PIPING

- A. Steel Pipe: ASTM A53/A53M Schedule 40, black, with AWWA C105 polyethylene jacket, or double layer, half-lapped polyethylene tape.
 - 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded; with double layer, half-lapped polyethylene tape.

2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
 3. Joints: Welded in accordance with AWS D1.1.
 4. Casing: Closed glass cell insulation.
- B. Copper Tube: ASTM B75 (ASTM B75M), O60 or O50 temper.
1. Type: Type K (A).
 2. Fittings: ASME B16.18, cast copper alloy, solder joint, pressure type.
 3. Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 copper/silver braze.
 4. Casing: Closed glass cell insulation.
- C. Cast Iron Pipe: AWWA C151/A21.51.
1. Fittings: AWWA C110, standard thickness.
 2. Joints: AWWA C111, rubber gasket.
 3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

2.03 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A795 Schedule 10 or ASTM A53 Schedule 40, black.
1. Steel Fittings: ASME B16.9, wrought steel, buttwelded.
 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings.
 3. Malleable Iron Fittings: ASME B16.3, threaded fittings.
 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), H58 drawn.
1. Fittings: ASME B16.18, cast copper alloy, grooved.
 2. Mechanical Grooved Couplings: Ductile iron housing with alkyd enamel paint coating clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.
- C. CPVC Pipe: ASTM F442/F442M, SDR 13.5.
1. Fittings: ASTM F438 Schedule 40, or ASTM F439 schedule 80, CPVC.
 2. Joints: Solvent welded, using ASTM F493 cement.
- D. Cast Iron Pipe: AWWA C151/A21.51.
1. Fittings: AWWA C110/A21.10, standard thickness.
 2. Joints: AWWA C111, rubber gasket.
 3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.04 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
- B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.

- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.05 GATE VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
- B. Over 2 inches:
 - 1. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged ends.
- C. Over 4 inches:
 - 1. Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

2.06 GLOBE VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.
- B. Over 2 inches:
 - 1. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.07 BALL VALVES

- A. Up to and including 2 inches:
 - 1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends.
- B. Over 2 inches:
 - 1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10 inches and over, flanged.

2.08 BUTTERFLY VALVES

- A. Bronze Body:
 - 1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
- B. Cast or Ductile Iron Body
 - 1. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC.

2.09 CHECK VALVES

- A. Up to and including 2 inches:
 - 1. Bronze body and swing disc, rubber seat, threaded ends.
- B. Over 2 inches:

1. Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
- C. 4 inches and Over:
1. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.10 DRAIN VALVES

- A. Compression Stop:
1. Bronze with hose thread nipple and cap.
- B. Ball Valve:
1. Brass with cap and chain, 3/4 inch hose thread.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Install standpipe piping, hangers, and supports in accordance with NFPA 14.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipes passing through partitions, walls, and floors.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Inserts:
1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
- I. Pipe Hangers and Supports:
1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 2. Place hangers within 12 inches of each horizontal elbow.
 3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

4. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 6. Provide copper plated hangers and supports for copper piping.
 7. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
 - K. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.
 - L. Do not penetrate building structural members unless indicated.
 - M. Provide sleeves when penetrating footings, floors, and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
 - O. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
 - P. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
 - Q. Provide gate, ball, or butterfly valves for shut-off or isolating service.
 - R. Provide drain valves at main shut-off valves, low points of piping and apparatus.

END OF SECTION

SECTION 21 05 13**MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT****PART 1 GENERAL****1.01 REFERENCE STANDARDS**

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc..
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers.
- C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.02 SUBMITTALS

- A. See Gilbane Building Company.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Conform to applicable electrical code, NFPA70, or local energy code.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.05 WARRANTY

- A. See Gilbane Building Company.

- B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Lincoln Motors: www.lincolnmotors.com.
- B. A. O. Smith Electrical Products Company: www.aosmithmotors.com.
- C. Reliance Electric/Rockwell Automation: www.reliance.com.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 27 17 for required electrical characteristics.
- B. Electrical Service:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors Larger than 1/2 Horsepower: 460 volts, three phase, 60 Hz.
- C. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 40 degrees C environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Motors with frame sizes 254T and larger: Energy Efficient Type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

2.03 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.
- B. Single phase motors for centrifugal pumps: Split phase type.
- C. Single phase motors for pumps: Capacitor start type.
- D. Single phase motors for pumps: Capacitor start, capacitor run type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.

- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 13.

- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- M. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- N. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

3.02 SCHEDULES

- A. NEMA Open Motor Service Factors.
 - 1. 1/6-1/3 hp:
 - a. 3600 rpm: 1.35.
 - b. 1800 rpm: 1.35.
 - c. 1200 rpm: 1.35.
 - d. 900 rpm: 1.35.
 - 2. 1/2 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.25.
 - c. 1200 rpm: 1.25.
 - d. 900 rpm: 1.15.
 - 3. 3/4 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.25.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
 - 4. 1 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.15.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
 - 5. 1.5-150 hp:
 - a. 3600 rpm: 1.15.
 - b. 1800 rpm: 1.15.

- c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
- B. Three Phase - Premium Efficiency, Open Drip-Proof Performance:
- 1. 1200 rpm.
 - a. 1 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 72.
 - 3) Minimum Percent Efficiency: 82.5
 - b. 1-1/2 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 73.
 - 3) Minimum Percent Efficiency: 83.
 - c. 2 hp:
 - 1) NEMA Frame: 184T.
 - 2) Minimum Percent Power Factor: 75.
 - 3) Minimum Percent Efficiency: 85.
 - d. 3 hp:
 - 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 60.
 - 3) Minimum Percent Efficiency: 86.
 - e. 5 hp:
 - 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 65.
 - 3) Minimum Percent Efficiency: 87.
 - f. 7-1/2 hp:
 - 1) NEMA Frame: 254T.
 - 2) Minimum Percent Power Factor: 73.
 - 3) Minimum Percent Efficiency: 89.
 - g. 10 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 74.
 - 3) Minimum Percent Efficiency: 89.
 - h. 15 hp:
 - 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 77.
 - 3) Minimum Percent Efficiency: 90.
 - i. 20 hp:
 - 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 78.
 - j. 30 hp:
 - 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 78.
 - 3) Minimum Percent Efficiency: 91.
 - k. 40 hp:
 - 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 77.
 - 3) Minimum Percent Efficiency: 93.
 - l. 50 hp:
 - 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 79.
 - 3) Minimum Percent Efficiency: 93.
 - m. 60 hp:
 - 1) NEMA Frame: 404T.

- 2) Minimum Percent Power Factor: 82.
- 3) Minimum Percent Efficiency: 93.
- n. 75 hp:
 - 1) Minimum Percent Power Factor: 80.
- o. 100 hp:
 - 1) NEMA Frame: 444T.
 - 2) Minimum Percent Power Factor: 80.
 - 3) Minimum Percent Efficiency: 93.
- p. 125 hp:
 - 1) NEMA Frame: 444T.
 - 2) Minimum Percent Power Factor: 84.
 - 3) Minimum Percent Efficiency: 93.
- 2. 1800 rpm.
 - a. 1 hp:
 - 1) NEMA Frame: 143T.
 - 2) Minimum Percent Power Factor: 84.
 - 3) Minimum Percent Efficiency: 82.
 - b. 1-1/2 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 84.
 - c. 2 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 84.
 - d. 3 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 86.
 - e. 5 hp:
 - 1) NEMA Frame: 184T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 87.
 - f. 7-1/2 hp:
 - 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 88.
 - g. 10 hp:
 - 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 89.
 - h. 15 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 91.
 - i. 20 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 91.
 - j. 25 hp:
 - 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 91.

- k. 30 hp:
 - 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 92.
- l. 40 hp:
 - 1) NEMA Frame: 324T.
 - 2) Minimum Percent Power Factor: 83.
 - 3) Minimum Percent Efficiency: 92.
- m. 50 hp:
 - 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 93.
- n. 60 hp:
 - 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 93.
- o. 75 hp:
 - 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 93.
- p. 100 hp:
 - 1) NEMA Frame: 404T.
 - 2) Minimum Percent Power Factor: 83.
 - 3) Minimum Percent Efficiency: 93.
- q. 125 hp:
 - 1) NEMA Frame: 405T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 93.
- r. 150 hp:
 - 1) NEMA Frame: 444T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 93.
- s. 200 hp:
 - 1) NEMA Frame: 445T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 94.
- 3. 3600 rpm.
 - a. 1-1/2 hp:
 - 1) NEMA Frame: 143T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 82.
 - b. 2 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 82.
 - c. 3 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 84.
 - d. 5 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 85.

- e. 7-1/2 hp:
 - 1) NEMA Frame: 184T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 86.
 - f. 10 hp:
 - 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 87.
 - g. 15 hp:
 - 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 89.
 - 3) Minimum Percent Efficiency: 89.
 - h. 20 hp:
 - 1) NEMA Frame: 254T.
 - 2) Minimum Percent Power Factor: 89.
 - 3) Minimum Percent Efficiency: 90.
 - i. 25 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 92.
 - 3) Minimum Percent Efficiency: 90.
 - j. 30 hp:
 - 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 91.
 - 3) Minimum Percent Efficiency: 91.
 - k. 40 hp:
 - 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 92.
 - 3) Minimum Percent Efficiency: 92.
 - l. 50 hp:
 - 1) NEMA Frame: 324T.
 - 2) Minimum Percent Power Factor: 89.
 - 3) Minimum Percent Efficiency: 93.
 - m. 60 hp:
 - 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 91.
 - 3) Minimum Percent Efficiency: 93.
 - n. 75 hp:
 - 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 93.
 - o. 100 hp:
 - 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 92.
- C. Three Phase - Energy Efficient, Totally Enclosed, Fan Cooled Performance:
- 1. 1200 rpm.
 - a. 1 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 72.
 - 3) Minimum Percent Efficiency: 81.
 - b. 1-1/2 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 73.

- 3) Minimum Percent Efficiency: 83.
- c. 2 hp:
 - 1) NEMA Frame: 184T.
 - 2) Minimum Percent Power Factor: 68.
 - 3) Minimum Percent Efficiency: 85.
- d. 3 hp:
 - 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 63.
 - 3) Minimum Percent Efficiency: 86.
- e. 5 hp:
 - 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 66.
 - 3) Minimum Percent Efficiency: 86.
- f. 7-1/2 hp:
 - 1) NEMA Frame: 254T.
 - 2) Minimum Percent Power Factor: 68.
 - 3) Minimum Percent Efficiency: 89.
- g. 10 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 75.
 - 3) Minimum Percent Efficiency: 89.
- h. 15 hp:
 - 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 72.
 - 3) Minimum Percent Efficiency: 90.
- i. 20 hp:
 - 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 76.
 - 3) Minimum Percent Efficiency: 90.
- j. 25 hp:
 - 1) NEMA Frame: 324T.
 - 2) Minimum Percent Power Factor: 71.
 - 3) Minimum Percent Efficiency: 90.
- k. 30 hp:
 - 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 79.
 - 3) Minimum Percent Efficiency: 91.
- l. 40 hp:
 - 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 78.
 - 3) Minimum Percent Efficiency: 92.
- m. 50 hp:
 - 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 81.
 - 3) Minimum Percent Efficiency: 92.
- n. 60 hp:
 - 1) NEMA Frame: 404T.
 - 2) Minimum Percent Power Factor: 83.
 - 3) Minimum Percent Efficiency: 92.
- o. 75 hp:
 - 1) NEMA Frame: 405T.
 - 2) Minimum Percent Power Factor: 80.
 - 3) Minimum Percent Efficiency: 92.

- p. 100 hp:
 - 1) NEMA Frame: 444T.
 - 2) Minimum Percent Power Factor: 83.
 - 3) Minimum Percent Efficiency: 93.
- q. 125 hp:
 - 1) NEMA Frame: 444T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 93.
- 2. 1800 rpm.
 - a. 1 hp:
 - 1) NEMA Frame: 143T.
 - 2) Minimum Percent Power Factor: 84.
 - 3) Minimum Percent Efficiency: 82.
 - b. 1-1/2 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 84.
 - c. 2 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 84.
 - d. 3 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 83.
 - 3) Minimum Percent Efficiency: 87.
 - e. 5 hp:
 - 1) NEMA Frame: 184T.
 - 2) Minimum Percent Power Factor: 83.
 - 3) Minimum Percent Efficiency: 88.
 - f. 7-1/2 hp:
 - 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 89.
 - g. 10 hp:
 - 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 84.
 - 3) Minimum Percent Efficiency: 90.
 - h. 15 hp:
 - 1) NEMA Frame: 254T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 91.
 - i. 20 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 91.
 - j. 25 hp:
 - 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 84.
 - 3) Minimum Percent Efficiency: 92.
 - k. 30 hp:
 - 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 93.

- l. 40 hp:
 - 1) NEMA Frame: 324T.
 - 2) Minimum Percent Power Factor: 83.
 - 3) Minimum Percent Efficiency: 93.
- m. 50 hp:
 - 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 93.
- n. 60 hp:
 - 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 93.
- o. 75 hp:
 - 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 93.
- p. 100 hp:
 - 1) NEMA Frame: 405T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 94.
- q. 125 hp:
 - 1) NEMA Frame: 444T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 94.
- r. 150 hp:
 - 1) NEMA Frame: 445T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 94.
- s. 200 hp:
 - 1) NEMA Frame: 447T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 95.
- 3. 3600 rpm.
 - a. 1-1/2 hp:
 - 1) NEMA Frame: 143T.
 - 2) Minimum Percent Power Factor: 85.
 - 3) Minimum Percent Efficiency: 82.
 - b. 2 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 82.
 - c. 3 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 87.
 - 3) Minimum Percent Efficiency: 82.
 - d. 5 hp:
 - 1) NEMA Frame: 184T.
 - 2) Minimum Percent Power Factor: 88.
 - 3) Minimum Percent Efficiency: 85.
 - e. 7-1/2 hp:
 - 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 86.

- f. 10 hp:
 - 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 86.
 - 3) Minimum Percent Efficiency: 87.
- g. 15 hp:
 - 1) NEMA Frame: 254T.
 - 2) Minimum Percent Power Factor: 91.
 - 3) Minimum Percent Efficiency: 88.
- h. 20 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 89.
 - 3) Minimum Percent Efficiency: 89.
- i. 25 hp:
 - 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 92.
 - 3) Minimum Percent Efficiency: 90.
- j. 30 hp:
 - 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 92.
 - 3) Minimum Percent Efficiency: 91.
- k. 40 hp:
 - 1) NEMA Frame: 324T.
 - 2) Minimum Percent Power Factor: 91.
 - 3) Minimum Percent Efficiency: 91.
- l. 50 hp:
 - 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 92.
 - 3) Minimum Percent Efficiency: 90.
- m. 60 hp:
 - 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 93.
 - 3) Minimum Percent Efficiency: 91.
- n. 75 hp:
 - 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 91.
 - 3) Minimum Percent Efficiency: 91.
- o. 100 hp:
 - 1) NEMA Frame: 405T.
 - 2) Minimum Percent Power Factor: 92.
 - 3) Minimum Percent Efficiency: 92.

END OF SECTION

SECTION 21 05 48**VIBRATION AND SEISMIC CONTROLS FOR EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Equipment support bases.
- B. Vibration isolators.
- C. Seismic restraints.

1.02 SUBMITTALS

- A. Product Data:
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures.
- C. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Isolation Technology, Inc: www.isolationtech.com.
- B. Kinetics Noise Control, Inc: www.kineticsnoise.com.
- C. Mason Industries: www.mason-ind.com.

2.02 PERFORMANCE REQUIREMENTS

- A. General:
 - 1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.

2.03 EQUIPMENT SUPPORT BASES**2.04 VIBRATION ISOLATORS**

- A. Open Spring Isolators:
 - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 - 2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- B. Restrained Open Spring Isolators:
 - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.

2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 4. Restraint: Provide heavy mounting frame and limit stops.
 5. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- C. Closed Spring Isolators:
1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- D. Restrained Closed Spring Isolators:
1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- E. Spring Hanger:
1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 2. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 3. Misalignment: Capable of 20 degree hanger rod misalignment.
 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- F. Neoprene Pad Isolators:
1. Rubber or neoprene waffle pads.
 - a. Hardness: 30 durometer.
 - b. Thickness: Minimum 1/2 inch.
 - c. Maximum Loading: 50 psi.
 - d. Rib Height: Maximum 0.7 times width.
 2. Configuration: Single layer.
 3. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- G. Rubber Mount or Hanger: Molded rubber designed for 0.4 inch deflection with threaded insert.
- H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

- I. Seismic Snubbers:
 1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
 2. Elements: Replaceable neoprene, minimum of 0.75 inch thick with minimum 1/8 inch air gap.
 3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
 4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. Comply with the requirements of NFPA 13.
- C. Bases:
 1. Set steel bases for one inch clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
 3. Adjust equipment level.
- D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- F. Provide seismic snubbers for all equipment, piping, and ductwork mounted on isolators. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- G. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
 1. Up to 4 Inches Pipe Size: First three points of support.
 2. 5 to 8 Inches Pipe Size: First four points of support.
 3. 10 inches Pipe Size and Over: First six points of support.
 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.02 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect isolated equipment after installation and submit report. Include static deflections.

3.03 SCHEDULES

- A. Pipe Isolation Schedule.
 1. 1 Inch Pipe Size: Isolate 120 diameters from equipment.
 2. 2 Inch Pipe Size: Isolate 90 diameters from equipment.
 3. 3 Inch Pipe Size: Isolate 80 diameters from equipment.
 4. 4 Inch Pipe Size: Isolate 75 diameters from equipment.
 5. 6 Inch Pipe Size: Isolate 60 diameters from equipment.
 6. 8 Inch Pipe Size: Isolate 60 diameters from equipment.

7. 10 Inch Pipe Size: Isolate 54 diameters from equipment.
8. 12 Inch Pipe Size: Isolate 50 diameters from equipment.
9. 16 Inch Pipe Size: Isolate 45 diameters from equipment.
10. 24 Inch Pipe Size: Isolate 38 diameters from equipment.
11. Over 24 Inch Pipe Size: As indicated.

END OF SECTION

SECTION 21 05 53**IDENTIFICATION FOR FIRE SUPP. PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.

1.04 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Brady Corporation: www.bradycorp.com.
- B. Champion America, Inc: www.Champion-America.com.
- C. Seton Identification Products: www.seton.com/aec.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/4 inch.
 - 3. Background Color: Black.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.06 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.

- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify pumps and valves with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- M. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 21 12 00**FIRE-SUPPRESSION STANDPIPES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Standpipe system.
- B. Fire department connection.
- C. Fire extinguishers located in hose cabinets.

1.02 RELATED REQUIREMENTS

- A. Section 10 44 00 - Fire Protection Specialties.
- B. Section 21 05 00 - Common Work Results for Fire Suppression: Fire protection piping.
- C. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment.
- D. Section 21 30 00 - Fire Pumps.
- E. Section 21 13 00 - Fire-Suppression Sprinkler Systems.
- F. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- G. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation.
- B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc..
- C. NFPA 10 - Standard for Portable Fire Extinguishers; National Fire Protection Association.
- D. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; National Fire Protection Association.
- E. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog sheet for equipment indicating rough-in size, finish, and accessories.
- B. Shop Drawings: Indicate supports, components, accessories, and sizes.
 - 1. Submit shop drawings and product data to Red Clay Consolidated School District's insurance underwriter for approval.
 - 2. Submit proof of approval to Architect.
- C. Project Record Documents: Record actual locations of components.
- D. Operation Data: Include manufacturer's data.
- E. Maintenance Data: Include servicing requirements and test schedule.
- F. Certificates: Provide certificate of compliance from authority having jurisdiction indicating approval of field acceptance tests.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 14. Maintain one copy on site.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.

1.06 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in shipping packaging until installation.

1.08 EXTRA MATERIALS

- A. Provide two extra hose nozzles and hoses.

PART 2 PRODUCTS

2.01 FIRE HOSE CABINETS

- A. Hose Cabinets:
 - 1. Style: Recessed mounted.
 - 2. Tub: 16 gage thick steel, prepared for pipe and accessory rough-in.
 - 3. Door: 12 gage thick steel, flush,; hinged, positive latch device.
 - 4. Finish: Prime Coated.
- B. Hose Rack: Steel with polished chrome finish; swivel type with pins and water stop.
- C. Hose: 1 inch diameter, 50 feet long, of linen hose; mildew and rot-resistant.
- D. Nozzle: Chrome plated brass; combination fog, straight stream, and adjustable shut-off.

2.02 VALVES

- A. Hose Station Valve: Angle type, brass finish, 1-1/2 inch nominal size with automatic ball drip; refer to Section 21 05 00.
- B. Hose Connection Valve: Angle type; brass finish; 2-1/2 inch size, thread to match fire department hardware, 300 psi working pressure, with threaded cap and chain of same material and finish; refer to Section 21 05 00.
- C. Pressure Reducing Valve: Angle type; brass finish with inner hydraulic controls; 1-1/2 inch size, thread to match fire department hardware, 400 psi inlet pressure, with threaded cap and chain of same material and finish; refer to Section 21 05 00.
- D. Hose Connection Valve Cabinets:
 - 1. Style: Recessed mounted.
 - 2. Tub: 16 gage thick steel, prepared for pipe and accessory rough-in.
 - 3. Door: 12 gage thick steel, flush,; hinged, positive latch device.
 - 4. Finish: Prime Coated.

2.03 FIRE DEPARTMENT CONNECTION

- A. Type: Flush mounted wall type with brass finish.
- B. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
- C. Drain: 3/4 inch automatic drip, outside.

- D. Label: "Standpipe - Fire Department Connection".

2.04 FIRE EXTINGUISHERS

- A. General: Comply with NFPA 10; UL listed.
- B. Water Type: Copper container with positive displacement pump and discharge hose.
 - 1. 2-1/2 gallon capacity with 2A rating.
 - 2. 5 gallon capacity with 4A rating.
- C. Carbon Dioxide Type: Insulated handle, hose and horn discharge assembly, self-closing lever or squeeze grip operated, insulated handle.
 - 1. 5 pound capacity with 5BC rating.
 - 2. 10 pound capacity with 10BC rating.
 - 3. 15 pound capacity with 10BC rating.
 - 4. 20 pound capacity with 10BC rating.
- D. Multi-Purpose Dry Chemical Type: Cartridge operated with hose and shut-off nozzle or integral shut-off nozzle.
 - 1. 2-1/2 pound capacity with 1A:10BC rating.
 - 2. 5 pound capacity with 2A:10BC rating.
 - 3. 6 pound capacity with 3A:40BC rating.
 - 4. 10 pound capacity with 4A:60BC rating.
 - 5. 20 pound capacity with 20A:120BC rating.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 14.
- C. Locate and secure cabinets plumb and level. Establish top of cabinet (inside horizontal) surface 66 inches above finished floor.
- D. Locate hose station valve in cabinet at 60 inches above finished floor.
- E. Connect standpipe system to water source ahead of domestic water connection.
- F. Where static pressure exceeds 100 psi but is less than 100 psi at any hose station, provide pressure orifice disc in discharge of hose station valve to prevent pressure on hose exceeding 90 psi.
- G. Where static pressure exceeds 100 psi at any hose station, provide pressure reducing valve to prevent pressure on hose exceeding 90 psi.
- H. Provide two way fire department outlet connection on roof.
- I. Flush entire system of foreign matter.

3.02 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Test entire system in accordance with NFPA 14.
- C. Test shall be witnessed by authority having jurisdiction.

END OF SECTION

SECTION 21 13 00**FIRE-SUPPRESSION SPRINKLER SYSTEMS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

1.02 RELATED REQUIREMENTS

- A. Section 28 31 00 - Fire Detection and Alarm.
- B. Section 21 05 00 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.
- C. Section 21 05 48 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- D. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment.
- E. Section 21 30 00 - Fire Pumps.
- F. Section 21 12 00 - Fire-Suppression Standpipes.
- G. Section 14 91 00 - Facility Chutes: Sprinkler heads inside chutes.
- H. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- I. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- J. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation.
- B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc..
- C. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association.
- D. NFPA 13R - Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height; National Fire Protection Association.
- E. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Shop Drawings:
 - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
 - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
 - 3. Submit shop drawings and hydraulic calculations to authority having jurisdiction, and Fire Marshall for approval. Submit proof of approval to Architect.

- C. Samples: Submit one of each style of sprinkler specified.
- D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- F. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- G. Maintenance Materials: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 - 1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
 - 2. Sprinkler Wrenches: For each sprinkler type.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in DE.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.
- F. Equipment and Components: Provide products that bear UL label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.06 MOCK-UP

- A. Provide components for installation in mock-up.
- B. Mock-up may not remain as part of the Work.

1.07 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.09 EXTRA MATERIALS

- A. Provide extra sprinklers of type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
- B. Provide suitable wrenches for each sprinkler type.

- C. Provide metal storage cabinet located adjacent to alarm valve.

PART 2 PRODUCTS

2.01 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for building areas noted.
- B. Occupancy: comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
 - 1. Revise design when test data available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections where indicated.
- F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

2.02 SPRINKLERS

- A. Suspended Ceiling Type: Standard, Semi-recessed, Recessed or Concealed pendant type with matching push on, clamp on or screw on escutcheon plate.
 - 1. Finish: Brass or Chrome plated.
 - a. Within Standard Acoustical Tile Ceilings: White with White Estucheon Plate
 - b. Within Wooden Finish Acoustical Clouds: Chrome Plated with Chrome Plated Estucheon Plate
 - 2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Exposed Area Type: Standard upright type with guard.
 - 1. Finish: Chrome plated.
 - 2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Sidewall Type: Standard, Semi-recessed or Recessed horizontal sidewall type with matching push on escutcheon plate and guard.
 - 1. Finish: Chrome plated.
 - 2. Escutcheon Plate Finish: Chrome plated.
 - 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- D. Dry Sprinklers: Standard, Recessed or Exposed pendant type with matching push on escutcheon plate.
 - 1. Finish: Chrome plated.
 - 2. Escutcheon Plate Finish: Chrome plated.
 - 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- E. Guards: Finish to match sprinkler finish.
- F. Spray Nozzles: Brass with solid cone discharge, 30 degrees of arc with blow-off dust cap.

2.03 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
- B. Flooding Deluge Valve: Gate type valve with rubber faced disc actuated manually with water motor alarm and electric alarm, with alarm testing trim.
- C. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.

- D. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- E. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- F. Fire Department Connections:
 - 1. Type: Flush mounted wall type with brass finish.
 - 2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
 - 3. Drain: 3/4 inch automatic drip, outside.
 - 4. Label: "Sprinkler - Fire Department Connection".
- G. Supervisory Switches:
- H. Water Level Supervisory Switches:
- I. Tank Temperature Supervisory Switches:
- J. Room Temperature Supervisory Switches:

2.04 PRESSURE MAINTENANCE PUMP

- A. Type: Close coupled motor and positive displacement pump unit.
- B. Construction: Bronze with stainless steel shafts, carbon bearings.
- C. Motor: Open drip proof, permanently lubricated.
- D. Electrical Characteristics:
 - 1. 0.33 hp.
 - 2. 115 volts, single phase, 60 Hz.
- E. Accessories: Include flexible hose connections, inlet strainer, and relief valve.
- F. Operation: Manual or Automatic with pressure switch actuation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Place pipe runs to minimize obstruction to other work.
- D. Place piping in concealed spaces above finished ceilings.
- E. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- F. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- G. Install and connect to fire pump system in accordance with Section 21 30 00.
- H. Flush entire piping system of foreign matter.
- I. Install guards on sprinklers where indicated.
- J. Hydrostatically test entire system.
- K. Require test be witnessed by Fire Marshal and authority having jurisdiction.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

END OF SECTION

SECTION 22 05 16**EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

- A. Section 21 05 00 - Common Work Results for Fire Suppression.
- B. Section 22 10 05 - Plumbing Piping.

1.03 REFERENCE STANDARDS

- A. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- B. EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- B. Design Data: Indicate selection calculations.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- D. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- E. Maintenance Data: Include adjustment instructions.

1.05 REGULATORY REQUIREMENTS

- A. Conform to UL or Warnock Hersey requirements.

1.06 EXTRA MATERIALS

- A. Supply two sets of packing for each packed expansion joint.

PART 2 PRODUCTS**2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING**

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.

2. Metraflex Company: www.metroflex.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Inner Hose: Carbon Steel, Stainless Steel or Bronze.
- C. Exterior Sleeve: Single braided or Double braided, stainless steel or bronze.
- D. Exterior Sleeve: None.
- E. Pressure Rating: 125 psi and 450 degrees F or 200 psi and 250 degrees F.
- F. Joint: As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturer:
1. Mercer Rubber Company: www.mercer-rubber.com.
 2. Metraflex Company: www.metroflex.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi and 450 degrees F or 200 psi and 250 degrees F.
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.
- H. Application: Copper piping.

2.03 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

- A. Working Pressure and Temperature: Class 150 or Class 300.
- B. Joint: As specified for pipe joints.
- C. Size: Use pipe sized units.
- D. Application: Steel piping 2 inches and over.

2.04 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

- A. Working Pressure: 125 psi.
- B. Maximum Temperature: 250 degrees F.
- C. Joint: As specified for pipe joints.
- D. Size: Use pipe sized units.
- E. Application: Copper or steel piping 2 inches and over.

2.05 ACCESSORIES

- A. Stainless Steel Pipe: ASTM A269.

- B. Pipe Alignment Guides:
 - 1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.
- C. Swivel Joints:
 - 1. Fabricated steel, Bronze, Ductile Iron or Cast steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION

SECTION 22 05 19**METERS AND GAGES FOR PLUMBING PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Positive displacement meters.
- B. Pressure gages and pressure gage taps.
- C. Thermometers and thermometer wells.
- D. Static pressure gages.
- E. Filter gages.

1.02 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; The American Society of Mechanical Engineers.
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- E. AWWA C700 - Cold Water Meters -- Displacement Type, Bronze Main Case; American Water Works Association (ANSI/AWWA C700).
- F. AWWA C701 - Cold Water Meters -- Turbine Type, for Customer Service; American Water Works Association.
- G. AWWA C702 - Cold Water Meters -- Compound Type; American Water Works Association.
- H. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold Water Meters; American Water Works Association (ANSI/AWWA C706).
- I. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; American Water Works Association.
- J. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Underwriters Laboratories Inc..

1.03 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Operation and Maintenance Data:.

1.04 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.05 EXTRA MATERIALS

- A. Supply two bottles of red gage oil for static pressure gages.
- B. Supply two pressure gages with pulsation damper or dial thermometers.

PART 2 PRODUCTS

2.01 PRESSURE GAGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Moeller Instrument Co., Inc: www.moellerinstrument.com.
 - 3. Omega Engineering, Inc: www.omega.com.
- B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 4-1/2 inch diameter.
 - 3. Size: 2 inch diameter.
 - 4. Mid-Scale Accuracy: One percent.
 - 5. Scale: Psi.

2.02 PRESSURE GAGE TAPPINGS

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass or Stainless Steel, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Omega Engineering, Inc: www.omega.com.
 - 3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Size: 9 inch scale.
 - 4. Window: Clear glass or Lexan.
 - 5. Accuracy: 2 percent, per ASTM E77.
 - 6. Calibration: Degrees F.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9 inch scale.
 - 2. Window: Clear Lexan.
 - 3. Size: 9 inch scale.
 - 4. Window: Clear glass or Lexan.
 - 5. Stem: 3/4 inch NPT brass.

6. Accuracy: 2 percent, per ASTM E77.
7. Calibration: Degrees F.

2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.05 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapters with 1/8 inch probes, two 1 inch dial thermometers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.
- D. Install pressure gages with pulsation dampers. Provide gage cock or needle valve to isolate each gage. Extend nipples and siphons to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 09 43.
- G. Coil and conceal excess capillary on remote element instruments.
- H. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- I. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- J. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- K. Locate test plugs adjacent thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, adjacent to control device sockets or where indicated.

3.02 SCHEDULES

- A. Positive Displacement Meters, Location:
 1. Domestic cold water.
 2. Expansion tank make-up.

- B. Pressure Gages, Location and Scale Range:
 - 1. Pumps, 0 to 100 psi.
 - 2. Expansion tanks, 0 to 100 psi.
 - 3. Sprinkler system, 0 to 100 psi.
 - 4. Backflow preventers, 0 to 100 psi.
- C. Pressure Gage Tappings, Location:
 - 1. Control valves 3/4 inch & larger - inlets and outlets.
 - 2. Major coils - inlets and outlets.
 - 3. Heat exchangers - inlets and outlets.
- D. Stem Type Thermometers, Location and Scale Range:
 - 1. Domestic hot water supply and recirculation, 0 to 220 degrees F.

END OF SECTION

SECTION 22 05 53**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Identification painting.
- B. Section 22 60 05 - Medical Air, Gas, and Vacuum Systems: Supply of pipe labels for placement under this section.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.

1.04 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Samples: Submit two labels; tags in size.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Brady Corporation: www.bradycorp.com.
- B. Champion America, Inc: www.Champion-America.com.
- C. Seton Identification Products: www.seton.com/aec.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: Black.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Yellow.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter or square.
- B. Metal Tags: Brass, aluminum, or stainless steel with stamped letters; tag size minimum 1-1/2 inch diameter or square with smooth edges.
- C. Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.06 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Plumbing Valves: Green.
 - 4. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates or stencil painting. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- N. Identify ductwork with plastic nameplates or stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- O. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 22 07 16**PLUMBING EQUIPMENT INSULATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Equipment insulation.
- B. Covering.
- C. Breeching insulation.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Painting insulation covering.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- C. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.
- D. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- E. Section 23 21 14 - Hydronic Specialties.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- G. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- J. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. See Gilbane Project Manual.

- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. Knauf Insulation; : www.knaufusa.com.
 - 2. Johns Manville Corporation; : www.jm.com.
 - 3. Owens Corning Corp; : www.owenscorning.com.
 - 4. CertainTeed Corporation; : www.certainteed.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. 'K' Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F, 850 degrees F, 1000 degrees F or 1200 degrees F.
 - 3. Maximum Water Vapor Sorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film or Vinyl.
 - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 2. Secure with self-sealing longitudinal laps and butt strips.

3. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive:
 1. Compatible with insulation.
- F. Insulating Cement/Mastic:
 1. ASTM C195; hydraulic setting on mineral wool.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
 1. Knauf Insulation: www.knaufusa.com.
 2. Johns Manville Corporation: www.jm.com.
 3. Owens Corning Corp: www.owenscorning.com.
 4. CertainTeed Corporation; www.certainteed.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
 1. 'K' Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 2. Maximum Service Temperature: 850 degrees F or 1200 degrees F.
 3. Maximum Water Vapor Sorption: 5.0 percent by weight.
 4. Maximum Density: 8.0 lb/cu ft or 12.0 lb/cu ft.
- C. Vapor Barrier Jacket:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film or Vinyl.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with self-sealing longitudinal laps and butt strips.
 4. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.
- E. Vapor Barrier Lap Adhesive:
 1. Compatible with insulation.
- F. Insulating Cement/Mastic:
 1. ASTM C195; hydraulic setting on mineral wool.

2.04 CELLULAR GLASS

- A. Manufacturer:
 1. Pittsburgh Corning Corporation: www.foamglasinsulation.com.
 2. Substitutions: See Gilbane Project Manual.
- B. Insulation: ASTM C552, Grade 2.
 1. 'K' Value: 0.41 at 100 degrees F.
 2. Service Temperature: Up to 900 degrees F.
 3. Water Vapor Permeability: 0.005 perm inch.
 4. Water Absorption: 0.2 percent by volume, maximum.
 5. Density: Minimum 6.80 lb/cu ft.

2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 1. Armacell International: www.armacell.com.

- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 3, Grad 2 or Grade 1, in sheet form.
 - 1. Minimum Service Temperature: -40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.06 JACKETS

- A. PVC Plastic:
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
 - b. Substitutions: See Gilbane Project Manual.
 - 2. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: -40 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive or Pressure sensitive color matching vinyl tape.
 - 3. Covering Adhesive Mastic:
 - a. Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 - 1. Lagging Adhesive:
 - a. Compatible with insulation.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch, 0.020 inch, 0.025 inch, 0.032 inch or 0.040 inch sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- D. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
 - 1. Thickness: 0.010 inch, 0.016 inch or 0.018 inch.
 - 2. Finish: Smooth.
 - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- J. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- K. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel or Steel between hangers and inserts.
 - 3. Insert location: Between support shield and equipment and under the finish jacket.
 - 4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- L. Finish insulation at supports, protrusions, and interruptions.
- M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULES

- A. Equipment: Domestic hot-water storage tanks, solar hot water tanks, heat exchangers, and expansion tanks, not factory insulated.
 - 1. Operating Temperature: 55 to 140 degrees F.
 - 2. Insulation Material: Glass Fiber
 - 3. Insulation Thickness: 2 inch.
 - 4. Field-Applied Jacket: PVC
 - 5. Vapor Retarder Required: No
 - 6. Finish: None.

END OF SECTION

SECTION 22 07 19**PLUMBING PIPING INSULATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- I. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- J. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- K. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- L. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- M. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- N. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- O. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber.
- P. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- R. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- S. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Samples: Submit two samples of any representative size illustrating each insulation type.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience, or and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 - 1. Knauf Insulation: www.knaufusa.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
 - 4. CertainTeed Corporation; : www.certainteed.com.
 - 5. Substitutions: See Gilbane Project Manual.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 - 1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
 - 2. Maximum service temperature: 850 degrees F; 1200 degrees F; 1600 degrees F.
 - 3. Maximum moisture absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547; semi-rigid, noncombustible, end grain adhered to jacket.

1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum service temperature: 650 degrees F.
 3. Maximum moisture absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Vapor Barrier Lap Adhesive:
1. Compatible with insulation.
- G. Insulating Cement/Mastic:
1. ASTM C195; hydraulic setting on mineral wool.
- H. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Blanket: 1.0 lb/cu ft density.
 3. Weave: 5x5; 10x10; or 10x20.
- I. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Vinyl emulsion type acrylic, compatible with insulation, black or white color.
- J. Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Outdoor Breather Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- L. Insulating Cement:
1. ASTM C449/C449M.

2.03 CELLULAR GLASS

- A. Manufacturers:
1. Pittsburgh Corning Corporation: www.foamglasinsulation.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C552, Grade 1.
1. 'K' value: 0.37 at 100 degrees F.
 2. Service Temperature: Up to 900 degrees F.
 3. Water Vapor Permeability: 0.005 perm inch.
 4. Water Absorption: 0.2 percent by volume, maximum.

2.04 EXPANDED POLYSTYRENE

- A. Manufacturers:
- B. Insulation: ASTM C578; rigid closed cell.
1. 'K' value: 0.23 at 75 degrees F.
 2. Maximum service temperature: 165 degrees F.
 3. Maximum water vapor permeance: 5.0 perms

2.05 EXPANDED PERLITE

- A. Manufacturers:
1. Schundler Company: www.schundler.com.

- B. Insulation: ASTM C610, molded.
 - 1. Maximum service temperature: 1200 degrees F.
 - 2. Maximum water vapor transmission: 0.1 perm.

2.06 POLYISOCYANURATE CELLULAR PLASTIC

- A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
 - 1. Dimension: Comply with requirements of ASTM C585.
 - 2. 'K' value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
 - 3. Minimum Service Temperature: -70 degrees F.
 - 4. Maximum Service Temperature: 300 degrees F.
 - 5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842..
 - 6. Moisture Vapor Transmission: 4.0 perm in.
 - 7. Connection: Waterproof vapor barrier adhesive.

2.07 POLYETHYLENE

- A. Manufacturers:
 - 1. Armacell International: www.armacell.com.
- B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
 - 1. 'K' value: ASTM C177; 0.25 at 75 degrees F.
 - 2. Maximum Service Temperature: 200 degrees F.
 - 3. Density: 2 lb/cu ft.
 - 4. Maximum Moisture Absorption: 1.0 percent by volume.
 - 5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
 - 6. Connection: Contact adhesive.

2.08 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Armacell International: www.armacell.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 3; grade 2; grade 1 use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: -40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.09 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 20 mil; 30 mil.

- e. Connections: Brush on welding adhesive, tacks, pressure sensitive color matching vinyl tape.
- 3. Covering Adhesive Mastic:
- B. ABS Plastic:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: -40 degrees F.
 - b. Maximum Service Temperature of 180 degrees F.
 - c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil.
 - e. Connections: Brush on welding adhesive.
- C. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 - 1. Lagging Adhesive:
 - a. Compatible with insulation.
- D. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch, 0.020 inch sheet.
 - 2. Finish: Smooth, embossed.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- E. Stainless Steel Jacket: ASTM A 666, Type 304 or 316 stainless steel.
 - 1. Thickness: 0.010 inch.
 - 2. Finish: Smooth.
 - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- H. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.
 - 4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.
- M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULES

3.04 INTERIOR INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot, recirculated hot water and solar piping.
 - 1. Operating Temperature: 60 to 140 deg F.
 - 2. Insulation Material: Flexible elastomeric or glass fiber.
 - 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, All Sizes: 1.0 inch.
 - 4. Jacket: None.
 - 5. Vapor Retarder Required: No.
 - 6. Finish: None.
- B. Service: Domestic cold water.
 - 1. Operating Temperature: 35 to 60 deg F.
 - 2. Insulation Material: Flexible elastomeric or glass fiber.
 - 3. Insulation Thickness: Apply the following insulation thicknesses:

- a. Pipe, 1" or less: 0.5 inch.
 - b. Pipe, 1¼" to 2" : 0.5 inch.
 - c. Pipe, 2-1/2" to 4": 1.0 inch.
 - d. Pipe, 5" and up : 1.0 inch.
4. Jacket: Foil and paper.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- C. Service: Rainwater conductors.
1. Operating Temperature: 32 to 100 deg F.
 2. Insulation Material: Mineral fiber.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 3" and up: 1.0 inch.
 4. Jacket:
 - a. Concealed Piping - None
 - b. Exposed Piping - PVC
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- D. Service: Roof drain bodies.
1. Operating Temperature: 32 to 100 deg F.
 2. Insulation Material: Mineral fiber.
 3. Insulation Thickness: 1.0 inch.
 4. Jacket:
 - a. Concealed - None
 - b. Exposed - PVC
 5. Vapor Retarder Required: Yes.
 6. Finish: None
- E. Service: Sanitary waste piping where heat tracing is installed.
1. Operating Temperature: 35 to 100 deg F.
 2. Insulation Material: Mineral fiber.
 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 3" and up: 1.0 inch.
 4. Jacket: Aluminum.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- F. Service: Condensate drain piping.
1. Operating Temperature: 35 to 75 deg F.
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: 0.5 inch.
 4. Jacket: None.
 5. Vapor Retarder Required: Yes.
 6. Finish: None.
- G. Service: Exposed sanitary drains and domestic water supplies and stops for fixtures for the disabled.
1. Operating Temperature: 35 to 120 deg F.
 2. Insulation Material: Molded closed cell vinyl.
 3. Insulation Thickness: 3/16 inch.
 4. Vapor Retarder Required: No.
 5. Finish: None.

3.05 EXTERIOR INSULATION APPLICATION SCHEDULE

- A. This application schedule is for aboveground insulation outside the building. Loose-fill insulation, for belowground piping, is specified in Division 2 piping distribution Sections.
- B. Service: Domestic water.
 - 1. Operating Temperature: 60 to 180 deg F.
 - 2. Insulation Material: Cellular glass, with jacket
 - 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 1" or less: 2.0 inch.
 - b. Pipe, 1-1/4" and larger: 2.0 inch.
 - 4. Jacket: Aluminum.
 - 5. Vapor Retarder Required: No.
 - 6. Finish: None.
- C. Service: Storm water.
 - 1. Operating Temperature: 32 to 100 deg F.
 - 2. Insulation Material: Flexible elastomeric.
 - 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 1-1/4" to 2": 0.5 inch.
 - b. Pipe, 2-1/2" and up: 1.0 inch.
 - 4. Field-Applied Jacket: Aluminum.
 - 5. Vapor Retarder Required: Yes.
 - 6. Finish: None.

END OF SECTION

SECTION 22 10 05**PLUMBING PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Pipe, pipe fittings, valves, and connections for piping systems.
 - 1. Sanitary sewer.
 - 2. Domestic water.
 - 3. Storm water.
 - 4. Gas.

1.02 RELATED REQUIREMENTS

- A. Section 31 23 16 - Excavation.
- B. Section 31 23 23 - Fill.
- C. Section 31 23 16.13 - Trenching.
- D. Section 33 13 00 - Disinfecting of Water Utility Distribution.
- E. Section 07 84 00 - Firestopping.
- F. Section 08 31 00 - Access Doors and Panels.
- G. Section 09 90 00 - Painting and Coating.
- H. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- I. Section 22 07 19 - Plumbing Piping Insulation.
- J. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers.
- C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers.
- D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers (ANSI B16.18).
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- G. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers.
- H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; The American Society of Mechanical Engineers.

- I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers.
- J. ASME B31.1 - Power Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.1).
- K. ASME B31.2 - Fuel Gas Piping; The American Society of Mechanical Engineers.
- L. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.9).
- M. ASME (BPV IV) - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers.
- N. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers.
- O. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings.
- P. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- Q. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- R. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- S. ASTM B32 - Standard Specification for Solder Metal.
- T. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes.
- U. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
- V. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed.
- W. ASTM B68M - Standard Specification for Seamless Copper Tube, Bright Annealed (Metric).
- X. ASTM B75/B75M - Standard Specification for Seamless Copper Tube.
- Y. ASTM B75M - Standard Specification for Seamless Copper Tube (Metric).
- Z. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- AA. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- AB. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- AC. ASTM B302 - Standard Specification for Threadless Copper Pipe, Standard Sizes.
- AD. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV).
- AE. ASTM C4 - Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile.
- AF. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
- AG. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe [Metric].
- AH. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

- AI. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).
- AJ. ASTM C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
- AK. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- AL. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
- AM. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- AN. ASTM C700 - Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
- AO. ASTM C1053 - Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.
- AP. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- AQ. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- AR. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- AS. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- AT. ASTM D2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
- AU. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- AV. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
- AW. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- AX. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
- AY. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
- AZ. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- BA. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.
- BB. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- BC. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

- BD. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
- BE. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
- BF. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- BG. ASTM D2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- BH. ASTM D2997 - Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- BI. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- BJ. ASTM D3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
- BK. ASTM D3517 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe.
- BL. ASTM D3754 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe.
- BM. ASTM D3840 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications.
- BN. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- BO. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- BP. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- BQ. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- BR. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
- BS. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- BT. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- BU. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core.
- BV. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- BW. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

- BX. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe.
- BY. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe.
- BZ. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- CA. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association (ANSI/AWWA C105/A21.5).
- CB. AWWA C110/A21.10 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids; American Water Works Association.
- CC. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association (ANSI/AWWA C111/A21.11).
- CD. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association (ANSI/AWWA C151/A21.51).
- CE. AWWA C651 - Disinfecting Water Mains; American Water Works Association (ANSI/AWWA C651).
- CF. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution; American Water Works Association (ANSI/AWWA C900).
- CG. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service; American Water Works Association.
- CH. AWWA C950 - Fiberglass Pressure Pipe; American Water Works Association (ANSI/AWWA C950).
- CI. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute.
- CJ. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute.
- CK. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CL. MSS SP-67 - Butterfly Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CM. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CN. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CO. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CP. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; Manufacturers

Standardization Society of the Valve and Fittings Industry, Inc..

- CQ. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CR. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CS. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CT. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- CU. NFPA 54 - National Fuel Gas Code; National Fire Protection Association.
- CV. NFPA 58 - Liquefied Petroleum Gas Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- B. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with local standards.
 - 1. Maintain one copy on project site.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME (BPV IX).
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with local plumbing code.
- B. Conform to applicable code for installation of backflow prevention devices.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.08 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

1.09 EXTRA MATERIALS

- A. Provide two repacking kits for each size valve.

PART 2 PRODUCTS**2.01 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET OF BUILDING**

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. PVC Pipe: ASTM D 3034 SDR 35. As permitted by code.
 - 1. Fittings: PVC.
 - 2. Joints: Push-on, using ASTM F477 elastomeric gaskets.
- C. PVC Pipe: ASTM D 2665 or ASTM D 3034. As permitted by code.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.02 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

2.03 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. PVC Pipe: ASTM D1785 Schedule 40, or ASTM D2241 SDR 26 for not less than 150 psi pressure rating.
 - 1. Fittings: ASTM D2466, PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 Solvent cement.

2.04 CHEMICAL RESISTANT SEWER PIPING

- A. PPFR Pipe: Polypropylene, flame retardant. By Orion/Watts MFG or approved equal.
 - 1. Fittings: Polypropylene, PVDF
 - 2. Joints: Electrical resistance fusion or no-hub coupling

2.05 WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: AWWA C110, ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, rubber gasket with 3/4 inch diameter rods.
- B. Copper Pipe: ASTM B42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 2. Joints: ASTM B 32, alloy Sn95 solder.
- C. Copper Pipe: ASTM B42, annealed.
1. Fittings: ASME B16.26, cast bronze.
 2. Joints: Flared.

2.06 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B42, hard drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 2. Joints: ASTM B 32, alloy Sn95 solder.
- B. Copper Pipe: ASTM B42, annealed.
1. Fittings: ASME B16.26, cast bronze.
 2. Joints: Flared.

2.07 WATER PIPING, ABOVE GRADE

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: ASTM B32, alloy Sn95 solder.

2.08 STORM WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Concrete Pipe: Nonreinforced, ASTM C14 (ASTM C14M) Class 1.
1. Fittings: Concrete, as specified for pipe.
 2. Joints: Elastomeric gaskets; ASTM C443 (ASTM C443M).
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.09 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A74 service weight.
1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
 2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.10 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A74 service weight.
1. Fittings: Cast iron.
 2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.
- B. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.

2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D2665 or ASTM D3034.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.11 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2. Joints: ASME B31.1, welded.

2.12 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A234/A234M, wrought steel welding type.

2. Joints: ASME B31.1 or ASME B31.9, welded.

3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.13 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.

2. Joints: NFPA 54, threaded or welded to ASME B31.1 or ASME B31.9.

2.14 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.

2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.

2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.15 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.

3. Trapeze Hangers: Welded steel channel frames attached to structure.

4. Vertical Pipe Support: Steel riser clamp.

- B. Plumbing Piping - Drain, Waste, and Vent:
1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
1. Conform to ASME B31.9.
 2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
 5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 10. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
 11. Vertical Support: Steel riser clamp.
 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
 14. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
 15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.16 GATE VALVES

- A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
 2. Nibco, Inc: www.nibco.com.
 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Up To and Including 3 Inches:
1. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.
- C. 2 Inches and Larger:
1. MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.17 GLOBE VALVES

- A. Manufacturers:
 - 1. Conbraco Industries: www.conbraco.com.
 - 2. Nibco, Inc: www.nibco.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Up To and Including 3 Inches:
 - 1. MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder ends.
- C. 2 Inches and Larger:
 - 1. MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.18 BALL VALVES

- A. Manufacturers:
 - 1. Conbraco Industries: www.conbraco.com.
 - 2. Nibco, Inc: www.nibco.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.19 PLUG VALVES

- A. Manufacturers:
 - 1. Conbraco Industries: www.conbraco.com.
 - 2. Nibco, Inc: www.nibco.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Construction 2-1/2 Inches and Larger: MSS SP-78, 175 psi CWP, cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.20 BUTTERFLY VALVES

- A. Manufacturers:
 - 1. Hammond Valve: www.hammondvalve.com.
 - 2. Crane Co.: www.cranevalve.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Construction 1-1/2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM, Buna N, or EPT seat, wafer, lug, or grooved ends, extended neck, 10 position lever handle.
- C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.21 FLOW CONTROLS

- A. Manufacturers:
 - 1. ITT Bell & Gossett: www.bellgossett.com.
 - 2. Griswold Controls: www.griswoldcontrols.com.
 - 3. Taco, Inc: www.taco-hvac.com.

- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
- C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.22 SWING CHECK VALVES

- A. Manufacturers:
 - 1. Hammond Valve: www.hammondvalve.com.
 - 2. Nibco, Inc: www.nibco.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Up to 3 Inches:
 - 1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.
- C. Over 3 Inches:
 - 1. MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.23 SPRING LOADED CHECK VALVES

- A. Manufacturers:
 - 1. Hammond Valve: www.hammondvalve.com.
 - 2. Crane Co.: www.cranevalve.com.
 - 3. Milwaukee Valve Company: www.milwaukeevalve.com.
- B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.24 WATER PRESSURE REDUCING VALVES

- A. Manufacturers:
 - 1. Amtrol Inc: www.amtrol.com.
 - 2. Cla-Val Co: www.cla-val.com.
 - 3. Watts Regulator Company: www.wattsregulator.com.
- B. Up to 2 Inches:
 - 1. MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single or double union ends.
- C. Over 2 Inches:
 - 1. MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.25 RELIEF VALVES

- A. Pressure Relief:
 - 1. Manufacturers:
 - a. Cla-Val Co: www.cla-val.com.
 - b. Henry Technologies: www.henrytech.com.
 - c. Watts Regulator Company: www.wattsregulator.com.
 - 2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- B. Temperature and Pressure Relief:
 - 1. Manufacturers:
 - a. Cla-Val Co: www.cla-val.com.

- b. Henry Technologies: www.henrytech.com.
- c. Watts Regulator Company: www.wattsregulator.com.
2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labelled.

2.26 STRAINERS

- A. Manufacturers:
 1. Armstrong International, Inc: www.armstronginternational.com.
 2. Green Country Filter Manufacturing: www.greencountryfilter.com.
 3. WEAMCO: www.weamco.com.
- B. Size 2 inch and Under:
 1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
 2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- C. Size 1-1/2 inch to 4 inch:
 1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.
- D. Size 5 inch and Larger:
 1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.
- H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.

- I. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.
- J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Provide support for utility meters in accordance with requirements of utility companies.
- M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- N. Excavate in accordance with Section 31 23 16.
- O. Backfill in accordance with Section 31 23 23.
- P. Install bell and spigot pipe with bell end upstream.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- S. Install water piping to ASME B31.9.
- T. Install fuel oil piping to ASME B31.9.
- U. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- V. Sleeve pipes passing through partitions, walls and floors.
- W. In all kitchen/cooking areas, any piping that is run exposed along walls shall maintain at least a 1" gap to the walls to allow for cleaning per codes.
- X. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
- Y. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 8. Provide copper plated hangers and supports for copper piping.

9. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 22 05 48.
11. Support cast iron drainage piping at every joint.

3.04 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring loaded check valves on discharge of water pumps.
- H. Provide plug valves in natural gas systems for shut-off service.
- I. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system in accordance with Section 33 13 00.
- B. Prior to starting work, verify system is complete, flushed and clean.
- C. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.

- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve.
 - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.
- C. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 7 inch wg. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.08 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe size: 1/2 inches to 1-1/4 inches:
 - 1) Maximum hanger spacing: 6.5 ft.
 - 2) Hanger rod diameter: 3/8 inches.
 - b. Pipe size: 1-1/2 inches to 2 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 3/8 inch.
 - c. Pipe size: 2-1/2 inches to 3 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 1/2 inch.
 - d. Pipe size: 4 inches to 6 inches:
 - 1) Maximum hanger spacing: 10 ft.
 - 2) Hanger rod diameter: 5/8 inch.
 - e. Pipe size: 8 inches to 12 inches:
 - 1) Maximum hanger spacing: 14 ft.
 - 2) Hanger rod diameter: 7/8 inch.
 - f. Pipe size: 14 inches and Over:
 - 1) Maximum hanger spacing: 20 ft.
 - 2) Hanger rod diameter: 1 inch.
 - 2. Plastic Piping:
 - a. Pipe Size 1" to 6":
 - 1) Maximum hanger spacing: 6 ft.
 - 2) Hanger rod diameter: 3/8 inch.
 - b. Pipe Size 8" and Over:
 - 1) Maximum hanger spacing: 6 ft.
 - 2) Hanger rod diameter: 7/8 inch.

END OF SECTION

SECTION 22 10 06**PLUMBING PIPING SPECIALTIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Roof and floor drains.
- B. Cleanouts.
- C. Hydrants.
- D. Backflow preventers.
- E. Water hammer arrestors.
- F. Interceptors.
- G. Thermostatic mixing valves.
- H. Catch basins and manholes.

1.02 RELATED REQUIREMENTS

- A. Section 33 05 13 - Manholes and Structures.
- B. Section 03 30 00 - Cast-in-Place Concrete: Manhole bottoms.
- C. Section 22 10 05 - Plumbing Piping.
- D. Section 22 40 00 - Plumbing Fixtures.
- E. Section 22 30 00 - Plumbing Equipment.
- F. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; The American Society of Mechanical Engineers.
- C. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering (ANSI/ASSE 1011).
- D. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; American Society of Sanitary Engineering (ANSI/ASSE 1012).
- E. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering.
- F. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering (ANSI/ASSE 1019).
- G. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
- H. ASTM C478M - Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
- I. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute.

1.04 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Certificates: Certify that grease or oil interceptors meet or exceed specified requirements.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.
- E. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.
- F. Operation Data: Indicate frequency of treatment required for interceptors.
- G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

1.07 EXTRA MATERIALS

- A. Supply for Red Clay Consolidated School District's use in maintenance of project:
 - 1. Two loose keys for outside hose bibbs.
 - 2. Two hose end vacuum breakers for hose bibbs.

PART 2 PRODUCTS**2.01 DRAINS**

- A. Manufacturers:
 - 1. Josam Company: www.josam.com.
 - 2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 3. Zurn Industries, Inc: www.zurn.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Roof Drains:
 - 1. Assembly: ASME A112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Removable polyethylene, cast metal, cast bronze, or cast iron dome with vandal proof screws.
 - 4. Accessories: Coordinate with roofing type.
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir.
 - f. Leveling frame.
 - g. Adjustable extension sleeve for roof insulation.
 - h. Perforated or slotted ballast guard extension for inverted roof.
 - i. Perforated stainless steel ballast guard extension.

- C. Parapet Drains:
 - 1. Lacquered or Galvanized cast iron body with aluminum flashing clamp collar and epoxy coated or nickel bronze sloping grate.
- D. Canopy and Cornice Drains:
 - 1. Lacquered or Galvanized cast iron body with aluminum flashing clamp collar and epoxy coated or nickel bronze flat strainer.
- E. Roof Overflow Drains:
 - 1. Lacquered or Galvanized cast iron body and clamp collar and bottom clamp ring; pipe extended to above flood elevation.
- F. Downspout Nozzles:
 - 1. Bronze round with straight bottom section.
- G. Area Drains:
 - 1. Assembly: ASME A112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Round nickel-bronze.
 - 4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp, roof sump receiver, waterproofing flange, levelling frame, adjustable extension sleeve (for insulation), and perforated stainless steel ballast guard extension.
- H. Floor Drain:
 - 1. Round, type 304 stainless steel adjustable floor drain with anchor flange and medium-duty vertically adjustable satin finish top.

2.02 CLEANOUTS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 - 2. Josam Company: www.josam.com.
 - 3. Zurn Industries, Inc: www.zurn.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Cleanouts at Exterior Surfaced Areas:
 - 1. Round cast nickel bronze access frame and non-skid cover.
- C. Cleanouts at Exterior Unsurfaced Areas:
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.
- D. Cleanouts at Interior Finished Floor Areas:
 - 1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
- E. Cleanouts at Interior Finished Wall Areas:
 - 1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
- F. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.03 HYDRANTS

- A. Manufacturers:
 - 1. Arrowhead Brass Company: www.arrowheadbrass.com.

2. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 3. Zurn Industries, Inc: www.zurn.com.
- B. Wall Hydrants: Exterior
1. ASSE 1019; tamper-proof, freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.
- C. Roof Hydrant:
1. Freezeless, cast iron support components. Drain connection, EPDM Boot.

2.04 BACKFLOW PREVENTERS

- A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
 2. Watts Regulator Company: www.wattsregulator.com.
 3. Zurn Industries, Inc: www.zurn.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Reduced Pressure Backflow Preventers:
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
 2. Compliant with local codes for service entrances.

2.05 DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers:
1. Conbraco Industries: www.conbraco.com.
 2. Watts Regulator Company: www.wattsregulator.com.
 3. Zurn Industries, Inc: www.zurn.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Double Check Valve Assemblies:
1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.
 2. Compliant with local codes for service entrances.

2.06 WATER HAMMER ARRESTORS

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
 2. Watts Regulator Company: www.wattsregulator.com.
 3. Zurn Industries, Inc: www.zurn.com.
 4. Souix Chief Company.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Water Hammer Arrestors:
1. Stainless steel construction, bellows or piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

2.07 MIXING VALVES

- A. Thermostatic Mixing Valves:
1. Manufacturers:
 - a. ESBE: www.esbe.se/en.

- b. Leonard Valve Company: www.leonardvalve.com.
 - c. Honeywell Water Controls: <http://yourhome.honeywell.com>.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
- a. Check valve on inlets.
 - b. Volume control shut-off valve on outlet.
 - c. Stem thermometer on outlet.
 - d. Strainer stop checks on inlets.
4. Cabinet: 16 gage prime coated steel, for recessed mounting with keyed lock.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, washing machines, toilets, urinal and any other quick closing valves.

END OF SECTION

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for water service and fire-service mains.
- B. Contractor shall furnish and install all mains, hydrants, valves and fittings as specified and indicated on the drawings.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for water system piping.
 - 1. Underground Piping: 150 psi (1035 kPa).1
 - 2. Underground Piping, Fire Suppression System: 200 psig (1380 kPa).
- B. Protection of Potable Water Supply:
 - 1. A minimum of 10 feet horizontal separation shall be provided between proposed water mains and proposed sewers.
 - 2. Clearances: Where specified crossing clearance cannot be obtained, sewer shall be encased in concrete for 10 feet each side of water main. For crossings of other utilities, sewer shall be encased with limits of the utility trench.
 - a. Sewer crossing water mains shall have a clearance of 18 inches below water main or shall be encased.
 - b. Sewers shall have a minimum of 6 inches clearance when crossing other utilities.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: none
- C. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.
- D. Field quality-control test reports.
- E. Record drawings at Project closeout of installed water system piping and products according to Division 1 Section "Project Closeout."

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
 - 2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- B. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- C. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- D. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- F. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping.
 - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.
- G. Provide listing/approval stamp, label, or other marking on equipment made to specified standards

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping 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.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Construction Manager & Owner no fewer than five days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of water-distribution service without Construction Manager's & Owner's written permission.
- B. Verify that water system piping may be installed in compliance with original design and referenced standards.
- C. Site Information: Reports on subsurface condition investigations made during the design of the Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions (between soil borings). Owner and Architect assumes no responsibility for interpretations or conclusions drawn from this information

1.8 COORDINATION

- A. Coordinate connection to Building Plumbing and other Division 22 work.
- B. Coordinate with other utility work including but not limited to fire protection systems piping.
- C. Coordinate electrical requirements of actual equipment furnished with requirements specified in Division 26.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.
- C. Flanges: ASME 16.1, Class 125, cast iron.
- D. Comply with NFPA 24 and local/state regulations for fire-service mains.

2.2 PVC PIPE AND FITTINGS

- A. PVC, AWWA Pipe: AWWA C900, Class 150 and Class 200, with bell end with gasket, and with spigot end.

- B. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1. Gaskets: AWWA C111, rubber.
- C. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Mains & Services for Fire Suppression
 - 1. Comply with UL 1285 for fire-service mains if indicated.
 - 2. Comply with NFPA 24 and local/state regulations for fire-service mains.

2.3 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Split-Sleeve Pipe Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Depend-O-Lok.
 - 2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
 - a. Standard: AWWA C219.
 - b. Sleeve Material: Stainless steel.
 - c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
 - d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
 - e. Pressure Rating: 200 psig minimum.
 - f. Metal Component Finish: Corrosion-resistant coating or material.

2.1 WATER METERS

- A. Water meters will be furnished by utility company.

2.2 CONCRETE METER VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A.C. Miller Precast Concrete Products
 - 2. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.

3. Access Hatch: Heavy Duty Aluminum to meet Utility Company Requirements

2.3 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Provide valves by Waterous, Mueller Co. or a comparable product approved by the Engineer.
2. Nonrising-Stem, Resilient-Seated Gate Valves:
 - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
 - 1) Standard: AWWA C509.
 - 2) Minimum Pressure Rating: 200 psig .
 - 3) End Connections: Mechanical joint.
 - 4) Interior Coating: Complying with AWWA C550.

2.4 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Manufacturers: Provide products by one of the following:
2. Provide Mueller Co.; Water Products Div or a comparable product approved by the utility.
3. Description: Sleeve and valve compatible with drilling machine.
 - a. Standard: MSS SP-60.
 - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
 - c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

- ### B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, extra deep lid with two holes, adjustable extension of length required for depth of burial of valve (valve boxes shall be adjustable between 2'-4" and 3'-4" except when deeper settings are required) , plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel 5 1/4 inches in diameter.

1. Provide boxes by Mueller, or a comparable product approved by the utility.
2. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.
3. All boxes for 4, 6, and 8-inch valves shall be equipped with #6 round base. Valve boxes shall be adjustable between 2'-4" and 3'-4" except when deeper settings are required.

2.5 CORPORATION VALVES AND CURB VALVES

A. Manufacturers:

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

- a. Ford Meter Box Company, Inc. (The); Pipe Products Div. model number per utility company standard.
- B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.
 - 1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
 - 2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
 - 3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.
- C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.
- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 4 1/4 inches in diameter.
 - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.
- A. Single-Detector Check Valve -Assembly:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Ames Fire & Waterworks; a division of Watts Regulator Co.
 - b. FEBCO; SPX Valves & Controls.
 - c. Watts Water Technologies, Inc.
 - d. Wilkins; a Zurn company.
 - 2. Standards: ASSE 1048 and UL listed or FMG approved.
 - 3. Size: NPS 8
 - 4. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved
 - 5. End Connections: Flanged.
 - 6. Configuration: Designed for horizontal, straight through flow.
 - 7. Accessories:
 - a. Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

2.6 FIRE HYDRANTS

- A. Dry-Barrel Fire Hydrants:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Darling B-62-B or equivalent.
 - b. Substitutions shall be approved by the Architect.
 - 2. Description:

- a. Standard: AWWA C502.
 - b. All hydrants to be furnished with non-kinking chains on the 2 ½-inch nozzles.
3. A sworn certificate of inspection and testing shall be furnished by the manufacturer. Install hydrants with restraint system as detailed on the drawings, or with a hydrant tee.

2.7 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Manufacturers: Subject to compliance with requirements of the DE State Fire Marshal and local health department and match local fire department threads. Contractor responsible to confirm location with the Local Fire Chief. Coordinate with Division 21.

2.8 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches (150 mm) wide by 4 mils (1 mm) thick, solid blue in color with continuously printed caption in black letters "CAUTION - WATER LINE BURIED BELOW."

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground Water-Service and Fire-Service-service piping shall be as noted on the drawings or any of the following:
1. PVC, AWWA C900 Class 150 and 200 pipe; Ductile Iron fabricated fittings and gasketed joints.
 2. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.
 3. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products
 4. Installation shall be coordinated with and overseen by the fire protection contractor.

3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults as indicated in utility company details. Use UL/FMG, non-rising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.
 - a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.
 - b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, resilient seated.
 - c. Check Valves: UL/FMG, swing type, bronze.
 - d. Ball Valves, NPS 2 and Smaller: Forged Brass
 - 2. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water. Detector check to be UL listed.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Drawings 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 except where deviations to layout are approved on coordination drawings.
- B. Install piping at indicated slope.
- C. Install restrained joints for buried piping within 5 feet (1.5m) of building. Use restrained-joint pipe and fittings, thrust blocks, anchors, tie-rods and clamps, and other supports at vertical and horizontal offsets.
- D. Install piping free of sags and bends.
- E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- F. Install fittings for changes in direction and branch connections.

3.5 PIPING INSTALLATION

- A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- B. Make connections larger than NPS 2 with tapping machine according to the following:
 - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
 - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
 - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
 - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
 - 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

- E. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- F. Bury piping with depth of cover over top at least 42 inches, with top at least 12 inches below level of maximum frost penetration.
- G. Each section of pipe shall be placed on a solid foundation for its full length, with recesses excavated to accommodate the bell of the pipe. Any pipe which has its grade or joint disturbed after installation shall be removed and reinstalled. No pipe shall be installed on frozen or wet subgrade. Bedding material shall be provided, if required, by the Architect.
- H. The interior of the pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench, and shall be kept clean during laying operations by means of plugs or other approved methods. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench or weather conditions are unsuitable for such work.
- I. At all times work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipe or fittings.
- J. Any section of pipe in place and found to be defective shall be removed and replaced immediately at no cost to the Owner.
- K. No section of pipe shall be installed with deflection greater than manufacturer's recommendations either vertically or horizontally. Any deviation required to be greater than recommended shall be made with a special fitting.
- L. All installation of ductile iron pipe shall be in accordance with AWWA Standard No. C600 with detector tape.
- M. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
 - 1. Terminate water-service piping to within 5' of building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- N. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- O. See Division 21 Section "Water-Based Fire-Suppression Systems" for fire-suppression-water piping inside the building.
- P. See Division 22 Section "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

- A. Make pipe joints according to the following:
 - 1. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
 - 2. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.7 ANCHORAGE INSTALLATION

- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Set-screw mechanical retainer glands.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
 - 1. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 2. Fire-Service-Main Piping: According to NFPA 24.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE & VALVE BOX INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- C. Valve boxes shall be installed at each outside valve. Boxes shall be sufficient length to provide a cover of not less than two feet over the pipe. Valve boxes shall be set plumb, and placed directly over the valve. Valve boxes shall be placed on two, 4-inch solid concrete blocks. After being correctly positioned, each fill shall be carefully tamped around the valve box for a distance of four (4) feet on all sides of the box. Any box found out of plumb or settled shall be reset at no cost to the Owner.

3.9 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

3.10 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

3.11 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant as required by the manufacturers recommendations. Provide with separate gate valve in supply pipe, anchor. If no detail provided, use restrained joints or thrust blocks. Support hydrant in upright position.
- B. AWWA Fire Hydrants: Comply with AWWA M17.

- C. Hydrant leads shall be ductile iron.

3.12 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install protective pipe bollards as required by local fire marshal at each fire department connection. Pipe bollards are specified in Division 05 Section "Metal Fabrications."

3.13 FIELD QUALITY CONTROL

- A. Piping Tests: The Contractor shall furnish all equipment, labor, and materials, including water, pumps, compressors, stopwatch, gauges, and meters as approved by the Project Civil Engineer for testing. The Project Civil Engineer shall determine the amount of main to be tested at anyone time and reserves the right to separate the installation into several test sections. All tests must be witnessed by the Project Civil Engineer or Owner.

- B. Domestic Water Main Hydrostatic Tests: Test at not less than one-and-one-half times working pressure or 100 psi, whichever is greater, for two hours.

- 1. Test Pressure shall:

- a. Be of at least two hour duration
- b. Not vary by more than \pm five psi.

- 2. Pressurization:

- a. Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under the test and corrected to the elevation of the test gauge shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner.

- 3. Air Removal:

- a. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points, so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, all corporation cocks shall be removed and plugged, or left in place at the discretion of the Owner.

- 4. Examination:

- a. All exposed pipe, fittings, valves, hydrants and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with same material and the test shall be repeated until it is satisfactory to the Owner.

- C. Leakage Test: A leakage test shall be conducted concurrently with the pressure test.

- a. Leakage Defined: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or at any valved section thereof, to maintain pressure within five psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
- b. Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$ND \text{ square root of } P$$

$$L = \frac{7400}{N \cdot D^2 \cdot P}$$

in which L is the allowable leakage, in gallons per hour, N is the number of joints in the length of pipe line tested; D is the nominal diameter of the pipe in inches; and P is the average test pressure during the leakage test in pounds per square inch gage.

Allowable leakage at various pressures is shown in Table I (appearing after this Subsection).

- c. When hydrants are in the test section, the test shall be made against the closed hydrant.
- d. Should the tests show the main to be defective, the Contractor shall remedy such defects and retest the main as specified above. This procedure shall be repeated until the test requirements are met.

TABLE I

Allowable Leakage per 1000 feet of Pipeline* - gph						
Avg. Test Pressure psi	Nominal Pipe Diameter - Inch					
	2	3	4	6	8	10
150	0.19	0.28	0.37	0.55	0.74	0.92
125	0.17	0.25	0.34	0.50	0.67	0.84
100	0.15	0.23	0.30	0.45	0.60	0.75

**For pipe with 18-ft nominal lengths. To obtain the recommended allowable leakage for pipe with 20-ft nominal lengths, multiply the leakage calculated from the table by 0.9. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.*

- D. Test fire suppression piping according to NFPA 24, as directed by the fire suppression contractor and local authorities
- E. Prepare reports of testing activities.

3.14 CLEANING

- A. Clean and disinfect water-distribution piping as follows:
 - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 - 2. Use purging and disinfecting procedure prescribed the Delaware Department of Health. Procedure shall be as described in AWWA C651.
 - 3. If method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

- a. Upon completion of water main construction, disinfect main and appurtenances. Disinfection shall be done in accordance with ANSI/AWWA C-651, latest edition. Contractor shall submit a plan of disinfection for approval by the Architect.
 - b. After the applicable retention period, the heavily chlorinated water shall be flushed from the main. This water shall be discharged to the sanitary sewer system. Only after water leaving the main is no higher in chlorine concentration than normal drinking water, will a discharge to storm drains be allowed. Convey flushed water to discharge point in a closed system.
 - c. Affidavits of compliance, certifying the water sampled from the water mains to be free of coliform bacteria, shall be submitted to the Architect. The Contractor is responsible for requesting tests from the Delaware Department of Public Health. He shall provide written documentation when a section of mains can be placed in service.
 - d. The Contractor shall place in each length of pipe, hydrants, hydrant branches, and other appurtenances, a sufficient amount of HTH tablets to insure adequate disinfection treatment of the main after its completion. Tablets shall be fastened to the inside top of every length of pipe as laid, using gasket cement known as "Permatex No. 2".
 - e. The Contractor will be held entirely responsible for securing a minimum residual chlorine content of 5 p.p.m. at the extremities of the mains after twenty-four (24) hours or more contact with the full water pressure on the main.
 - f. Water for filling the mains shall be introduced at a velocity of less than one (1) foot per second in order to permit the HTH or Perchloron to completely dissolve and have a reasonable uniform distribution throughout the mains. It is the intent of this Specification to require a sufficient amount of chemical to be equivalent to a dosage of 50 p.p.m. of chlorine.
 - g. After the chlorine has been in contact with the mains or storage units for twenty-four (24) hours or longer, samples collected from the extremities of the mains shall indicate a residual chlorine content of 5 p.p.m. or more.
 - h. If less than 5 p.p.m. residual chlorine is indicated, the system shall be drained and the disinfection treatment repeated.
 - i. If samples collected at the extremities indicate a residual chlorine of 5 p.p.m. or more, the system shall be flushed until there is only a normal chlorine residual (1.0 p.p.m. or less) present, as determined by the DPD Method Test. Samples of water shall be collected from various points along the lines, by a lab certified in the State of Delaware for bacteriological analysis. If satisfactory bacteriological results are obtained, the lines may then be allowed to be placed in service. A copy of all test results shall be submitted to the Architect.
4. Contractor shall provide all disinfection testing within the lump sum prices bid.
- B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes gravity-flow, non-pressure sanitary sewerage outside the building, with the following components:
 - 1. Pipe Line and Trench Excavation
 - 2. Precast concrete manholes.
 - 3. Pipe and Fittings
 - 4. Cleanouts
- B. All work performed on sanitary sewer system components shall be completed and approved by the county to the standards and specifications issued by New Castle County Department of Special Services.
- C. The Contractor shall furnish all materials and shall construct the pipe lines and all required appurtenances at the locations and to the lines, slopes and elevations shown on the drawings or designated by the Engineer.
- D. Manholes shall be built at such points on the pipe lines and of such form and dimensions as are shown on the drawings or as may be directed. Manholes shall be built as pipe laying progresses and the Engineer may stop work entirely on the laying pipe if manhole construction is delayed to such an extent as to be hazardous to construction or the public.
- E. The Contractor shall perform all excavation, backfilling grubbing and grading required for construction and installation of pipelines, structures and appurtenances. Excavation shall include removal of pavement, concrete, rock, earth and debris, regardless of character. Trenches and excavations shall be sheeted, shored and braced by the Contractor, as necessary to allow construction and provide safe working conditions, additionally, the Contractor shall be responsible for maintaining a dry excavation by dewatering. He shall also locate, support and protect existing utilities and structures encountered in the work, provide traffic control, dispose of surplus and unsuitable excavated materials and restore backfilled areas to original condition or as required by the drawings and specifications. All backfilled and restored areas shall be maintained by the Contractor, in a proper condition, for the duration of the project.
- F. The Contractor is responsible for direct or indirect damage to existing structures, pipelines, conduits, poles, wires and utilities of every description in the vicinity of his work whether above or below ground, or that may be encountered in trench or structure excavation. This responsibility shall include the cost of protection by sheeting, bracing, hand excavation, when warranted, and the expense to repair or replace any existing facility damaged directly or indirectly by construction activities under this contract, whether such facility is or is not shown on the drawings.
- G. The Contractor shall verify the location, size and elevation of all existing utilities at the various points of connection and/or crossings prior to starting any work. Any discrepancies in locations or elevations shall be brought to the attention of the Engineer in order that the designs may be adjusted accordingly. Damages suffered or additional costs incurred by the Contractor as a result of his failure to conform to the requirements of this paragraph shall be the sole responsibility of the Contractor. Connections to existing utilities shall be made by the Contractor at such a time and in such a manner as the Engineer may direct, and

the cost shall be included in the price bid for pipeline and structures, unless otherwise defined in the proposal.

- H. Excavation and backfill, within an area where a State agency has jurisdiction, shall be done in accordance with requirements and provisions of the permits issued by the agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these specifications.

1.3 SUBMITTALS

- A. Product Data: For the following:

- 1. Special pipe fittings.

- B. Shop Drawings: For the following:

- 1. Manholes: Include plans, elevations, sections, details, and frames and covers.

- 2. Pipe and fittings

- 3. The Contractor shall submit certifications to the Engineer that all pipe, fittings and joints are as specified herein.

- C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.

- B. Utility Compliance: Comply with local Municipality/utility company regulations and standards pertaining to sanitary sewer systems.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain first paragraph below for ABS, PVC, or fiberglass piping.
- B. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- C. Protect pipe, pipe fittings, and seals from dirt and damage.
- D. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities in the areas of work. Call "Miss Utility" (1-800-282-8555) and the Kent County Department of Public Works for assistance in locating existing utilities. If utilities are to remain in place, provide adequate means of protection during construction of sanitary sewer system.
- B. If utilities are to remain in place, provide adequate means of protection during construction of sanitary sewer system.

- C. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranged to provide temporary service according to requirements indicated:
1. Notify, the Construction Manager, Engineer, and the Owner no fewer than 5 days in advance of proposed interruption of service.
 2. Do not proceed with interruption of service without the Construction Manager's and the Owner's written permission.
- D. Should uncharted or incorrectly charted piping or other utilities be encountered during work, consult Owner immediately for directions as to procedure. Repair damaged utilities that are to remain in service to satisfaction of the associated jurisdiction.

PART 2 - PRODUCTS

2.1 EXCAVATION MATERIALS

- A. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

2.2 PRECAST REINFORCED CONCRETE MANHOLES

- A. Precast reinforced concrete risers, eccentric cones and bases shall be in conformance with ASTM C478. Joints between riser sections shall be fitted with an "O" ring rubber gasket, meeting the requirements of ASTM C443. Installation of risers shall be in accordance with manufacturer's recommendations under the supervision of the Engineer. Minimum compressive strength of concrete shall be 4000 psi in 28 days.
- B. Precast reinforced concrete base and riser sections shall be as manufactured by Atlantic Concrete Products Company, Virginia Precast Corporation, or equal.
- C. Interior and exterior joint spaces of all manhole risers shall be filled prior to application of the exterior waterproofing. The interior joint shall be mortared. The exterior joint may be mortared or filled with a joint filler compound. Said compound shall be Pioneer 301 as manufactured by Daubert Chemical Co., Oakbrook, Illinois, or equal.
- D. Lifting holes in the walls of precast reinforced concrete risers will be allowed but shall be plugged with rubber stoppers and grouted flush with face or manhole wall after the installation of manhole riser sections. Not more than two holes shall be cast in the walls of each riser section for the purpose of handling.
- E. The exterior surface of all precast manholes shall receive a minimum two coat application of a 68 percent solids coal tar type protective coating. The total average dry film thickness shall measure 24 mils with no single measurement to be less than 20 mils. Surfaces shall be prepared in accordance with the manufacturer's instructions and coatings applied in the field in a manner acceptable to the Engineer. The coating material shall be Bitumastic Super Service Black manufactured by Koppers Co., Inc., Pittsburgh, Pennsylvania, Tar-Jet Super Black XX-32-B-22 manufactured by Pennsbury Coatings Corp., New Britain, Pennsylvania, or equal.

2.3 FLOW CHANNELS

- A. All manhole flow channels and benches shall be constructed of brick or pre-cast into the manhole with care taken to secure smooth and even surfaces with full mortar joints. Channel sections shall be built up to true line and radius, and curved sections shall provide a uniform transition in the flow direction.
- B. Materials and construction of flow channels shall be in accordance with appropriate sections for materials so used, as hereinafter specified.

2.4 CONCRETE

- A. All concrete for manhole base and cradles, encasements, blocking, etc. shall have a minimum compressive strength of 4,000 psi at 28 days.

2.5 BRICK

- A. All brick shall conform to the "Standard Specifications for Sewer Brick", ASTM C32, Grade SS except that the maximum absorption for the average of five bricks shall not exceed 10 percent; and the individual brick maximum shall not exceed 14 percent.

2.6 MORTAR

- A. Cement shall be in accordance with the "Standard Specifications for Portland Cement", ASTM C150 for Type II.
- B. Sand shall be composed of sharp, angular, silicious grains, coarse, or graded from fine to coarse with the coarsest grains predominating, and sensibly free from clay, loam, dirt, mica, organic matter, or other impurities. Sand containing more than 5 percent by weight of foreign material shall not be used. This limit may be changed for special classes of work if hereinafter specified. Sand exhibiting more than an acceptable amount of fine matter or impurities may be required to be washed after delivery on the work or shall be rejected altogether. Sand for mortar shall be screened to reject all particles of a greater diameter than 1/4-inch and shall not contain more than 5 percent by weight of a very fine material.
- C. Unless hereinafter specified otherwise, all mortar shall be composed of cement and sand of the character above specified. The proportion of volume shall be one part of cement to two of sand. One volume of cement shall be 94 pounds net. One volume of sand shall be 0.9 cubic feet, the sand not being packed more closely than by throwing it into a box in the usual way. Mortar shall be fresh mixed in small batches for the work in hand. Tight boxes or platforms made for the purposes shall be used. The sand and cement shall be thoroughly mixed dry, in the proper proportions, until uniform color has been produced, whereupon a moderate dose of water shall be added, so as to produce a stiff paste of the proper consistency.
- D. Sand obtained from the excavation shall not be used.

2.7 MANHOLE STEPS

- A. Manhole steps shall be made of 3/8 inch diameter (No. 3) steel reinforcing bars, ASTM A615, Grade 60, encased in polypropylene plastic. Manhole steps shall have notched tread ridge with retainer lug on each side.
- B. Manhole steps shall be cast in place during manufacture of precast reinforced concrete manholes. Embedment length shall be suitable for minimum 5 inch thick, precast reinforced concrete riser walls.

- C. Manhole steps shall be OSHA approved and as manufactured by M.A. Industries, Inc., Peachtree City, Georgia, ICM, Inc., Jacksonville, Arkansas, or equal.
- D. Manhole steps shall be spaced twelve (12) inches apart. The maximum spacing from top of manhole to the first step shall not exceed sixteen (16) inches.

2.8 MANHOLE FRAMES AND COVERS

- A. Frames and covers for manholes shall be set by the Contractor as the work progresses. The frame shall be well bedded in mortar.
- B. Material for frames and covers shall be in accordance with the standard specifications for gray iron castings ASTM A48 for Class No. 35.
- C. All frames and covers shall be of the sizes and types detailed on the drawings with "NEW CASTLE COUNTY SANITARY SEWER" cast on the cover for manholes in public right of way and "SANITARY SEWER" for manholes on private property.

2.9 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe for gravity sewer construction shall be Tyton Joint, Class 52 ductile iron pipe as manufactured by U.S. Pipe. All fittings shall be 250 PSI cast iron or 350 PSI ductile iron fittings per ANSI/AWWA requirements.
- B. Pipe and fittings shall have a 401 internal coating and external asphaltic coating approximately 1 mil thick.

2.10 POLYVINYL CHLORIDE PIPE AND FITTINGS

- A. Polyvinyl chloride (PVC) pipe, used for sewer construction, shall equal or exceed the requirements of ASTM D 3034 and shall have a minimum standard dimension (SDR) ratio of 26 and the minimum pipe stiffness, as tested in accordance with ASTM D 2412, shall be 45 when measured under 5 percent deflection at 73 degrees Fahrenheit. Pipe shall be manufactured with integral wall bell and spigot joints in standard lengths not exceeding 20.0 feet.
- B. All fittings shall have a minimum SDR of 26.
- C. All polyvinyl chloride (PVC) pipe and fittings shall utilize an elastomeric O-ring gasketed joint assembled in accordance with the manufacturer's recommendations.
- D. Polyvinyl chloride wye branches, pipe stoppers and other fittings shall be manufactured in accordance with the same specifications and shall have the same thickness, depth of socket, and annular space as the pipe. Tee wye fittings will not be permitted for use. Wye branches shall be complete pipe sections. Saddles will not be permitted for use.
- E. Polyvinyl chloride pipe shall be delivered and stockpiled in unit pallets. Stacking of pallets above 5 feet in height will not be allowed. If pipe is stockpiled for more than 30 days prior to installation in the trench, it must be suitably covered with reflective material to protect the pipe from ultra-violet rays emanating from sunlight. Do not use plastic sheets. Allow for air circulation under covering.
- F. Bowed sections of pipe will be unacceptable and installation of pipe which has bowed, whether or not the bow has been corrected, will not be allowed on this project.

PART 3 - EXECUTION

3.1 PIPELINE AND MANHOLE TRENCH EXCAVATION

- A. The Contractor shall excavate, maintain and backfill all excavation necessary for completing the work under the contract. Unless otherwise specified or approved, excavation shall be open cut. No extra compensation will be allowed for hand excavation and backfill necessary to complete the work or required by the Engineer.
- B. Trenches shall be excavated to the necessary width and depth, as shown on the drawings and as required for the protective sheeting, pull boxes, etc. No extra compensation will be allowed for trenches wider than that detailed on the drawings.
- C. The sides of the trenches shall be practically plumb and shall not be sloped unless approved in writing by the Engineer. Trench sides shall be supported or sheeted as required to protect utilities, etc., and required for safety. Safety regulations shall be as required by state safety codes and OSHA.
- D. In non-paved areas strip surface vegetation and topsoil and place in stock piles which are separated from the trench excavated materials. Topsoil shall not be used for general trench refill.
- E. The excavation of all trenches shall be fully completed at least twenty (20) feet in advance of pipe laying, unless otherwise authorized or directed. The Engineer may require the backfilling of open trench, over completed pipelines, or ahead of the pipe laying operation, if in his judgement such action is necessary, and the Contractor shall have no claim for extra compensation.
- F. Should work be stopped for any reason and any excavation is left open for an unreasonable length of time, the Contractor shall refill the excavation at his own expense if so directed, by the Engineer or the DOH Inspector. He shall not reopen the excavation until he is ready to complete the facility. Should the Contractor refuse or fail to refill any excavation completely within forty-eight (48) hours or immediately if it poses a safety hazard after a proper notice, has been given by the Engineer or DOH Inspector the Owner shall be authorized to do the work. The resulting expenses shall be deducted from monies due the Contractor.
- G. The Contractor shall complete excavation as nearly as practicable to the lines of the pipeline to be installed as detailed. All cavities in the bottom of the trench shall be filled to the required level with compacted crushed stone or gravel.
- H. Excavated materials shall be graded, hauled, stored and protected as such material found suitable will be required for backfilling, repaving or other purposes. Material classified as unsuitable shall be disposed of by the Contractor at a location approved by the Engineer. Hauling of excavated materials for any purpose shall not entitle the Contractor to additional compensation. Only those excavated materials designated by the Owner shall become property of the Contractor.
- I. All stockpiled materials shall be placed in such a way to prevent damage to the trench, structures, drainage areas or private property. Excavated materials shall not be placed on private property unless a temporary easement agreement is obtained from the property Owner by the Contractor.
- J. The Contractor shall remove, relocate, change or protect all structures including but not limited to signs, mailboxes, overhead and buried utilities as required for construction whether shown on drawings or not. No extra compensation will be allowed for property damage, injury or loss of time due to obstructions encountered not shown on plans.
- K. The Contractor shall be responsible for any damage to curb, gutter, sidewalk, traffic control devices, pavement material and lawns. Any damage resulting directly or indirectly shall be replaced in kind by the

Contractor without additional compensation. The reuse of disturbed curb, gutter or sidewalk is prohibited. New sections shall be installed to the nearest undisturbed control joint.

3.2 PIPELINE TRENCH BACKFILL

- A. Materials excavated from the trench except topsoil shall be used for trench backfill, provided that, in the opinion of the Engineer, the excavated material is suitable for this purpose. Backfill material shall be free from large lumps, pavement, pieces of concrete and stones.
- B. Suitable material, as approved by the Engineer, shall be carefully deposited in the trench by methods which will not damage or disturb the pipeline or structure, and shall be solidly tamped around the pipe or structure. Backfill material shall be placed in 8-inch layers. Compaction shall be accomplished by mechanical tampers. Care shall be taken in the use of mechanical tampers not to injure or move the pipe or to cause the pipe to be supported unevenly. Each layer shall be mechanically tamped for the full trench width unless an alternative method is approved in writing by the Engineer.
- C. Every backfill layer shall be compacted to 95% of maximum density at optimum moisture content as determined by the Modified Proctor Test, ASTM D1557 Method C. Materials containing an excess of moisture shall be permitted to dry until the moisture content is within the specified range. Materials too dry shall be wetted uniformly until the moisture content is in the specified range. Backfilled trench sections which fail to meet density requirements three consecutive times shall be excavated and properly disposed of by the Contractor.
- D. No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the backfill materials have dried sufficiently to permit proper compaction or such other precautions shall be taken as may be necessary to obtain proper compaction. The Contractor is responsible for hauling, storing and drying of excavated material to be used in backfill operations within the prices bid.
- E. The Contractor shall coordinate with the Construction Manager who will hire a geotechnical testing agency to provide compaction tests of the backfilled trenches during construction or upon completion of the backfill operations. Field density testing may be performed at a rate of 1 test per 100 linear feet of trench, at a depth specified by the Engineer. Such testing shall be arranged by the Contractor and performed by an independent testing agency approved by the Engineer.
- F. Whenever test results indicate compaction densities less than specified, the Contractor shall, at his own expense, secure the specified compaction using methods approved by the Engineer. The testing agency, so employed by the Contractor, shall submit a copy of all testing reports directly to the Engineer. Each report shall contain the project identification name and number, name of Contractor, name of testing agency, and location of sample tested by station, street and depth, as a minimum.
- G. The Contractor shall, at his own expense, maintain all refilled excavations in proper condition. Trench surfaces shall be reshaped when necessary. If the Contractor fails to make repairs within forty eight (48) hours after receipt of written notice from the Owner, the Owner may refill said depression wherever necessary and the cost of so doing will be retained from any monies due or to become due the Contractor under the Contract. The Contractor shall be fully responsible for any injury or damage that may result from lack of maintenance of any refilled excavation at any time prior to final acceptance.
- H. All unauthorized excavations made by the Contractor shall be immediately backfilled in accordance with the requirements of the specifications for trench backfill at the Contractor's expense.
- I. After completion of backfilling, all material not used shall be disposed of as approved by the Engineer, and all places on the line of the work shall be left clean and in good condition. This cleaning up shall be done by the Contractor without extra compensation. If he fails to do this work within a reasonable time after

receipt of notice, it will be performed by the Owner, and the cost will be retained from the monies due the Contractor under the contract.

- J. No backfilling of pipelines will be allowed until measurements of pipe and an inspection has been performed by the Owner's representative, and until the Engineer has authorized the backfill. Any unauthorized backfill of pipelines shall be uncovered by the Contractor at his expense if required by the Engineer.

3.3 DEWATERING

- A. All excavations must be kept free of water below the subgrade of the work while work is in progress. This may be accomplished by ordinary pumping methods or by well points, whichever will produce the required results. Upon removal of dewatering equipment, the Contractor shall backfill all holes and restore disturbed areas to their original condition.
- B. Dewatering for the structures and pipelines shall commence when groundwater is first encountered and shall be continued until such time as backfill has been completed. No concrete or pipe shall be laid in water nor shall water be allowed to rise over them until the concrete or mortar has set at least eight (8) hours. Groundwater shall not be allowed to rise around the pipe until the trench is backfilled.
- C. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be disposed of in such a manner as not to damage property or be a menace to the Public Health.
- D. In the event the Contractor's dewatering operations affect any water supplies within the project area, the Contractor shall take whatever steps that are required to provide uninterrupted water service.
- E. The Contractor shall remove any siltation deposits in storm sewer systems, resulting from his dewatering or construction operations. He shall also be responsible for conveyance of dewatering flows and for erosion and sediment control.

3.4 SHEETING, SHORING AND BRACING

- A. The contractor shall furnish and install all sheeting, shoring and bracing necessary to insure safe working conditions and to prevent damage to public and private property and structures. If, in the opinion of the Engineer, the sheeting, shoring, or bracing is not of proper quality or is not properly placed to insure safe working conditions and to prevent property damage, the Contractor shall remedy such inadequacy at his own expense as may be directed by the Engineer. Sheeting, shoring, and bracing shall be removed as backfilling progresses, except at such locations as the Engineer may direct or approve it to be left in place.
- B. The condition of all excavations made by the Contractor shall be the responsibility of the Contractor. No extra compensation will be allowed for property damage, injury or loss of time, due to excavation slides or cave-ins at any time under any circumstances.
- C. The Contractor shall cut off any sheeting left in place, at least eighteen (18) inches below finished grade, and shall remove the material cut off without compensation.
- D. Where necessary, in quicksand, soft ground, or for the protection of any structure or property, sheeting shall be driven to such depth below the bottom of the trench as may be required to protect all existing and/or proposed work.

- E. The cost for furnishing, placing and removal of sheeting, shoring or bracing shall be included in the prices bid.
- F. A trench box is an acceptable alternative to sheeting, shoring or bracing providing such boxes conform to safety codes.

3.5 SELECT BACKFILL

- A. Should the Contractor encounter unsuitable material during excavation, he shall remove and dispose of such material at a location approved by the Engineer. The cost of such disposal shall be included in the prices bid for pipe and structures.
- B. Should sufficient suitable material from excavations on the project not be available for backfill, the Contractor shall furnish Select Backfill upon approval of the Engineer. Special backfill shall conform to Delaware Department of Transportation Standard Specifications.

3.6 LAYING BRICK

- A. All brickwork shall be laid by competent mechanics.
- B. All brick shall be laid in a full bed of mortar with all vertical and horizontal joints filled solid with mortar.
- C. Joints shall be not less than 3/8-inch or more than 1/2-inch wide except as otherwise specified in (E) below.
- D. No brickwork shall be laid when the temperature is below 40 degrees or when the indications are for lower temperature within 24 hours. The contractor shall take such measures as may be approved to prevent brickwork from being exposed to freezing temperatures for a period of not less than five days after laying.
- E. Special care shall be taken in laying brick in inverts of manholes to insure a uniform flow of water through the sections. In such locations, joints shall not exceed 1/16-inch in thickness and each brick shall be laid in full mortar bed with joints on bottom side and end made in one operation. No grouting or working in of mortar after laying the brick will be permitted.

3.7 MANHOLE TESTS

- A. If inspection reveals any visible leakage or seepage in any manhole, the contractor will be required to accomplish such remedial measures as may be directed by the Engineer. Caulking or patching of interior manhole surfaces will not be acceptable.

3.8 PIPE INSTALLATION

- A. Pipe and fittings shall be carefully handled and lowered into the trench. Special care shall be taken to insure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe.
- B. Before pipe is placed, the bottom of the trench shall be carefully shaped to fit the lower part of the pipe exterior with reasonable closeness for width of at least 60% of the pipe width. Bell holes shall be dug sufficiently large to insure the making of proper joints and so that after placement, only the barrel of the pipe receives bearing pressure from the trench bottom. No pipe shall be brought into position until the

preceding length has been thoroughly bedded and secure in place. Any defects due to settlement shall be made good by the Contractor without additional compensation therefore.

- C. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipe shall be used.
- D. Whenever a pipe requires cutting to fit into the line or to bring it to the required location, the work shall be done in a satisfactory manner so as to leave a smooth end.
- E. The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipe lines shall be provided with a stopper carefully fitted so as to keep dirt and other substances from entering. This stopper shall be kept in the end of the pipe line at all times when laying is not in actual progress.
- F. All concrete required to support and reinforce wye branches, bends and other fittings shall be placed as directed, and the cost thereof shall be included and covered within the price bid.
- G. Backfill materials shall be hand placed and mechanically tamped in six inch layers, placed uniformly on both sides of the pipe, to a point at least one foot above the pipe crown. Each layer shall be thoroughly compacted for the full trench width and under, around and over the pipe.
- H. Pipeline detectable tape shall be installed continuously along all sewer mains. The tape shall be installed directly above the pipe and 12 inches from the ground surface. The tape shall be Lineguard type III Detectable tape as manufactured by Lineguard, Inc. of Wheaton, Illinois or equal. The tape shall be a minimum of two inches wide, imprinted in green with the words "CAUTION -- SEWER LINE BELOW" and be capable of being detected with inductive methods.
- I. For refill of the remaining trench depth, refer to "Excavation and Backfill" Section of these specifications.
- J. Pipe installation shall be achieved at the elevations identified on the contract drawings.

3.9 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 6 inches above finished surface in non-paved areas and place berm to top elevation per New Castle County Standard.

3.10 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.11 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Heavy-Duty, top-loading classification cleanouts in all areas. Cover shall read "SEWER" or "S". Casting manufactured by East Jordan Iron Works Model 1574.
- B. Set cleanout frames and covers in cast-in-place-concrete, 10 inches on all sides of riser pipe by 4 inches deep and placed 8 inches below grade. In non-paved areas place fill on concrete up to grade. In paved areas place pavement on concrete up to grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.12 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."
- B. Make connections to existing underground manholes.
 1. Make branch connections to underground manholes by cutting opening into existing unit large enough to allow for installation of pipe to manhole connector. Connector to be Z-Lok by A-Lok Products. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
 - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
 - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
 2. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- C. Connect to grease interceptors specified in Section 221323 "Sanitary Waste Interceptors."

3.13 LAYING PIPE IN FREEZING WEATHER

- A. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the Engineer shall deem that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation unless all required precautions as to the minimum length of open trench and promptness of backfilling are observed.

3.14 ARTIFICIAL FOUNDATION

- A. Whenever directed, the Contractor shall lay pipe upon an artificial foundation which he shall construct. Such foundation may consist of gravel, sills, planks, or other timber construction, or of concrete; all to be of the form and dimensions and placed in the manner required by the Engineer.

3.15 PIPE TESTING

- A. GENERAL

1. Contractor shall furnish all labor, tools, materials, and equipment, including mirrors, flashlights or other artificial lighting, pump, compressors, stopwatch, gauges, and meters, subject to the approval of the Engineer for testing in accordance with these specifications.

B. MIRROR TESTING OF SANITARY SEWERS

1. Upon completion of pipe laying and backfilling to a point at least two (2) feet above the crown of the pipe, the Engineer will conduct a mirror test to check for defects, excess deflection, leakage, and for horizontal or vertical misalignment. Mirror testing shall consist of reflecting sunlight or artificial light via mirrors through the completed section of pipeline, which, in order to be accepted, shall be true and straight in horizontal and vertical alignment to allow for the full passage of the reflected light.

C. LEAK TESTING USING AIR

1. Sewers shall be tested in sections not exceeding 400 feet unless otherwise approved by the Engineer. Each section shall be tested immediately upon completion thereof. Each section shall meet the air pressure drop limitations specified herein.
2. All material and labor required for leakage tests shall be furnished by the Contractor within the price bid.
3. Sewers shall be tested using the low-pressure air method in accordance with the requirements of ASTM C-828 and the Uni-Bell Plastic Pipe Association recommendations, based upon the Ramseier test time criteria. Procedural and equipment details shall be submitted to the Engineer prior to acceptance of its use for testing.
4. If the test time for the designated size and length, elapses before the test pressure drops 0.5 psig, the section undergoing the test shall have passed.
5. If the pressure drops 0.5 psig before the appropriate test time has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test. Contractor shall determine at his own expense the source or sources of leakage and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the Engineer. The completed pipe installation shall then be retested and required to meet the requirements of this test.

D. MANDREL TESTING OF SANITARY SEWERS

1. Sanitary sewer pipe shall be deflection tested not less than 30 days after the trench backfill and compaction has been completed. The test shall be conducted by pulling an approved solid pointed mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the inside diameter of the pipe. The mandrel shall be a rigid, non-adjustable mandrel having an effective length of not less than its nominal diameter.
2. Testing shall be conducted on a manhole to manhole basis and shall be done after the line has been completely cleaned and flushed. Any portion of the sewer which fails to pass the test shall be excavated, repaired or realigned and retested with both air and deflection tests.

3.16 DEFECTS TO BE MADE GOOD

- A. If, at any time before the expiration of the guarantee period under this contract, any broken pipe, or any other defects are found in any of the lines or in any of the appurtenances, the Contractor shall cause the same to be removed and replaced by the proper material and workmanship, without extra compensation for the labor and material required, even though such injury or damage may not have been due to any act,

default, or negligence on the part of the Contractor. All materials shall be carefully examined by the Contractor for defects prior to installation, and any found defective shall be rejected for use.

END OF SECTION 221313

SECTION 22 30 00**PLUMBING EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Water heaters.
- B. Expansion Tanks.
- C. Pumps.
 - 1. Circulators.
 - 2. Sump / Sewage Pumps.
 - 3. Cooling Condensate Removal Pumps.

1.02 RELATED REQUIREMENTS

- A. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less.
- B. ANSI Z21.10.3 - Gas Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous Water Heaters.
- C. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.
- B. Shop Drawings:
 - 1. Indicate heat exchanger dimensions, size of tappings, and performance data.
 - 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- C. Manufacturer's Instructions.
- D. Project Record Documents: Record actual locations of components.
- E. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Red Clay Consolidated School District's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of experience.
- B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- C. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 CERTIFICATIONS

- A. Water Heaters: NSF approved.
- B. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable, in addition to requirements specified elsewhere.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

- A. Provide five year manufacturer warranty for domestic water heaters and in-line circulator.

1.09 EXTRA MATERIALS

- A. Provide two pump seals.

PART 2 PRODUCTS**2.01 COMMERCIAL GAS FIRED WATER HEATERS**

- A. Type: Automatic, tankless, stainless-steel natural gas-fired.
- B. Manufacturers:
 - 1. Noritz
 - 2. Rinnai
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Performance: See plans.
- D. Accessories: Provide:
 - 1. Venting Kit.
 - 2. Isolation Valves
- E. Certification: As water heater by ASME, rated for output temperatures of 100 to 180 degrees F..
- F. Controls: Digital controls for output temperature management (default setting at 120 degrees), safety controls for flame failure, boiling protection, combustion fan failure, over-current, and gas valve failure..

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc: www.amtrol.com.
 - 2. ITT Bell & Gossett: www.bellgossett.com.
 - 3. Taco, Inc: www.taco-hvac.com.
- B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 55 psig.

2.03 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
 - 1. Armstrong Pumps Inc: www.armstrongpumps.com.
 - 2. ITT Bell & Gossett: www.bellgossett.com.
 - 3. SIHI Group: www.sterlingsihi.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Casing: Bronze, rated for 125 psig working pressure.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.

2.04 COOLING CONDENSATE REMOVAL PUMPS

- A. Construction: Commercial grade, nonferrous pump with stainless steel shaft, integral discharge check valve, integral float switch, safety switch, thermoplastic reservoir, motor assembly, and power cord with ground.
- B. Safety: UL 778.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related gas venting and electrical work to achieve operating system.
- C. Pumps:
 - 1. Provide air cock and drain connection on horizontal pump casings.
 - 2. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
 - 3. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
 - 4. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
 - 5. Align and verify alignment of base mounted pumps prior to start-up.

END OF SECTION

SECTION 22 40 00**PLUMBING FIXTURES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Sinks.
- E. Service sinks.
- F. Drinking fountains.

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers: Seal fixtures to walls and floors.
- B. Section 22 10 05 - Plumbing Piping.
- C. Section 22 10 06 - Plumbing Piping Specialties.
- D. Section 22 30 00 - Plumbing Equipment.
- E. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ANSI Z124.1 - American National Standard for Plastic Bathtub Units.
- B. ANSI Z124.2 - American National Standard for Plastic Shower Units.
- C. ANSI Z124.1.2 - American National Standard for Plastic Bathtub and Shower Units.
- D. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment.
- E. ARI 1010 - Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers; Air-Conditioning and Refrigeration Institute.
- F. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; The American Society of Mechanical Engineers.
- G. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers.
- H. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers.
- I. ASME A112.19.2 - Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals; The American Society of Mechanical Engineers.
- J. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use); The American Society of Mechanical Engineers.
- K. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; The American Society of Mechanical Engineers.

- L. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals; The American Society of Mechanical Engineers.
- M. ASME A112.19.14 - Six Liter Water Closets Equipped with Dual Flushing Device.

1.04 SUBMITTALS

- A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. Samples: Submit two sets of color chips for each standard color.
- C. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- E. Waterless Urinals: Submit recommended frequency of maintenance and parts replacement, methods of cleaning, sources of replacement supplies and parts.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Red Clay Consolidated School District's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of experience.

1.06 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.07 MOCK-UP

- A. Provide mock-up of typical bathroom group.
- B. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.09 WARRANTY

- A. Provide five year manufacturer warranty for electric water cooler.

1.10 EXTRA MATERIALS

- A. Supply two sets of faucet washers, flush valve service kits, and lavatory supply fittings.

PART 2 PRODUCTS

2.01 FLUSH VALVE WATER CLOSETS

- A. Water Closets: Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps.
 - 1. Flush Volume: 1.28 gallon, maximum.

2. Flush Valve: Exposed (top spud).
 3. Flush Operation: Sensor operated, push-button override.
 4. Handle Height: 44 inches or less.
 5. Manufacturers:
 - a. American Standard Inc: www.americanstandard.com.
 - b. Kohler.
 - c. Toto USA: www.totousa.com.
 - d. Zurn Industries, Inc: www.zurn.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
1. Sensor-Operated Type: Solenoid operator, battery powered with self-generating hydro-electric turbine, infrared sensor and over-ride push button.
 2. ASME A112.19.2; floor mounted, siphon jet or wall hung blow out vitreous china closet bowl, with elongated rim, 1-1/2 inch top spud, china bolt caps.
 3. Manufacturers:
 - a. Toto USA: www.totousa.com
 - b. Sloan Valve Company: www.sloanvalve.com.
 - c. Zurn Industries, Inc: www.zurn.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Seats:
1. Manufacturers:
 - a. Kohler
 - b. Bemis Manufacturing Company: www.bemismfg.com.
 - c. Church Seat Company: www.churchseats.com.
 - d. Olsonite: www.olsonite.com.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Solid plastic, open front, extended back, brass bolts, with cover.
- D. Water Closet Carriers:
1. Manufacturers:
 - a. JR Smith.
 - b. Sloan Valve Company: www.sloanvalve.com.
 - c. Zurn Industries, Inc: www.zurn.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.02 WALL HUNG URINALS

- A. Wall Hung Urinal Manufacturers:
1. Kohler Company: www.kohler.com.
 2. Zurn Industries, Inc: www.zurn.com.
- B. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
1. Flush Volume: 1/8 gallon (0.5 liter).
 2. Flush Style: Washout.
 3. Trap: Integral.
- C. Flush Valves: ASME A112.18.1, diaphragm type, complete with vacuum breaker stops and accessories.
1. Sensor-Operated Type: Solenoid operator, battery powered with self-generating hydro-electric turbine, infrared sensor and over-ride push button.

- D. Carriers:
1. Manufacturers:
 - a. JR Smith
 - b. Sloan Valve Company: www.sloanvalve.com.
 - c. Zurn Industries, Inc: www.zurn.com.
 2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.03 LAVATORIES

- A. Lavatory Manufacturers:
1. American Standard Inc
 2. Eljer
 3. Kohler Company: www.kohler.com.
 4. Zurn Industries, Inc: www.zurn.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Sensor Operated Faucet: Cast brass, chrome plated, deck mounted with sensor located on neck of spout.
1. Spout Style: Standard,
 2. Power Supply: Self-generating, hydro-powered turbine charging rechargeable battery.
 3. Mixing Valve: automatic.
 4. Water Supply: 1/2 inch compression connections.
 5. Aerator: Vandal resistant, 1 GPM,.
 6. Automatic Shut-off: 30 seconds.
 7. Sensor range: Automatically adjusts.
 - a. Accessory: Optional remote reprogrammer module to adjust pre-set factory functions.
 8. Finish: Polished chrome.
 9. Accessory: 4 inch or 8 inch deck plate.
 10. Sensor Operated Faucet Manufacturers:
 - a. American Standard Inc: www.americanstandard.com.
 - b. Sloan Valve Company: www.sloanvalve.com.
 - c. Toto USA: www.totousa.com.
 - d. Zurn industries, Inc: www.zurn.com.
- C. Accessories:
1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 2. Offset waste with perforated open strainer.
 3. Screwdriver stops.
 4. Rigid supplies.
 5. Carrier:
 - a. Manufacturers:
 - 1) JR Smith
 - 2) Sloan Valve Company: www.sloanvalve.com.
 - 3) Zurn Industries, Inc: www.zurn.com.
 - b. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, or concealed arm supports bearing plate and studs.

2.04 WATER FOUNTAINS

- A. Electric Water Cooler Manufacturers:
1. Tri Palm International/Oasis: www.tripalmint.com.
 2. Elkay Manufacturing Company: www.elkay.com.

3. Haws Corporation: www.hawesco.com.
- B. Fountain:
 1. A surface handicapped-height, fully ADA compliant mounted water fountain with stainless steel top, stainless steel; stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, bottle filling station, and mounting bracket.

2.05 SERVICE SINKS

- A. Service Sink Manufacturers:
 1. Kohler
 2. Elkay Manufacturing Company: www.elkay.com.
- B. Bowl:
 1. White floor mounted, with one inch wide shoulders. Vinyl bumper guard stainless steel strainer.
- C. Trim:
 1. ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.
- D. Accessories:
 1. 5 feet of 1/2 inch diameter plain end reinforced plastic or rubber hose.
 2. Hose clamp hanger.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall supports or wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 05, color to match fixture.
- F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Clean plumbing fixtures and equipment.

END OF SECTION

SECTION 23 05 13**MOTOR REQUIREMENTS FOR HVAC AND PLUMBING EQUIP****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single phase electric motors.
- B. Three phase electric motors.

1.02 RELATED REQUIREMENTS

- A. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
- B. Section 26 29 13 - Enclosed Controllers.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc..
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers.
- C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.
- E. National Grid "Motor-Up" Rebate Program/Initiative.

1.04 SUBMITTALS

- A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- B. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Operation Data: Include instructions for safe operating procedures.
- E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Conform to applicable electrical code, NFPA 70 and local energy code.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.07 WARRANTY

- A. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Lincoln Motors: www.lincolnmotors.com.
- B. A. O. Smith Electrical Products Company: www.aosmithmotors.com.
- C. Reliance Electric/Rockwell Automation: www.reliance.com.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Refer to Section 26 27 17 for required electrical characteristics.
- B. Electrical Service, General. See drawings for specific details:
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz
 - 2. Motors Larger than 1/2 Horsepower: 460 volts, three phase, 60 Hz.
- C. Construction:
 - 1. Open drip-proof type except where specifically noted otherwise.
 - 2. Design for continuous operation in 40 degrees C environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Motors with frame sizes 254T and larger: Premium Efficiency Type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor.
- F. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

2.03 APPLICATIONS

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.
- B. Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.
- C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type or electronically commutated (ECM) type. See schedules for requirements.
- D. Single phase motors for fans, pumps, and blowers: Capacitor start type.
- E. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.

- F. Motors located in outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-treated type.

2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.

- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 13.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- M. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- N. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Provide detailed installation and purchase information for reimbursement by Utility for rebate program.

3.02 SCHEDULE - Premium Efficiency

- A. NEMA Open Motor Service Factors.
 - 1. 1/6-1/3 hp:
 - a. 3600 rpm: 1.35.
 - b. 1800 rpm: 1.35.
 - c. 1200 rpm: 1.35.
 - d. 900 rpm: 1.35.
 - 2. 1/2 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.25.
 - c. 1200 rpm: 1.25.
 - d. 900 rpm: 1.15.
 - 3. 3/4 hp:
 - a. 3600 rpm: 1.25.

- b. 1800 rpm: 1.25.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
 - 4. 1 hp:
 - a. 3600 rpm: 1.25.
 - b. 1800 rpm: 1.15.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
 - 5. 1.5-150 hp:
 - a. 3600 rpm: 1.15.
 - b. 1800 rpm: 1.15.
 - c. 1200 rpm: 1.15.
 - d. 900 rpm: 1.15.
- B. Three Phase - Premium Efficiency, Open Drip-Proof Performance:
- 1. Ratings.
 - a. 1 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 72.
 - 3) Minimum Percent Efficiency: 82.5% @ 1200 RPM, 85.5% @ 1800 RPM, 77% @ 3600 RPM
 - b. 1-1/2 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 73.
 - 3) Minimum Percent Efficiency: 86.5% @ 1200 RPM, 86.5% @ 1800 RPM, 84% @ 3600 RPM
 - c. 2 hp:
 - 1) NEMA Frame: 184T.
 - 2) Minimum Percent Power Factor: 75.
 - 3) Minimum Percent Efficiency: 87.5% @ 1200 RPM, 86.5% @ 1800 RPM, 85.5% @ 3600 RPM
 - d. 3 hp:
 - 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 60.
 - 3) Minimum Percent Efficiency: 88.5% @ 1200 RPM, 89.5% @ 1800 RPM, 85.5% @ 3600 RPM
 - e. 5 hp:
 - 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 65.
 - 3) Minimum Percent Efficiency: 89.5% @ 1200 RPM, 89.5% @ 1800 RPM, 86.5% @ 3600 RPM
 - f. 7-1/2 hp:
 - 1) NEMA Frame: 254T.
 - 2) Minimum Percent Power Factor: 73.
 - 3) Minimum Percent Efficiency: 90.2% @ 1200 RPM, 91% @ 1800 RPM, 88.5% @ 3600 RPM
 - g. 10 hp:
 - 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 74.
 - 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 91.7% @ 1800 RPM, 89.5% @ 3600 RPM
 - h. 15 hp:
 - 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 77.

- 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 93% @ 1800 RPM, 90.2% @ 3600 RPM.
 - i. 20 hp:
 - 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 78.
 - 3) Minimum Percent Efficiency: 92.4% @ 1200 RPM, 93% @ 1800 RPM, 91% @ 3600 RPM
 - j. 25 hp:
 - 1) NEMA Frame: 324T.
 - 2) Minimum Percent Power Factor: 74.
 - 3) Minimum Percent Efficiency: 93% @ 1200 RPM, 93.6% @ 1800 RPM, 91.7% @ 3600 RPM
 - k. 30 hp:
 - 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 78.
 - 3) Minimum Percent Efficiency: 93.6% @ 1200 RPM, 94.1% @ 1800 RPM, 91.7% @ 3600 RPM
 - l. 40 hp:
 - 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 77.
 - 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.1 @ 1800 RPM, 92.4% @ 3600 RPM
 - m. 50 hp:
 - 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 79.
 - 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.5% @ 1800 RPM, 93% @ 3600 RPM
 - n. 60 hp:
 - 1) NEMA Frame: 404T.
 - 2) Minimum Percent Power Factor: 82.
 - 3) Minimum Percent Efficiency: 93.
 - o. 75 hp:
 - 1) NEMA Frame: 405T.
 - 2) Minimum Percent Power Factor: 80.
 - 3) Minimum Percent Efficiency: 93.
 - p. 100 hp:
 - 1) NEMA Frame: 444T.
 - 2) Minimum Percent Power Factor: 80.
 - 3) Minimum Percent Efficiency: 93.
- C. Three Phase - Premium Efficiency, Totally Enclosed, Fan Cooled Performance:
- 1. 1200 rpm.
 - a. 1 hp:
 - 1) NEMA Frame: 145T.
 - 2) Minimum Percent Power Factor: 72.
 - 3) Minimum Percent Efficiency: 82.5% @ 1200 RPM, 85.5% @ 1800 RPM, 77% @ 3600 RPM
 - b. 1-1/2 hp:
 - 1) NEMA Frame: 182T.
 - 2) Minimum Percent Power Factor: 73.
 - 3) Minimum Percent Efficiency: 87.5% @ 1200 RPM, 86.5% @ 1800 RPM, 84% @ 3600 RPM
 - c. 2 hp:
 - 1) NEMA Frame: 184T.

- 2) Minimum Percent Power Factor: 68.
 - 3) Minimum Percent Efficiency: 88.5% @ 1200 RPM, 86.5% @ 1800 RPM, 85.5% @ 3600 RPM
- d. 3 hp:
- 1) NEMA Frame: 213T.
 - 2) Minimum Percent Power Factor: 63.
 - 3) Minimum Percent Efficiency: 89.5% @ 1200 RPM, 89.5% @ 1800 RPM, 86.5% @ 3600 RPM
- e. 5 hp:
- 1) NEMA Frame: 215T.
 - 2) Minimum Percent Power Factor: 66.
 - 3) Minimum Percent Efficiency: 89.5% @ 1200 RPM, 89.5% @ 1800 RPM, 88.5% @ 3600 RPM
- f. 7-1/2 hp:
- 1) NEMA Frame: 254T.
 - 2) Minimum Percent Power Factor: 68.
 - 3) Minimum Percent Efficiency: 91% @ 1200 RPM, 91.7% @ 1800 RPM, 89.5% @ 3600 RPM
- g. 10 hp:
- 1) NEMA Frame: 256T.
 - 2) Minimum Percent Power Factor: 75.
 - 3) Minimum Percent Efficiency: 91% @ 1200 RPM, 91.7% @ 1800 RPM, 90.2% @ 3600 RPM
- h. 15 hp:
- 1) NEMA Frame: 284T.
 - 2) Minimum Percent Power Factor: 72.
 - 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 92.4% @ 1800 RPM, 91% @ 3600 RPM
- i. 20 hp:
- 1) NEMA Frame: 286T.
 - 2) Minimum Percent Power Factor: 76.
 - 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 93% @ 1800 RPM, 91% @ 3600 RPM
- j. 25 hp:
- 1) NEMA Frame: 324T.
 - 2) Minimum Percent Power Factor: 71.
 - 3) Minimum Percent Efficiency: 93% @ 1200 RPM, 93.6% @ 1800 RPM, 91.7% @ 3600 RPM
- k. 30 hp:
- 1) NEMA Frame: 326T.
 - 2) Minimum Percent Power Factor: 79.
 - 3) Minimum Percent Efficiency: 93% @ 1200 RPM, 93.6% @ 1800 RPM, 91.7% @ 3600 RPM.
- l. 40 hp:
- 1) NEMA Frame: 364T.
 - 2) Minimum Percent Power Factor: 78.
 - 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.1% @ 1800 RPM, 92.4% @ 3600 RPM
- m. 50 hp:
- 1) NEMA Frame: 365T.
 - 2) Minimum Percent Power Factor: 81.
 - 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.5% @ 1800 RPM, 93% @ 3600 RPM

- n. Over 50 HP - Refer to National Grid "Motor Up" Energy Efficiency requirements for reimbursement.

END OF SECTION

SECTION 23 05 16**EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 23 00 - Refrigerant Piping.

1.03 REFERENCE STANDARDS

- A. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- B. EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- B. Design Data: Indicate selection calculations.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- D. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- E. Maintenance Data: Include adjustment instructions.

1.05 REGULATORY REQUIREMENTS

- A. Conform to UL requirements.

1.06 EXTRA MATERIALS

- A. Supply two sets of packing for each packed expansion joint.

PART 2 PRODUCTS**2.01 FLEXIBLE PIPE CONNECTORS - STEEL PIPING**

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.

2. Metraflex Company: www.metraflex.com.
- B. Inner Hose: Carbon Steel.
- C. Exterior Sleeve: Single braided, stainless steel or bronze.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.

2.02 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturer:
 1. Mercer Rubber Company: www.mercer-rubber.com.
 2. Metraflex Company: www.metraflex.com.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi and 450 degrees F.
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Maximum offset: 3/4 inch on each side of installed center line.
- H. Application: Copper piping.

2.03 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 1. Mercer Rubber Company: www.mercer-rubber.com.
 2. Metraflex Company: www.metraflex.com.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 1-3/4 inches.
- D. Maximum Extension: 1/4 inch.
- E. Joint: As specified for pipe joints.
- F. Size: Use pipe sized units.
- G. Application: Steel piping 3 inches and under.

2.04 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 1. Mercer Rubber Company: www.mercer-rubber.com.
 2. Metraflex Company: www.metraflex.com.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 15/16 inch.

- D. Maximum Extension: 5/16 inch.
- E. Maximum Offset: 1/8 inch.
- F. Joint: Flanged.
- G. Size: Use pipe sized units.
- H. Accessories: Internal flow liner.
- I. Application: Steel piping over 2 inches.

2.05 EXPANSION JOINTS - SINGLE SPHERE, ELBOW OR FLEXIBLE COMPENSATOR

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. Metraflex Company: www.metraflex.com.
- B. Body: Teflon.
- C. Pressure Rating, Sizes 3/4 Inch to 2 Inch: 150 psi and 210 degrees F.
- D. Pressure Rating, Sizes 1-1/2 Inch to 12 Inch: 150 psi and 250 degrees F.
- E. Pressure Rating, Sizes 14 Inch to 24 Inch: 105 psi and 250 degrees F.
- F. Maximum Compression: 3/4 inch.
- G. Maximum Elongation: 1/2 inch.
- H. Maximum Offset: 1/2 inch.
- I. Maximum Angular Movement: 15 degrees.
- J. Joint: Tapped steel flanges.
- K. Size: Use pipe sized units.
- L. Accessories: Control rods.
- M. Application: Steel piping 2 inches and over.

2.06 EXPANSION JOINTS - TWO-PLY BRONZE BELLOWS TYPE

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. Metraflex Company: www.metraflex.com.
- B. Construction: Bronze with anti-torque device, limit stops, internal guides.
- C. Pressure Rating: 125 psi and 400 degrees F.
- D. Maximum Compression: 1-3/4 inches.
- E. Maximum Extension: 1/4 inch.
- F. Joint: As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Application: Copper piping.

2.07 EXPANSION JOINTS - LOW PRESSURE COMPENSATOR WITH TWO-PLY BRONZE BELLOWS

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com.
 - 2. Metraflex Company: www.metraflex.com.
- B. Working Pressure: 75 psi.
- C. Maximum Temperatures: 250 degrees F.
- D. Maximum Compression: 1/2 inch.
- E. Maximum Extension: 5/32 inch.
- F. Joint: Soldered.
- G. Size: Use pipe sized units.
- H. Application: Copper or steel piping 3 inches and under.

2.08 EXPANSION JOINTS - STEEL WITH PACKED SLIDING SLEEVE

- A. Working Pressure and Temperature: Class 150.
- B. Joint: As specified for pipe joints.
- C. Size: Use pipe sized units.
- D. Application: Steel piping 2 inches and over.

2.09 EXPANSION JOINTS - COPPER WITH PACKED SLIDING SLEEVE

- A. Working Pressure: 125 psi.
- B. Maximum Temperature: 250 degrees F.
- C. Joint: As specified for pipe joints.
- D. Size: Use pipe sized units.
- E. Application: Copper or steel piping 2 inches and over.

2.10 ACCESSORIES

- A. Stainless Steel Pipe: ASTM A269.
- B. Pipe Alignment Guides:
 - 1. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.
- C. Swivel Joints:
 - 1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- G. Substitute grooved piping for vibration isolated equipment instead of flexible connectors. Grooved piping need not be anchored.

END OF SECTION

SECTION 23 05 19**METERS AND GAGES FOR HVAC PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Positive displacement meters.
- B. Flow meters.
- C. Pressure gages and pressure gage taps.
- D. Thermometers and thermometer wells.
- E. Static pressure gages.
- F. Filter gages.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 09 23 - Direct-Digital Control System for HVAC.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; The American Society of Mechanical Engineers.
- C. ASTM E1 - Standard Specification for ASTM Thermometers.
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- E. AWWA C700 - Cold Water Meters -- Displacement Type, Bronze Main Case; American Water Works Association (ANSI/AWWA C700).
- F. AWWA C701 - Cold Water Meters -- Turbine Type, for Customer Service; American Water Works Association.
- G. AWWA C702 - Cold Water Meters -- Compound Type; American Water Works Association.
- H. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold Water Meters; American Water Works Association (ANSI/AWWA C706).
- I. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; American Water Works Association.
- J. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Underwriters Laboratories Inc..
- K. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Operation and Maintenance Data: Manufacturer's Standards and Operations and maintenance manuals and catalog cuts.

1.05 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.06 EXTRA MATERIALS

- A. Supply two bottles of red gage oil for static pressure gages.
- B. Supply two pressure gages with pulsation damper or dial thermometers.

PART 2 PRODUCTS

2.01 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Venture Measurement Company: www.venturemeasurement.com.
 - 3. McCrometer: www.mccrometer.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. AWWA C700, positive displacement disc type suitable for fluid with bronze case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading to AWWA C706.
- C. Meter: Brass body turbine meter with magnetic drive register.
 - 1. Service: Cold water, 122 degrees F.
 - 2. Service: Hot water, 200 degrees F.
 - 3. Accuracy: 1-1/2 percent.
 - 4. Maximum Counter Reading: 10 million gallons.
 - 5. Size: 1/2 inch.

2.02 PRESSURE GAGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Moeller Instrument Co., Inc: www.moellerinstrument.com.
 - 3. Omega Engineering, Inc: www.omega.com.
- B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Steel with brass bourdon tube.
 - 2. Size: 2-1/2 inch diameter.
 - 3. Mid-Scale Accuracy: One percent.
 - 4. Scale: Psi.

2.03 PRESSURE GAGE TAPPINGS

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass or Stainless Steel, 1/4 inch NPT for minimum 150 psi.

- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40 or Brass, 1/4 inch angle or straight pattern.

2.04 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Omega Engineering, Inc: www.omega.com.
 - 3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
 - 1. Size: 7 inch scale.
 - 2. Window: Clear glass or Lexan.
 - 3. Stem: Brass.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 7 inch scale.
 - 2. Window: Clear glass or Lexan.
 - 3. Stem: 3/4 inch NPT brass.
 - 4. Accuracy: 2 percent, per ASTM E77.
 - 5. Calibration: Degrees F.

2.05 DIAL THERMOMETERS

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 - 2. Omega Engineering, Inc: www.omega.com.
 - 3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
- B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
 - 1. Size: 2-1/2 inch diameter dial.
 - 2. Lens: Clear glass or Lexan.
 - 3. Accuracy: 1 percent.
 - 4. Calibration: Degrees F.
- C. Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
 - 1. Size: 3 inch diameter dial.
 - 2. Lens: Clear glass or Lexan.
 - 3. Accuracy: 1 percent.
 - 4. Calibration: Degrees F.
- D. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.
 - 1. Size: 2-1/2 inch diameter dial.
 - 2. Lens: Clear glass or Lexan.

3. Length of Capillary: Minimum 5 feet.
4. Accuracy: 2 percent.
5. Calibration: Degrees F.

2.06 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.07 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapters with 1/8 inch probes, two 1 inch dial thermometers.

2.08 STATIC PRESSURE GAGES

- A. Manufacturers:
 1. Dwyer Instruments, Inc: www.dwyer-inst.com.
 2. Omega Engineering, Inc: www.omega.com.
 3. Weksler Glass Thermometer Corp: www.wekslerglass.com.
- B. 2-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- C. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- D. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.
- D. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Provide siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometers in air duct systems on flanges.

- G. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 09 43. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, adjacent to control device sockets or where indicated.

3.02 SCHEDULE

- A. Pressure Gages, Location:
 - 1. Pumps.
 - 2. Expansion tanks.
 - 3. Pressure tanks.
 - 4. Standpipe, highest points.
 - 5. Standpipe and sprinkler water supply connection.
 - 6. Sprinkler system.
 - 7. Pressure reducing valves.
 - 8. Backflow preventers.
- B. Pressure Gage Tappings, Location:
 - 1. Control valves 3/4 inch & larger - inlets and outlets.
 - 2. Major coils - inlets and outlets.
 - 3. Heat exchangers - inlets and outlets.
 - 4. Chiller - inlets and outlets.
 - 5. Boiler - inlets and outlets.
- C. Stem Type Thermometers, Location and Scale Range:
 - 1. Headers to central equipment.
 - 2. Coil banks - inlets and outlets.
 - 3. Heat exchangers - inlets and outlets.
 - 4. Boilers - inlets and outlets.
 - 5. Chiller - inlets and outlets.
 - 6. Water zone supply and return.
 - 7. After major coils.
 - 8. Domestic hot water supply and recirculation.
- D. Thermometer Sockets, Location:
 - 1. Control valves 1 inch & larger - inlets and outlets.
 - 2. Reheat coils - inlets and outlets.
 - 3. Cabinet heaters - inlets and outlets.
 - 4. Unit heaters - inlets and outlets.

- E. Dial Thermometers, Location and Scale Range:
 - 1. ERV Outside air.
 - 2. ERV Return air.
 - 3. ERV Exhaust air.
 - 4. ERV Supply air.

- F. Static Pressure and Filter Gages, Location and Scale Range:
 - 1. Built up filter banks.
 - 2. Unitary filter sections.
 - 3. Supply fan discharge.
 - 4. Building static.

END OF SECTION

SECTION 23 05 48**VIBRATION AND SEISMIC CONTROLS FOR HVAC****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Equipment support bases.
- B. Vibration isolators.
- C. Inertia bases.
- D. Vibration isolators.
- E. Seismic restraints.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 SUBMITTALS

- A. Product Data: Provide schedule of vibration isolator type with location and load on each.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures.
- C. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Isolation Technology, Inc: www.isolationtech.com.
- B. Kinetics Noise Control, Inc: www.kineticsnoise.com.
- C. Mason Industries: www.mason-ind.com.

2.02 PERFORMANCE REQUIREMENTS

- A. General:
 - 1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
 - 2. Steel springs to function without undue stress or overloading.

2.03 EQUIPMENT SUPPORT BASES**2.04 VIBRATION ISOLATORS****2.05 INERTIA BASES**

- A. Concrete Inertia Bases:
 - 1. Construction: Structural steel channel perimeter frame, with gusseted brackets and anchor bolts, reinforcing; concrete filled.
 - 2. Mass: Minimum of 1.5 times weight of isolated equipment.
 - 3. Connecting Point: Reinforced to connect isolators and snubbers to base.
 - 4. Concrete: Minimum 3000 psi concrete.

2.06 VIBRATION ISOLATORS

- A. Open Spring Isolators:
 - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 - 2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- B. Restrained Open Spring Isolators:
 - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 - 2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
 - 3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 - 4. Restraint: Provide heavy mounting frame and limit stops.
 - 5. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- C. Closed Spring Isolators:
 - 1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 - 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
 - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- D. Restrained Closed Spring Isolators:
 - 1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 - 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
 - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- E. Spring Hangers:
 - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
 - 2. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 - 3. Misalignment: Capable of 20 degree hanger rod misalignment.

4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- F. Neoprene Pad Isolators:
1. Rubber or neoprene waffle pads.
 - a. Hardness: 30 durometer.
 - b. Thickness: Minimum 1/2 inch.
 - c. Maximum Loading: 50 psi.
 - d. Rib Height: Maximum 0.7 times width.
 2. Configuration: Single layer.
 3. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- G. Rubber Mount or Hanger: Molded rubber designed for 0.4 inch deflection with threaded insert.
- H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.
- I. Seismic Snubbers:
1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
 2. Elements: Replaceable neoprene, minimum of 0.75 inch thick with minimum 1/8 inch air gap.
 3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
 4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.
- J. Roof Mounting Curb: 14 inches high with rigid steel lower section containing adjustable spring pockets with restrained spring isolators, steel upper section to support rooftop equipment, and continuous elastomeric membrane extending from upper section for counterflashing over roofing. Provide acoustical package consisting of interior perimeter angles and cross members to support up to two layers of gypsum board.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. Bases:
 1. Set steel bases for one inch clearance between housekeeping pad and base.
 2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
 3. Adjust equipment level.
- C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- E. Provide pairs of horizontal limit springs on fans with more than 6.0 inches WC static pressure, and on hanger supported, horizontally mounted axial fans.

- F. Provide seismic snubbers for all equipment, piping, and ductwork mounted on isolators. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- G. Support piping connections to equipment mounted on isolators using isolators or resilient hangers as follows:
 - 1. Up to 4 Inches Pipe Size: First three points of support.
 - 2. 5 to 8 Inches Pipe Size: First four points of support.
 - 3. 10 inches Pipe Size and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.02 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

3.03 SCHEDULE

- A. Pipe Isolation Schedule.
 - 1. 1 Inch Pipe Size: Isolate 120 diameters from equipment.
 - 2. 2 Inch Pipe Size: Isolate 90 diameters from equipment.
 - 3. 3 Inch Pipe Size: Isolate 80 diameters from equipment.
 - 4. 4 Inch Pipe Size: Isolate 75 diameters from equipment.
 - 5. 6 Inch Pipe Size: Isolate 60 diameters from equipment.
 - 6. 8 Inch Pipe Size: Isolate 60 diameters from equipment.
 - 7. 10 Inch Pipe Size: Isolate 54 diameters from equipment.
 - 8. 12 Inch Pipe Size: Isolate 50 diameters from equipment.
 - 9. 16 Inch Pipe Size: Isolate 45 diameters from equipment.
 - 10. 24 Inch Pipe Size: Isolate 38 diameters from equipment.
 - 11. Over 24 Inch Pipe Size: As indicated.
- B. Equipment Isolation Schedule.
 - 1. Pumps.

END OF SECTION

SECTION 23 05 53**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Identification painting.

1.03 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.

1.04 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Samples: Submit two labels or tags 1/2 x 4 inch in size.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Brady Corporation: www.bradycorp.com.
- B. Champion America, Inc: www.Champion-America.com.
- C. Seton Identification Products: www.seton.com/aec.

2.02 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height: 1/2 inch.
 - 3. Background Color: Black.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

- B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
 - 2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
 - 4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
 - 5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
 - 6. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

2.05 PIPE MARKERS

- A. Color: Conform to ASME A13.1.
- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.06 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.

- C. Apply stencil painting in accordance with Section 09 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers or stencilled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- N. Identify ductwork with plastic nameplates or stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- O. Locate ceiling tacks to locate valves, units, or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93**TESTING, ADJUSTING, AND BALANCING FOR HVAC****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic and refrigerating systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Sound measurement of equipment operating conditions.
- E. Vibration measurement of equipment operating conditions.
- F. Commissioning activities.

1.02 RELATED REQUIREMENTS

- A. Section 23 08 00 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council.
- B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association.

1.04 SUBMITTALS

- A. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit to the Commissioning Authority, Construction Manager, and HVAC controls contractor.
 - 3. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 4. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 5. Include at least the following in the plan:
 - a. Preface: An explanation of the intended use of the control system.
 - b. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

- c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - d. Identification and types of measurement instruments to be used and their most recent calibration date.
 - e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - f. Final test report forms to be used.
 - g. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Branch/submain proportioning.
 - 4) Total flow calculations.
 - 5) Rechecking.
 - 6) Diversity issues.
 - h. Expected problems and solutions, etc.
 - i. Criteria for using air flow straighteners or relocating flow stations and sensors.
 - j. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - 2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
 - k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - l. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - n. Method of checking building static and exhaust fan and/or relief damper capacity.
 - o. Proposed selection points for sound measurements and sound measurement methods.
 - p. Methods for making coil or other system plant capacity measurements, if specified.
 - q. Time schedule for TAB work to be done in phases (by floor, etc.).
 - r. Description of TAB work for areas to be built out later, if any.
 - s. Time schedule for deferred or seasonal TAB work, if specified.
 - t. False loading of systems to complete TAB work, if specified.
 - u. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
 - v. Interstitial cavity differential pressure measurements and calculations, if specified.
 - w. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - x. Procedures for formal progress reports, including scope and frequency.
 - y. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Field Logs: Submit at least once a week to Commissioning Authority and Construction Manager.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Progress Reports.

- F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Submit to the Commissioning Authority, Construction Manager, and HVAC controls contractor within two weeks after completion of testing, adjusting, and balancing.
 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
 5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 7. Units of Measure: Report data in I-P (inch-pound) units only.
 8. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Project altitude.
 - j. Report date.
- G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

1.05 QUALITY ASSURANCE (moved to PART 3)

1.06 PRE-BALANCING MEETING (moved to PART 3)

1.07 SEQUENCING AND SCHEDULING (moved to PART 3)

1.08 WARRANTY (moved to PART 3)

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
1. AABC MN-1, AABC National Standards for Total System Balance.
 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
 5. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.
- F. TAB Supervisor Qualifications: Professional Engineer licensed in DE.

3.02 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 10 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Red Clay Consolidated School District.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive and sheave changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. On fan powered VAV boxes, adjust air flow switches for proper operation.
- P. For laboratories, lab classrooms, and prep rooms, offset CFM values (differential between exhaust/return and supply airflows) shall be required to maintain a plus 10% minus 5% offset.

3.07 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.08 COMMISSIONING

- A. Perform prerequisites prior to starting commissioning activities.
- B. Fill out Prefunctional Checklists for:
 - 1. Air side systems.
 - 2. Water side systems.
- C. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

- D. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 10 percent of the air handlers plus a random sample equivalent to 5 percent of the final TAB report data as directed by Commissioning Authority.
 - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
 - 2. Use the same test instruments as used in the original TAB work.
 - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
 - 4. For purposes of re-check, failure is defined as follows:
 - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
 - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
 - c. Temperatures: Deviation of more than one degree F.
 - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
 - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
 - 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- E. In the presence of the Commissioning Authority, verify that:
 - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
 - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
 - 3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.
- F. No seasonal tests are required.
- G. No further monitoring is required.
- H. No deferred testing is required.

3.09 SCOPE

- A. Test, adjust, and balance the following:
 - 1. Electric Water Coolers
 - 2. Plumbing Pumps
 - 3. HVAC Pumps/Hydronic Systems
 - 4. Packaged Boilers
 - 5. Combined Heating, Cooling, and Power hydronic systems
 - 6. Absorption Chillers

7. Cooling towers
8. Air Cooled Refrigerant Condensers
9. Terminal Heat Transfer Units
10. Heat Exchangers
11. Laboratory fume hoods
12. Air Handling Units/Rooftop Mounted Air handling units
13. Fans
14. Air Filters
15. Air Terminal Units/Chilled Beams (air and hydronic)
16. Air Inlets and Outlets

3.10 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
 1. Manufacturer
 2. Model/Frame
 3. HP/BHP
 4. Phase, voltage, amperage; nameplate, actual, no load
 5. RPM
 6. Service factor
 7. Starter size, rating, heater elements
 8. Sheave Make/Size/Bore
- B. V-Belt Drives:
 1. Identification/location
 2. Required driven RPM
 3. Driven sheave, diameter and RPM
 4. Belt, size and quantity
 5. Motor sheave diameter and RPM
 6. Center to center distance, maximum, minimum, and actual
- C. Pumps:
 1. Identification/number
 2. Manufacturer
 3. Size/model
 4. Impeller
 5. Service
 6. Design flow rate, pressure drop, BHP
 7. Actual flow rate, pressure drop, BHP
 8. Discharge pressure
 9. Suction pressure
 10. Total operating head pressure
 11. Shut off, discharge and suction pressures
 12. Shut off, total head pressure
- D. Hydronic System Control
 1. Differential pressure setpoints for BAS contractor / commissioning.
- E. Combustion Equipment:
 1. Boiler manufacturer
 2. Model number
 3. Serial number
 4. Firing rate
 5. Overfire draft
 6. Gas meter timing dial size

7. Gas meter time per revolution
 8. Gas pressure at meter outlet
 9. Gas flow rate
 10. Heat input
 11. Burner manifold gas pressure
 12. Percent carbon monoxide (CO)
 13. Percent carbon dioxide (CO₂)
 14. Percent oxygen (O₂)
 15. Percent excess air
 16. Flue gas temperature at outlet
 17. Ambient temperature
 18. Net stack temperature
 19. Percent stack loss
 20. Percent combustion efficiency
 21. Heat output
- F. Air Cooled Condensers:
1. Identification/number
 2. Location
 3. Manufacturer
 4. Model number
 5. Serial number
 6. Entering DB air temperature, design and actual
 7. Leaving DB air temperature, design and actual
 8. Number of compressors
- G. Chillers:
1. Identification/number
 2. Manufacturer
 3. Capacity
 4. Model number
 5. Serial number
 6. Evaporator entering water temperature, design and actual
 7. Evaporator leaving water temperature, design and actual
 8. Evaporator pressure drop, design and actual
 9. Evaporator water flow rate, design and actual
 10. Condenser entering water temperature, design and actual
 11. Condenser pressure drop, design and actual
 12. Condenser water flow rate, design and actual
- H. Cooling Tower:
1. Tower identification/number
 2. Manufacturer
 3. Model number
 4. Serial number
 5. Rated capacity
 6. Entering air WB temperature, specified and actual
 7. Leaving air WB temperature, specified and actual
 8. Ambient air DB temperature
 9. Condenser water entering temperature
 10. Condenser water leaving temperature
 11. Condenser water flow rate
 12. Fan RPM
- I. Heat Exchangers:

1. Identification/number
 2. Location
 3. Service
 4. Manufacturer
 5. Model number
 6. Serial number
 7. Steam pressure, design and actual
 8. Primary water entering temperature, design and actual
 9. Primary water leaving temperature, design and actual
 10. Primary water flow, design and actual
 11. Primary water pressure drop, design and actual
 12. Secondary water leaving temperature, design and actual
 13. Secondary water leaving temperature, design and actual
 14. Secondary water flow, design and actual
 15. Secondary water pressure drop, design and actual
- J. Cooling Coils:
1. Identification/number
 2. Location
 3. Service
 4. Manufacturer
 5. Air flow, design and actual
 6. Entering air DB temperature, design and actual
 7. Entering air WB temperature, design and actual
 8. Leaving air DB temperature, design and actual
 9. Leaving air WB temperature, design and actual
 10. Water flow, design and actual
 11. Water pressure drop, design and actual
 12. Entering water temperature, design and actual
 13. Leaving water temperature, design and actual
 14. Saturated suction temperature, design and actual
 15. Air pressure drop, design and actual
- K. Heating Coils:
1. Identification/number
 2. Location
 3. Service
 4. Manufacturer
 5. Air flow, design and actual
 6. Water flow, design and actual
 7. Water pressure drop, design and actual
 8. Entering water temperature, design and actual
 9. Leaving water temperature, design and actual
 10. Entering air temperature, design and actual
 11. Leaving air temperature, design and actual
 12. Air pressure drop, design and actual
- L. Air Moving Equipment:
1. Location
 2. Manufacturer
 3. Model number
 4. Serial number
 5. Arrangement/Class/Discharge
 6. Air flow, specified and actual

7. Return air flow, specified and actual
 8. Outside air flow, specified and actual
 9. Total static pressure (total external), specified and actual
 10. Inlet pressure
 11. Discharge pressure
 12. Sheave Make/Size/Bore
 13. Number of Belts/Make/Size
 14. Fan RPM
- M. Return Air/Outside Air:
1. Identification/location
 2. Design air flow
 3. Actual air flow
 4. Design return air flow
 5. Actual return air flow
 6. Design outside air flow
 7. Actual outside air flow
 8. Return air temperature
 9. Outside air temperature
 10. Required mixed air temperature
 11. Actual mixed air temperature
 12. Design outside/return air ratio
 13. Actual outside/return air ratio
- N. Exhaust Fans:
1. Location
 2. Manufacturer
 3. Model number
 4. Serial number
 5. Air flow, specified and actual
 6. Total static pressure (total external), specified and actual
 7. Inlet pressure
 8. Discharge pressure
 9. Sheave Make/Size/Bore
 10. Number of Belts/Make/Size
 11. Fan RPM
 12. Associated with Fume Hoods, Include:
 - a. Face velocity test at max/min sash position.
- O. Duct Traverses:
1. System zone/branch
 2. Duct size
 3. Area
 4. Design velocity
 5. Design air flow
 6. Test velocity
 7. Test air flow
 8. Duct static pressure
 9. Air temperature
 10. Air correction factor
- P. Duct Leak Tests:
1. Description of ductwork under test
 2. Duct design operating pressure
 3. Duct design test static pressure

4. Duct capacity, air flow
 5. Maximum allowable leakage duct capacity times leak factor
 6. Test apparatus
 - a. Blower
 - b. Orifice, tube size
 - c. Orifice size
 - d. Calibrated
 7. Test static pressure
 8. Test orifice differential pressure
 9. Leakage
- Q. Flow Measuring Stations:
1. Identification/number
 2. Location
 3. Size
 4. Manufacturer
 5. Model number
 6. Serial number
 7. Design Flow rate
 8. Design pressure drop
 9. Actual/final pressure drop
 10. Actual/final flow rate
 11. Station calibrated setting
- R. Terminal Unit Data:
1. Manufacturer
 2. Type, constant, variable, single, dual duct
 3. Identification/number
 4. Location
 5. Model number
 6. Size
 7. Minimum static pressure
 8. Minimum design air flow
 9. Maximum design air flow
 10. Maximum actual air flow
 11. Inlet static pressure
- S. Air Distribution Tests:
1. Air terminal number
 2. Room number/location
 3. Terminal type
 4. Terminal size
 5. Area factor
 6. Design velocity
 7. Design air flow
 8. Test (final) velocity
 9. Test (final) air flow
 10. Percent of design air flow
- T. Sound Level Reports:
1. Location
 2. Octave bands - equipment off
 3. Octave bands - equipment on
- U. Vibration Tests:

1. Location of points:
 - a. Fan bearing, drive end
 - b. Fan bearing, opposite end
 - c. Motor bearing, center (if applicable)
 - d. Motor bearing, drive end
 - e. Motor bearing, opposite end
 - f. Casing (bottom or top)
 - g. Casing (side)
 - h. Duct after flexible connection (discharge)
 - i. Duct after flexible connection (suction)
2. Test readings:
 - a. Horizontal, velocity and displacement
 - b. Vertical, velocity and displacement
 - c. Axial, velocity and displacement
3. Normally acceptable readings, velocity and acceleration
4. Unusual conditions at time of test
5. Vibration source (if non-complying)

END OF SECTION

SECTION 23 07 13**DUCT INSULATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Duct insulation.
- B. Duct Lagging.
- C. Insulation jackets.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Painting insulation jackets.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- C. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- D. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- D. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
- G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- J. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- K. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- L. SMACNA (DCS) - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. Knauf Insulation: www.knaufusa.com.
 - 2. Johns Manville Corporation: www.jm.com.
 - 3. Owens Corning Corp: www.owenscorning.com.
 - 4. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Sorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 2. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

- F. Tie Wire: Annealed steel, 16 gage.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
1. Knauf Insulation: www.knaufusa.com.
 2. Johns Manville Corporation: www.jm.com.
 3. Owens Corning Corp: www.owenscorning.com.
 4. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
1. 'K' value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 2. Maximum service temperature: 450 degrees F.
 3. Maximum Water Vapor Sorption: 5.0 percent.
 4. Maximum Density: 8.0 lb/cu ft.
- C. Vapor Barrier Jacket:
1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 2. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.04 JACKETS

- A. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.016 inch sheet.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch laps.
 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
 6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

2.05 DUCT LAGGING

- A. Manufacturers:
1. Sound Seal: www.soundseal.com
 2. Kinetics Noise Control: www.kineticsnoise.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Lagging: Loaded vinyl noise barrier with a scrim reinforced aluminum foil facing on one side with a 1" thick fiberglass decoupler.
1. Apparent Thermal Conductivity: Maximum of .25 at 75 degrees F
 2. Service Temperature: Up to 350 degrees F.
- C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.

- B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated ducts conveying air below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ducts conveying air above ambient temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

3.03 SCHEDULES

- A. INDOOR DUCT AND PLENUM APPLICATION SCHEDULE
 - 1. NOTE: Apply duct lagging where indicated on drawings.
 - 2. Service: Round, supply-air ducts, concealed.
 - a. Material: Mineral-fiber blanket.
 - b. Thickness: 1-1/2 inches.
 - c. Jacket: Foil and paper.
 - d. Vapor Retarder Required: Yes.
 - 3. Service: Round, return-air ducts, concealed.
 - a. Material: Mineral-fiber blanket.
 - b. Thickness: 1 inch.
 - c. Jacket: Foil and paper.
 - d. Vapor Retarder Required: No.
 - 4. Service: Round, outside-air ducts, concealed.
 - a. Material: Mineral-fiber blanket
 - b. Thickness: 1-1/2 inches.
 - c. Jacket: Foil and paper.
 - d. Vapor Retarder Required: Yes.
 - 5. Service: Rectangular, supply-air ducts, concealed.
 - a. Material: Mineral-fiber blanket
 - b. Thickness: 1-1/2 inches.
 - c. Jacket: Foil and paper.

- d. Vapor Retarder Required: Yes.
- 6. Service: Rectangular, return-air ducts, concealed.
 - a. Material: Mineral-fiber blanket
 - b. Thickness: 1 inch.
 - c. Jacket: Foil and paper.
 - d. Vapor Retarder Required: No.
- 7. Service: Rectangular, outside-air ducts, concealed.
 - a. Material: Mineral-fiber blanket
 - b. Thickness: 1- 1/2 inches.
 - c. Jacket: Foil and paper.
 - d. Vapor Retarder Required: Yes.
- 8. Service: Round, supply-air ducts, exposed.
 - a. Material: Mineral-fiber blanket
 - b. Thickness: 2 inches.
 - c. Jacket: Spiral-wound steel, paintable.
 - d. Vapor Retarder Required: Yes.
- 9. Service: Round, return-air ducts, exposed.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 1 inch.
 - c. Jacket: Spiral-wound steel, paintable.
 - d. Vapor Retarder Required: No.
 - e. NOTE: Provide double-walled spiral ductwork in areas noted on drawings as defined in specification section 15890.
- 10. Service: Round, outside-air ducts, exposed.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 2 inches.
 - c. Jacket: Spiral-wound steel, paintable.
 - d. Vapor Retarder Required: Yes.
 - e. NOTE: Provide double-walled spiral ductwork in areas noted on drawings as defined in specification section 15890.
- 11. Service: Rectangular, supply-air ducts, exposed.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 2 inches.
 - c. Jacket: Aluminum, painted to architects specifications.
 - d. Vapor Retarder Required: Yes.
- 12. Service: Rectangular, return-air ducts, exposed.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 1 inch.
 - c. Jacket: Aluminum, painted to architects specifications
 - d. Vapor Retarder Required: No.
- 13. Service: Rectangular, outside-air ducts, exposed.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 2 inches.
 - c. Jacket: Aluminum, painted to architects specifications.
 - d. Vapor Retarder Required: Yes.
- 14. Service: Rectangular, dishwasher exhaust ducts, concealed.
 - a. Material: Mineral-fiber blanket.
 - b. Thickness: 1/2 inch.
 - c. Jacket: Foil and Paper
 - d. Vapor Retarder Required: No.
- 15. Service: Rectangular, dishwasher exhaust ducts, exposed.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 1/2 inch.

- c. Jacket: Aluminum
- d. Vapor Retarder Required: No.

B. OUTDOOR DUCT AND PLENUM APPLICATION SCHEDULE

- 1. Service: Round, supply-air ducts.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 2 inches.
 - c. Field-Applied Jacket: aluminum
 - 1) Aluminum Thickness: 0.032 inch
 - d. Vapor Retarder Required: Yes.
- 2. Service: Round, return-air ducts.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 2 inches.
 - c. Field-Applied Jacket: aluminum
 - 1) Aluminum Thickness: 0.032 inch
 - d. Vapor Retarder Required: Yes.
- 3. Service: Rectangular, supply-air ducts.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 2 inches.
 - c. Field-Applied Jacket: aluminum
 - 1) Aluminum Thickness: 0.032 inch
 - d. Vapor Retarder Required: Yes.
- 4. Service: Rectangular, return-air ducts.
 - a. Material: Mineral-fiber board.
 - b. Thickness: 2 inches.
 - c. Field-Applied Jacket: aluminum
 - 1) Aluminum Thickness: 0.032 inch
 - d. Vapor Retarder Required: Yes.

END OF SECTION

SECTION 23 07 16**HVAC EQUIPMENT INSULATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Equipment insulation.
- B. Covering.
- C. Breeching insulation.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 90 00 - Painting and Coating: Painting insulation covering.
- C. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- D. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- E. Section 23 21 14 - Hydronic Specialties.
- F. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- E. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- G. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- H. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- I. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- J. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- K. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- L. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- N. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- O. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. Knauf Insulation; : www.knaufusa.com.
 - 2. Johns Manville Corporation; : www.jm.com.
 - 3. Owens Corning Corp; : www.owenscorning.com.
 - 4. CertainTeed Corporation; : www.certainteed.com.
- B. Insulation: ASTM C553; flexible, noncombustible.
 - 1. 'K' Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.

2. Maximum Service Temperature: 450 degrees F.
 3. Maximum Water Vapor Sorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 2. Secure with self-sealing longitudinal laps and butt strips.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.03 GLASS FIBER, RIGID

- A. Manufacturer:
1. Knauf Insulation: www.knaufusa.com.
 2. Johns Manville Corporation: www.jm.com.
 3. Owens Corning Corp: www.owenscorning.com.
 4. CertainTeed Corporation; : www.certainteed.com.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
1. 'K' Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 2. Maximum Service Temperature: 850 degrees F.
 3. Maximum Water Vapor Sorption: 5.0 percent by weight.
 4. Maximum Density: 8.0 lb/cu ft.
- C. Vapor Barrier Jacket:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with self-sealing longitudinal laps and butt strips.

2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
1. Armacell International: www.armacell.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 3, in sheet form.
1. Minimum Service Temperature: -40 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.

2.05 JACKETS

- A. PVC Plastic:
1. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: -40 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- J. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- K. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert location: Between support shield and equipment and under the finish jacket.
 - 4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- L. Finish insulation at supports, protrusions, and interruptions.
- M. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- N. Exterior Applications: Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.
- O. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement aluminum jacket.
- P. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- Q. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.03 SCHEDULE

- A. Heating, cooling, and dual temperature hydronic systems:
 - 1. Pump Bodies: 1.5" thick fiberglass insulation, vapor barrier, PVC jacket.
 - 2. Heat Exchangers/Converters: 1.5" thick fiberglass insulation, vapor barrier, PVC jacket.
 - 3. Air Separators: 1.5" thick fiberglass insulation, vapor barrier, PVC jacket.
 - 4. Expansion Tanks: 1.5" thick fiberglass insulation, vapor barrier, PVC jacket.
 - 5. Absorption Chiller Hot Surfaces (Not Factory Insulated): 1.5" thick fiberglass insulation, vapor barrier, PVC jacket.
 - 6. Chiller Cold Surfaces (Not Factory Insulated): 1.5" thick fiberglass insulation, vapor barrier, PVC jacket.

END OF SECTION

SECTION 23 07 19**HVAC PIPING INSULATION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 09 90 00 - Painting and Coating: Painting insulation jacket.
- C. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.
- D. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- E. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

1.03 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- I. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- J. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- L. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- N. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.

- O. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
- P. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- Q. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber.
- R. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- T. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- U. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.02 GLASS FIBER

- A. Manufacturers:
 1. Knauf Insulation: www.knaufusa.com.
 2. Johns Manville Corporation: www.jm.com.
 3. Owens Corning Corp: www.owenscorning.com.

4. CertainTeed Corporation: www.certainteed.com.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
 1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum service temperature: 850 degrees F.
 3. Maximum moisture absorption: 0.2 percent by volume.
- C. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
 1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
 2. Maximum service temperature: 650 degrees F.
 3. Maximum moisture absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Vapor Barrier Lap Adhesive:
 1. Compatible with insulation.
- G. Insulating Cement/Mastic:
 1. ASTM C195; hydraulic setting on mineral wool.
- H. Fibrous Glass Fabric:
 1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Blanket: 1.0 lb/cu ft density.
 3. Weave: 5x5.
- I. Indoor Vapor Barrier Finish:
 1. Cloth: Untreated; 9 oz/sq yd weight.
 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- J. Outdoor Vapor Barrier Mastic:
 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Outdoor Breather Mastic:
 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- L. Insulating Cement:
 1. ASTM C449/C449M.

2.03 CELLULAR GLASS

- A. Manufacturers:
 1. Pittsburgh Corning Corporation: www.foamglasinsulation.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C552, Grade 1.
 1. 'K' value: 0.37 at 100 degrees F.
 2. Service Temperature: Up to 900 degrees F.
 3. Water Vapor Permeability: 0.005 perm inch.
 4. Water Absorption: 0.2 percent by volume, maximum.

2.04 EXPANDED POLYSTYRENE

- A. Insulation: ASTM C578; rigid closed cell.
 1. 'K' value: 0.23 at 75 degrees F.

2. Maximum service temperature: 165 degrees F.
3. Maximum water vapor permeance: 5.0 perms

2.05 EXPANDED PERLITE

- A. Manufacturers:
 1. Schundler Company: www.schundler.com.
- B. Insulation: ASTM C610, molded.
 1. Maximum service temperature: 1200 degrees F.
 2. Maximum water vapor transmission: 0.1 perm.

2.06 HYDROUS CALCIUM SILICATE

- A. Manufacturers:
 1. Johns Manville Corporation: www.jm.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
 1. 'K' value: ASTM C177 and C518; 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
 2. Maximum service temperature: 1200 degrees F.
 3. Density: 15 lb/cu ft.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Insulating Cement:
 1. ASTM C449/C449M.

2.07 POLYISOCYANURATE CELLULAR PLASTIC

- A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
 1. Dimension: Comply with requirements of ASTM C585.
 2. 'K' value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
 3. Minimum Service Temperature: -70 degrees F.
 4. Maximum Service Temperature: 300 degrees F.
 5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842..
 6. Moisture Vapor Transmission: 4.0 perm in.
 7. Connection: Waterproof vapor barrier adhesive.

2.08 POLYETHYLENE

- A. Manufacturers:
 1. Armacell International: www.armacell.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
 1. 'K' value: ASTM C177; 0.25 at 75 degrees F.
 2. Maximum Service Temperature: 200 degrees F.
 3. Density: 2 lb/cu ft.
 4. Maximum Moisture Absorption: 1.0 percent by volume.
 5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
 6. Connection: Contact adhesive.

2.09 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
 - 1. Armacell International: www.armacell.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 3; use molded tubular material wherever possible.
 - 1. Minimum Service Temperature: -40 degrees F.
 - 2. Maximum Service Temperature: 220 degrees F.
 - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.10 JACKETS

- A. PVC Plastic.
 - 1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: 0 degrees F.
 - b. Maximum Service Temperature: 150 degrees F.
 - c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil.
 - e. Connections: Brush on welding adhesive.
 - 3. Covering Adhesive Mastic:
 - a. Compatible with insulation.
- B. ABS Plastic:
 - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - a. Minimum Service Temperature: -40 degrees F.
 - b. Maximum Service Temperature of 180 degrees F.
 - c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 30 mil.
 - e. Connections: Brush on welding adhesive.
- C. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
 - 1. Lagging Adhesive:
 - a. Compatible with insulation.
- D. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
 - 1. Thickness: 0.016 inch sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- E. Stainless Steel Jacket: ASTM A666, Type 302 stainless steel.
 - 1. Thickness: 0.010 inch.
 - 2. Finish: Smooth.
 - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- H. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- I. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert location: Between support shield and piping and under the finish jacket.
 - 4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

- M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

A. PIPING INSULATION SCHEDULES

- 1. General: Abbreviations used in the following schedules include:
 - a. Field Applied Jackets: P - PVC, K-Foil and Paper, A - Aluminum, SS - Stainless Steel.
 - b. Piping Sizes: NPS - Nominal Pipe Size.

B. INTERIOR PIPING APPLICATION SCHEDULE

- 1. Service: Condensate drain piping.
 - a. Operating Temperature: 35 to 75 deg F.
 - b. Insulation Material: Flexible elastomeric.
 - c. Insulation Thickness: 0.5 inch.
 - d. Jacket: None.
 - e. Vapor Retarder Required: Yes.
 - f. Finish: None.

C. Service: Chilled-water and dual-temperature supply and return.

- 1. Operating Temperature: 35 to 250 deg F.
- 2. Insulation Material: Mineral fiber or glass fiber
- 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 1" or less: 1.0 inch.
 - b. Pipe, 1 ¼" and up: 1.5 inch.
- 4. Jacket: PVC.
- 5. Vapor Retarder Required: Yes.
- 6. Finish: none

D. Service: Refrigerant suction and hot-gas piping.

- 1. Operating Temperature: 35 to 140 deg F.
- 2. Insulation Material: Flexible elastomeric.
- 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 1" or less: 1.0 inch.
 - b. Pipe, 1-1/4" and up: 1.5 inch.
- 4. Jacket: None.
- 5. Vapor Retarder Required: No.
- 6. Finish: None.

E. Service: Heating hot-water supply and return.

- 1. Operating Temperature: 100 to 250 deg F.
- 2. Insulation Material: Mineral fiber or glass fiber.
- 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 1" or less: 1.0 inch.
 - b. Pipe, 1-1/4" to 4": 1.5 inch.
 - c. Pipe, 5" and up: 2.0 inch.
- 4. Jacket: PVC.
- 5. Vapor Retarder Required: No.
- 6. Finish: None.

F. EXTERIOR PIPING INSULATION APPLICATION SCHEDULE

G. Service: Refrigerant suction.

1. Operating Temperature: 35 to 140 deg F.
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, 1" or less: 1.0 inch.
 - b. Pipe, 1-1/4" to 2": 1.5 inch.
 - c. Pipe, 2-1/2" and up: 1.5 inch.
4. Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

H. Service: Chilled-water and dual temperature supply and return.

1. Operating Temperature: 35 to 250 deg F.
2. Insulation Material: Cellular glass, with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, Any pipe size: 2.0 inch.
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: Yes.
6. Finish: None.

I. Service: Heating hot-water supply and return.

1. Operating Temperature: 100 to 250 deg F.
2. Insulation Material: Mineral fiber
3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Pipe, Any pipe size: 2.0 inch.
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: No.
6. Finish: None.

END OF SECTION

SECTION 23 08 00**COMMISSIONING OF HVAC****PART 1 GENERAL****1.01 SUMMARY**

- A. See Section 01 91 13 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 91 13.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
 - 1. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. DRAFT Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
 - 1. System name.
 - 2. List of devices.
 - 3. Step-by-step procedures for testing each controller after installation, including:
 - 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. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 - 4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
 - 5. 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 Commissioning Authority and TAB contractor for this determination.

- C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
 - 1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
 - 2. Full as-built set of control drawings.
 - 3. Full as-built sequence of operations for each piece of equipment.
 - 4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
 - a. Floor.
 - b. Room number.
 - c. Room name.
 - d. Air handler unit ID.
 - e. Reference drawing number.
 - f. Air terminal unit tag ID.
 - g. Heating and/or cooling valve tag ID.
 - h. Minimum air flow rate.
 - i. Maximum air flow rate.
 - 5. Full print out of all schedules and set points after testing and acceptance of the system.
 - 6. Full as-built print out of software program.
 - 7. Electronic copy on disk of the entire program for this facility.
 - 8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
 - 9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 - 10. Control equipment component submittals, parts lists, etc.
 - 11. Warranty requirements.
 - 12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 - 13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller and/or module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Valves and valve actuators.
 - h. Dampers and damper actuators.
 - i. Program setups (software program printouts).
- E. Project Record Documents: See Section 01 78 00 for additional requirements.
 - 1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
 - 2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- F. Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
 - 1. Follow the recommendations of ASHRAE Guideline 1.

2. Control system manufacturer's recommended training.
 3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- G. Training Manuals: See Section 01 79 00 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Red Clay Consolidated School District.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Red Clay Consolidated School District; such equipment, tools, and instruments are to become the property of Red Clay Consolidated School District.

PART 3 EXECUTION

3.01 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with the contract documents.

3.02 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Provide two-way radios for use during the testing.

- D. Valve/Damper Stroke Setup and Check:
 - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 - 2. Set pump/fan to normal operating mode.
 - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
 - 5. Command valve/damper to a few intermediate positions.
 - 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- E. Isolation Valve or System Valve Leak Check: For valves not by coils.
 - 1. With full pressure in the system, command valve closed.
 - 2. Use an ultra-sonic flow meter to detect flow or leakage.
- F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Red Clay Consolidated School District.

3.03 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with the contract documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
 - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Red Clay Consolidated School District.

2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
 1. Setpoint changing features and functions.
 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
 1. That all specified functions and features are set up, debugged and fully operable.
 2. That scheduling features are fully functional and setup, including holidays.
 3. That all graphic screens and value readouts are completed.
 4. Correct date and time setting in central computer.
 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Red Clay Consolidated School District.
 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Red Clay Consolidated School District.
 7. Power failure and battery backup and power-up restart functions.
 8. Global commands features.
 9. Security and access codes.
 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
 11. O&M schedules and alarms.
 12. Occupancy sensors and controls.
 13. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Red Clay Consolidated School District.

3.05 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Red Clay Consolidated School District.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Red Clay Consolidated School District.

3.06 DEMONSTRATION AND TRAINING

- A. See Section 01 79 00 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Red Clay Consolidated School

District' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Red Clay Consolidated School District's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
- E. TAB Review: Instruct Red Clay Consolidated School District's personnel for minimum ____ hours, after completion of TAB, on the following:
 - 1. Review final TAB report, explaining the layout and meanings of each data type.
 - 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 - 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 - 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 - 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. HVAC Control System Training: Perform training in at least three phases:
 - 1. Phase 1 - Basic Control System: Provide minimum of ____ hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - a. This training may be held on-site or at the manufacturer's facility.
 - b. If held off-site, the training may occur prior to final completion of the system installation.
 - c. For off-site training, Contractor shall pay expenses of up to two attendees.
 - 2. Phase 2 - Integrating with HVAC Systems: Provide minimum of ____ hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
 - a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
 - d. Every display screen, allowing time for questions.
 - e. Point database entry and modifications.
 - 3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of ____ hours of training. Tailor training session to questions and topics solicited beforehand from Red Clay Consolidated School District. Also be prepared to address topics brought up and answer questions concerning operation of the system.

- G. Provide the services of manufacturer representatives to assist instructors where necessary.
- H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

SECTION 23 09 23

DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

-1.01 SECTION PROVIDED FOR REFERENCE ONLY. BUILDING AUTOMATION SYSTEM/CONTROLS PACKAGE PURCHASED UNDER SEPARATE CONTRACT.

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. System Description
- B. Operator Interface
- C. Controllers
- D. Power Supplies and Line Filtering
- E. System Software
- F. Controller Software
- G. HVAC Control Programs
- H. Control equipment.
- I. Software.

1.02 RELATED REQUIREMENTS

- A. Section 28 31 00 - Fire Detection and Alarm.
- B. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
- E. Section 27 52 23.50 - Educational Intercommunications and Programs - Education For Sustainability Systems

1.03 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units. No other vendors are acceptable.
- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and all hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 09 13.

- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment, power transformers and electrical feeds, and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List connected data points, including connected control unit and input device.
 - 3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration diskette containing graphics.
 - 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 - 5. Indicate description and sequence of operation of operating, user, and application software.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
 - 2. Include submittals data in final "Record Documents" form.
- F. Operation and Maintenance Data:
 - 1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 - 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Red Clay Consolidated School District's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Design system software under direct supervision of a Professional Engineer experienced in design of this Work and licensed at DE.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section 5 years documented experience approved by manufacturer.

- E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.07 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this Section.
- B. Require attendance of parties directly affecting the work of this Section.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Substantial Completion.
- C. Provide five year manufacturer's warranty for field programmable micro-processor based units.

1.09 MAINTENANCE SERVICE

- A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.
- B. Provide four complete inspections per year, two in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.
- C. Provide complete service of systems, including call backs. Make minimum of 4 complete normal inspections of approximately 4 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

1.10 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.

1.11 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Red Clay Consolidated School District and the party providing the software will enter into a software license agreement with provisions for the following:
 1. Limiting use of software to equipment provided under these specifications.
 2. Limiting copying.
 3. Preserving confidentiality.
 4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Trane
- B. Substitutions: Not Permitted.

2.02 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to Building Management System.
- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.

- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 09 13.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.03 CONTROLLERS

A. BUILDING CONTROLLERS

- 1. General:
 - a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
- 2. Communication:
 - a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
 - b. Perform routing when connected to a network of custom application and application specific controllers.
 - c. Provide required communication to District-wide BAS.
- 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
- 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
- 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
- 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.

- c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. INPUT/OUTPUT INTERFACE

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Conform to all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:
 - a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
 - b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.04 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies:
 - 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
 - 2. Limit connected loads to 80 percent of rated capacity.
 - 3. Match DC power supply to current output and voltage requirements.
 - 4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
 - 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
 - 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
 - 7. Operational Ambient Conditions: 32 to 120 degrees F.
 - 8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD 810 for shock and vibration.
 - 9. Line voltage units UL recognized and CSA approved.
- B. Power Line Filtering:
 - 1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
 - 2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.05 OPERATOR INTERFACE - DISTRICT WIDE

- A. Work Station:
 - 1. Utilize existing workstations within the District for full access to the system.
- B. System Support: Full LAN interface units (desktop, laptop, tablet, etc.) connected to multi-user, multi-tasking environment with concurrent capability to:
 - 1. Access DDC network.
 - 2. Access or control same control unit.
 - 3. Access or modify same control unit data base.
 - 4. Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.
 - 5. Develop and edit data base.
 - 6. Implement and tune DDC control.
 - 7. Develop graphics.
 - 8. Control facility.

2.06 CONTROL UNITS

- A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.
- B. Battery Backup: For minimum of 48 hours for complete system including RAM without interruption, with automatic battery charger.
- C. Control Units Functions:
 - 1. Monitor or control each input/output point.
 - 2. Completely independent with hardware clock/calendar and software to maintain control independently.

3. Acquire, process, and transfer information to operator station or other control units on network.
 4. Accept, process, and execute commands from other control unit's or devices or operator stations.
 5. Access both data base and control functions simultaneously.
 6. Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.
 7. Perform in stand-alone mode:
 - a. Start/stop.
 - b. Duty cycling.
 - c. Automatic Temperature Control.
 - d. Demand control via a sliding window, predictive algorithm.
 - e. Event initiated control.
 - f. Calculated point.
 - g. Scanning and alarm processing.
 - h. Full direct digital control.
 - i. Trend logging.
 - j. Global communications.
 - k. Maintenance scheduling.
- D. Global Communications:
1. Broadcast point data onto network, making that information available to all other system control units.
 2. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
- E. Input/Output Capability:
1. Discrete/digital input (contact status).
 2. Discrete/digital output.
 3. Analog input.
 4. Analog output.
 5. Pulse input (5 pulses/second).
 6. Pulse output (0-655 seconds in duration with 0.01 second resolution).
- F. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.
- G. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
- H. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard wired LAN, or 60 seconds over voice grade phone lines.
- I. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
1. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from work station.
 2. Control output points but change only data base state or value; leave external field hardware unchanged.

3. Enable control actions on output points but change only data base state or value.
- J. Local display and adjustment panel: Portable control unit, containing digital display, and numerical keyboard. Display and adjust:
 1. Input/output point information and status.
 2. Controller set points.
 3. Controller tuning constants.
 4. Program execution times.
 5. High and low limit values.
 6. Limit differential.
 7. Set/display date and time.
 8. Control outputs connected to the network.
 9. Automatic control outputs.
 10. Perform control unit diagnostic testing.
 11. Points in "Test" mode.

2.07 LOCAL AREA NETWORK (LAN)

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 100 stations or nodes.
- C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- D. LAN Data Speed: Minimum 19.2 Kb.
- E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
- F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
- G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.08 SYSTEM SOFTWARE

- A. Operating System:
 1. Concurrent, multi-tasking capability.
 - a. Common Software Applications Supported: Microsoft Excel.
 2. System Graphics:
 - a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
 - b. Animation displayed by shifting image files based on object status.
 - c. Provide method for operator with password to perform the following:
 - 1) Move between, change size, and change location of graphic displays.
 - 2) Modify on-line.
 - 3) Add, delete, or change dynamic objects consisting of:
 - (a) Analog and binary values.
 - (b) Dynamic text.
 - (c) Static text.
 - (d) Animation files.
 3. Custom Graphics Generation Package:
 - a. Create, modify, and save graphic files and visio format graphics in PCX formats.

- b. HTML graphics to support web browser compatible formats.
- c. Capture or convert graphics from AutoCAD.
- 4. Standard HVAC Graphics Library:
 - a. HVAC Equipment:
 - b. Ancillary Equipment:
- B. Workstation System Applications:
 - 1. Automatic System Database Save and Restore Functions:
 - a. Current database copy of each Building Controller is automatically stored on hard disk.
 - b. Automatic update occurs upon change in any system panel.
 - c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - 2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - a. Save database from any system panel.
 - b. Clear a panel database.
 - c. Initiate a download of a specified database to any system panel.
 - 3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
 - 4. On-line Help:
 - a. Context-sensitive system assists operator in operation and editing.
 - b. Available for all applications.
 - c. Relevant screen data provided for particular screen display.
 - d. Additional help available via hypertext.
 - 5. Security:
 - a. Operator log-on requires user name and password to view, edit, add, or delete data.
 - b. System security selectable for each operator.
 - c. System supervisor sets passwords and security levels for all other operators.
 - d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
 - f. All system security data stored in encrypted format.
 - 6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Workstations.
 - 2) Printers.
 - 3) Modems.
 - 4) Network connections.
 - 5) Building management panels.
 - 6) Controllers.
 - b. Device failure is annunciated to the operator.
 - 7. Alarm Processing:
 - a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
 - b. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.
 - 4) Reactions for each object.
 - 8. Alarm Messages:
 - a. Descriptor: English language.

- b. Recognizable Features:
 - 1) Source.
 - 2) Location.
 - 3) Nature.
- 9. Configurable Alarm Reactions by Workstation and Time of Day:
 - a. Logging.
 - b. Printing.
 - c. Starting programs.
 - d. Displaying messages.
 - e. Dialing out to remote locations.
 - f. Paging.
 - g. Providing audible annunciation.
 - h. Displaying specific system graphics.
- 10. Custom Trend Logs:
 - a. Definable for any data object in the system including interval, start time, and stop time.
 - b. Trend Data:
 - 1) Sampled and stored on the building controller panel.
 - 2) Archivable on hard disk.
 - 3) Retrievable for use in reports, spreadsheets and standard database programs.
 - 4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
 - 5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
- 11. Alarm and Event Log:
 - a. View all system alarms and change of states from any system location.
 - b. Events listed chronologically.
 - c. Operator with proper security acknowledges and clears alarms.
 - d. Alarms not cleared by operator are archived to the workstation hard disk.
- 12. Object, Property Status and Control:
 - a. Provide a method to view, edit if applicable, the status of any object and property in the system.
 - b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.
- 13. Reports and Logs:
 - a. Reporting Package:
 - 1) Allows operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Archivable to hard disk.
 - b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
 - c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
 - d. Set to be printed on operator command or specific time(s).
- 14. Reports:
 - a. Standard:
 - 1) Objects with current values.
 - 2) Current alarms not locked out.
 - 3) Disabled and overridden objects, points and SNVTs.
 - 4) Objects in manual or automatic alarm lockout.
 - 5) Objects in alarm lockout currently in alarm.

- 6) Logs:
 - (a) Alarm History.
 - (b) System messages.
 - (c) System events.
 - (d) Trends.
 - b. Custom:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
 - c. Tenant Override:
 - 1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
 - 2) Annual report showing override usage on a monthly basis.
 - d. Electrical, Fuel, and Weather:
 - 1) Electrical Meter(s):
 - (a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
 - (b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
 - 2) Fuel Meter(s):
 - (a) Monthly showing daily natural gas consumption for each meter.
 - (b) Annual summary showing monthly consumption for each meter.
 - 3) Weather:
 - (a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.
- C. Workstation Applications Editors:
1. Provide editing software for all system applications at the PC workstation.
 2. Downloaded application is executed at controller panel.
 3. Full screen editor for each application allows operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.
 - d. Set-points.
 4. Scheduling:
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be scheduled and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
 5. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:
 - 1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
 - 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
 - 3) Insert, add, modify, and delete custom programming code that incorporates word

processing features such as cut/paste and find/replace.

- 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
- 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
- 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
- 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
- 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
- 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.09 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 1. User access secured via user passwords and user names.
 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 3. User Log On/Log Off attempts are recorded.
 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
 1. Binary object is set to alarm based on the operator specified state.
 2. Analog object to have high/low alarm limits.
 3. All alarming is capable of being automatically and manually disabled.
 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - c. Reporting Options:
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation in Section 23 09 93.

- H. PID Control Characteristics:
 - 1. Direct or reverse action.
 - 2. Anti-windup.
 - 3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
 - 4. User selectable controlled variable, set-point, and PED gains.
- I. Staggered Start Application:
 - 1. Prevents all controlled equipment from simultaneously restarting after power outage.
 - 2. Order of equipment startup is user selectable.
- J. Energy Calculations:
 - 1. Accumulated instantaneous power or flow rates are converted to energy use data.
 - 2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
 - 3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
- K. Anti-Short Cycling:
 - 1. All binary output objects protected from short-cycling.
 - 2. Allows minimum on-time and off-time to be selected.
- L. On-Off Control with Differential:
 - 1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
 - 2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- M. Run-Time Totalization:
 - 1. Totalize run-times for all binary input objects.
 - 2. Provides operator with capability to assign high run-time alarm.

2.10 OPERATING SYSTEM SOFTWARE

- A. Input/Output Capability From Operator Station:
 - 1. Request display of current values or status in tabular or graphic format.
 - 2. Command selected equipment to specified state.
 - 3. Initiate logs and reports.
 - 4. Change analog limits.
 - 5. Add, delete, or change points within each control unit or application routine.
 - 6. Change point input/output descriptors, status, alarm descriptors, and engineering unit descriptors.
 - 7. Add new control units to system.
 - 8. Modify and set up maintenance scheduling parameters.
 - 9. Develop, modify, delete or display full range of color graphic displays.
 - 10. Automatically archive select data even when running third party software.
 - 11. Provide capability to sort and extract data from archived files and to generate custom reports.
 - 12. Support two printer operations.
 - a. Alarm printer: Print alarms, operator acknowledgements, action messages, system alarms, operator sign-on and sign-off.
 - b. Data printer: Print reports, page prints, and data base prints.
 - 13. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
 - 14. Print selected control unit data base.

- B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.
- C. Data Base Creation and Support: Changes shall utilize standard procedures. Control unit shall automatically check work station data base files upon connection and verify data base match. Minimum capability shall include:
 - 1. Add and delete points.
 - 2. Modify any point parameter.
 - 3. Change, add, or delete English language descriptors.
 - 4. Add, modify, or delete alarm limits.
 - 5. Add, modify, or delete points in start/stop programs, trend logs, etc.
 - 6. Create custom relationship between points.
 - 7. Create or modify DDC loops and parameters.
 - 8. Create or modify override parameters.
 - 9. Add, modify, and delete any applications program.
 - 10. Add, delete, develop, or modify dynamic color graphic displays.
- D. Dynamic Color Graphic Displays:
 - 1. Utilizes custom symbols or system supported library of symbols.
 - 2. Sixteen (16) colors.
 - 3. Sixty (60) outputs of real time, live dynamic data per graphic.
 - 4. Dynamic graphic data.
 - 5. 1,000 separate graphic pages.
 - 6. Modify graphic screen refresh rate between 1 and 60 seconds.
- E. Operator Station:
 - 1. Accept data from LAN as needed without scanning entire network for updated point data.
 - 2. Interrogate LAN for updated point data when requested.
 - 3. Allow operator command of devices.
 - 4. Allow operator to place specific control units in or out of service.
 - 5. Allow parameter editing of control units.
 - 6. Store duplicate data base for every control unit and allow down loading while system is on line.
 - 7. Control or modify specific programs.
 - 8. Develop, store and modify dynamic color graphics.
 - 9. Provide data archiving of assigned points and support overlay graphing of this data utilizing up to four (4) variables.
- F. Alarm Processing:
 - 1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state/value and which alarms shall cause automatic dial-out.
 - 2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
 - 3. Print on line changeable message, up to 100 characters in length, for each alarm point specified.
 - 4. Display alarm reports on video. Display multiple alarms in order of occurrence.
 - 5. Define time delay for equipment start-up or shutdown.
 - 6. Allow unique routing of specific alarms.
 - 7. Operator specifies if alarm requires acknowledgement.
 - 8. Continue to indicate unacknowledged alarms after return to normal.

9. Alarm notification:
 - a. Automatic print.
 - b. Display indicating alarm condition.
 - c. Selectable audible alarm indication.
- G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change-of-state, specified state, or alarm occurrence or return to normal.
- H. Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop.
- I. Messages:
 1. Automatically display or print user-defined message subsequent to occurrence of selected events.
 2. Compose, change, or delete any message.
 3. Display or log any message at any time.
 4. Assign any message to any event.
- J. Reports:
 1. Manually requested with time and date.
 2. Long term data archiving to hard disk.
 3. Automatic directives to download to transportable media such as floppy diskettes for storage.
 4. Data selection methods to include data base search and manipulation.
 5. Data extraction with mathematical manipulation.
 6. Data reports shall allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
 7. Generating reports either normally at operator direction, or automatically under work station direction.
 8. Reports may either manually displayed or printed, or may be printed automatically on daily, weekly, monthly, yearly or scheduled basis.
 9. Include capability for statistical data manipulation and extraction.
 10. Provide capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.
- K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
- L. Data Collection:
 1. Automatically collect and store in disk files.
 2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2 year period.
 3. Daily consumption for up to 30 meters over a 2 year period.
 4. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
 5. Provide archiving of stored data for use with system supplied custom reports.
- M. Graphic Display: Support graphic development on work station with software features:
 1. Page linking.
 2. Generate, store, and retrieve library symbols.
 3. Single or double height characters.

4. Sixty (60) dynamic points of data per graphic page.
 5. Pixel level resolution.
 6. Animated graphics for discrete points.
 7. Analog bar graphs.
 8. Display real time value of each input or output line diagram fashion.
- N. Maintenance Management:
1. Run time monitoring, per point.
 2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
 3. Equipment safety targets.
 4. Display of maintenance material and estimated labor.
 5. Target point reset, per point.
- O. Advisories:
1. Summary which contains status of points in locked out condition.
 2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
 3. Report of power failure detection, time and date.
 4. Report of communication failure with operator device, field interface unit, point, programmable control unit.

2.11 LOAD CONTROL PROGRAMS

- A. General: Support inch-pounds and SI (metric) units of measurement.
- B. Demand Limiting:
1. Monitor total power consumption per power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
 2. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
 3. Forecast demand (kW): Predicted by sliding window method.
 4. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
 5. Demand Target: Minimum of 3 per demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.
 6. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
 7. Limits: Include control band (upper and lower limits).
 8. Output advisory if loads are not available to satisfy required shed amount, advise shed requirements and requiring operator acknowledgement.
- C. Duty Cycling:
1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.
 2. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by same amount that off portion is reduced.
 3. Set and modify following parameters for each individual load.
 - a. Minimum and maximum Off time.
 - b. On/Off time in one minute increments.
 - c. Time period from beginning of interval until load can be cycled.
 - d. Manually override the DCC program and place a load in an On or Off state.
 - e. Cooling Target Temperature and Differential.
 - f. Heating Target Temperature and Differential.
 - g. Cycle off adjustment.

- D. Automatic Time Scheduling:
1. Self-contained programs for automatic start/stop/scheduling of building loads.
 2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
 3. Special days schedule shall support up to 30 unique date/duration combinations.
 4. Any number of loads assigned to any time program; each load can have individual time program.
 5. Each load assigned at least 16 control actions per day with 1 minute resolution.
 6. Time schedule operations may be:
 - a. Start.
 - b. Optimized Start.
 - c. Stop.
 - d. Optimized Stop.
 - e. Cycle.
 - f. Optimized Cycle.
 7. Minimum of 30 holiday periods up to 100 days in length may be specified for the year.
 8. Create temporary schedules.
 9. Broadcast temporary "special day" date and duration.
- E. Start/Stop Time Optimization:
1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
 2. Adaptive and self-tuning, adjusting to changing conditions unattended.
 3. For each point under control, establish and modify:
 - a. Occupancy period.
 - b. Desired temperature at beginning of occupancy period.
 - c. Desired temperature at end of occupancy period.
- F. Night Setback/Setup Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
- G. Calculated Points: Define calculations and totalization computed from monitored points (analog/digital points), constants, or other calculated points.
1. Employ arithmetic, algebraic, Boolean, and special function operations.
 2. Treat calculated values like any other analog value, use for any function that a "hard wired point" might be used.
- H. Event Initiated Programming: Event may be initiated by any data point, causing series of controls in a sequence.
1. Define time interval between each control action between 0 to 3600 seconds.
 2. Output may be analog value.
 3. Provide for "skip" logic.
 4. Verify completion of one action before proceeding to next. If not verified, program shall be able to skip to next action.
- I. Direct Digital Control: Each control unit shall provide Direct Digital Control software so that the operator may customize control strategies and sequences of operation by defining the appropriate control loop algorithms and choosing the optimum loop parameters.
1. Control loops: Defined using "modules" that are analogous to standard control devices.
 2. Output: Paired or individual digital outputs for pulse-width modulation, and analog outputs, as required.
 3. Firmware:
 - a. PID with analog or pulse-width modulation output.

- b. Floating control with pulse-width modulated outputs.
 - c. Two-position control.
 - d. Primary and secondary reset schedule selector.
 - e. Hi/Lo signal selector.
 - f. Single pole double throw relay.
 - g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
- 4. Direct Digital Control loops: Downloaded upon creation or on operator request. On sensor failure, program shall execute user defined failsafe output.
 - 5. Display: Value or state of each of the lines which interconnect DDC modules.
- J. Fine Tuning Direct Digital Control PID or floating loops:
- 1. Display information:
 - a. Control loop being tuned
 - b. Input (process) variable
 - c. Output (control) variable
 - d. Setpoint of loop
 - e. Proportional band
 - f. Integral (reset) Interval
 - g. Derivative (rate) Interval
 - 2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" vs "variable".
- K. Trend logging:
- 1. Each control unit will store samples of control unit's data points.
 - 2. Update file continuously at discretely assignable intervals.
 - 3. Automatically initiate upload request and then store data on hard disk.
 - 4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
 - 5. Co-ordinate sampling with on/off state of specified point.
 - 6. Display trend samples on work station in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time vs data.

2.12 HVAC CONTROL PROGRAMS

- A. General:
- 1. Support Inch-pounds and SI (metric) units of measurement.
 - 2. Identify each HVAC Control system.
- B. Optimal Run Time:
- 1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
 - 2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
 - 3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
 - 4. Use outside air temperature to determine early shut down with ventilation override.
 - 5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
 - 6. Operator commands:
 - a. Define term schedule
 - b. Add/delete fan status point.
 - c. Add/delete outside air temperature point.

- d. Add/delete mass temperature point.
 - e. Define heating/cooling parameters.
 - f. Define mass sensor heating/cooling parameters.
 - g. Lock/unlock program.
 - h. Request optimal run time control summary.
 - i. Request optimal run time mass temperature summary.
 - j. Request HVAC point summary.
 - k. Request HVAC saving profile summary.
7. Control Summary:
- a. HVAC Control system begin/end status.
 - b. Optimal run time lock/unlock control status.
 - c. Heating/cooling mode status.
 - d. Optimal run time schedule.
 - e. Start/Stop times.
 - f. Selected mass temperature point ID.
 - g. Optimal run time system normal start times.
 - h. Occupancy and vacancy times.
 - i. Optimal run time system heating/cooling mode parameters.
8. Mass temperature summary:
- a. Mass temperature point type and ID.
 - b. Desired and current mass temperature values.
 - c. Calculated warm-up/cool-down time for each mass temperature.
 - d. Heating/cooling season limits.
 - e. Break point temperature for cooling mode analysis.
9. HVAC point summary:
- a. Control system identifier and status.
 - b. Point ID and status.
 - c. Outside air temperature point ID and status.
 - d. Mass temperature point ID and point.
 - e. Calculated optimal start and stop times.
 - f. Period start.
- C. Supply Air Reset:
- 1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
 - 2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
 - a. Raising cooling temperatures to highest possible value.
 - b. Reducing heating temperatures to lowest possible level.
 - 3. Operator commands:
 - a. Add/delete fan status point.
 - b. Lock/unlock program.
 - c. Request HVAC point summary.
 - d. Add/Delete discharge controller point.
 - e. Define discharge controller parameters.
 - f. Add/delete air flow rate.
 - g. Define space load and load parameters.
 - h. Request space load summary.
 - 4. Control summary:
 - a. HVAC control system status (begin/end).
 - b. Supply air reset system status.

- c. Optimal run time system status.
 - d. Heating and cooling loop.
 - e. High/low limits.
 - f. Deadband.
 - g. Response timer.
 - h. Reset times.
5. Space load summary:
- a. HVAC system status.
 - b. Optimal run time status.
 - c. Heating/cooling loop status.
 - d. Space load point ID.
 - e. Current space load point value.
 - f. Control heat/cool limited.
 - g. Gain factor.
 - h. Calculated reset values.
 - i. Fan status point ID and status.
 - j. Control discharge temperature point ID and status.
 - k. Space load point ID and status.
 - l. Air flow rate point ID and status.
- D. Enthalpy Switchover:
1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
 2. Operator commands:
 - a. Add/delete fan status point.
 - b. Add/delete outside air temperature point.
 - c. Add/delete discharge controller point.
 - d. Define discharge controller parameters.
 - e. Add/delete return air temperature point.
 - f. Add/delete outside air dew point/humidity point.
 - g. Add/delete return air dew point/humidity point.
 - h. Add/delete damper switch.
 - i. Add/delete minimum outside air.
 - j. Add/delete atmospheric pressure.
 - k. Add/delete heating override switch.
 - l. Add/delete evaporative cooling switch.
 - m. Add/delete air flow rate.
 - n. Define enthalpy deadband.
 - o. Lock/unlock program.
 - p. Request control summary.
 - q. Request HVAC point summary.
 3. Control summary:
 - a. HVAC control system begin/end status.
 - b. Enthalpy switchover optimal system status.
 - c. Optimal return time system status.
 - d. Current outside air enthalpy.
 - e. Calculated mixed air enthalpy.
 - f. Calculated cooling cool enthalpy using outside air.
 - g. Calculated cooling cool enthalpy using mixed air.
 - h. Calculated enthalpy difference.
 - i. Enthalpy switchover deadband.

- j. Status of damper mode switch.

2.13 PROGRAMMING APPLICATION FEATURES

- A. Trend Point:
 - 1. Sample up to 150 points, real or computed, with each point capable of collecting 100 samples at intervals specified in minutes, hours, days, or month.
 - 2. Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.
- B. Alarm Messages:
 - 1. Allow definition of minimum of 100 messages, each having minimum length of 100 characters for each individual message.
 - 2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
 - 3. Output assigned alarm with "message requiring acknowledgement".
 - 4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.
- C. Weekly Scheduling:
 - 1. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
 - 2. Provide program times for each day of week, per point, with one minute resolution.
 - 3. Automatically generate alarm output for points not responding to command.
 - 4. Provide for holidays, minimum of 366 consecutive holidays.
 - 5. Operator commands:
 - a. System logs and summaries.
 - b. Start of stop point.
 - c. Lock or unlock control or alarm input.
 - d. Add, delete, or modify analog limits and differentials.
 - e. Adjust point operation position.
 - f. Change point operational mode.
 - g. Open or close point.
 - h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
 - i. Begin or end point totalization.
 - j. Modify totalization values and limits.
 - k. Access or secure point.
 - l. Begin or end HVAC or load control system.
 - m. Modify load parameter.
 - n. Modify demand limiting and duty cycle targets.
 - 6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.
- D. Interlocking:
 - 1. Permit events to occur, based on changing condition of one or more associated master points.
 - 2. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.
 - 3. Operator commands:
 - a. Define single master/multiple master interlock process.
 - b. Define logic interlock process.

- c. Lock/unlock program.
- d. Enable/disable interlock process.
- e. Execute terminate interlock process.
- f. Request interlock type summary.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.02 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 09 93.
- C. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.
- D. Provide conduit and electrical wiring in accordance with Section 26 27 17. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- E. Ensure that all components necessary to execute the sequences of operation are coordinated and installed by all contractors.
- F. Contractor shall demolish and remove all existing control components, including but not limited to thermostats, pneumatic tabing, compressors, panels, and devices unless otherwise noted on the drawings. Demolition shall be coordinated on phased projects to maintain the existing system where needed until complete charge-over has been accomplished.

3.03 MANUFACTURER'SFIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Red Clay Consolidated School District's representative in operation of systems plant and equipment for 2 day period.
- C. Provide basic operator training for 4 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 8 hours dedicated instructor time. Provide training on site.

3.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Red Clay Consolidated School District.

3.05 SCHEDULES

- A. Input/Output Schedule:
 - 1. Point Description:
 - 2. Digital Input:
 - a. Demand Meter (kW):

- b. Auxiliary Contact:
 - c. Switches:
 - 1) Switch Closing:
 - 2) Flow Switch:
 - 3) Optical:
 - d. Current:
 - e. Pressure:
 - 3. Digital Output:
 - a. Control Relay:
 - b. Solenoid:
 - c. Contactor:
 - 4. Analog Input:
 - a. Temperature:
 - b. Relative Humidity:
 - c. Pressure/Vacuum:
 - d. Filter:
 - e. Flow:
 - f. Current:
 - g. Liquid Level:
 - h. Photocell:
 - 5. Analog Output:
 - a. Pneumatic Transducer:
 - b. 4-20 ma Module:
 - c. 0-16 v DC:
 - 6. Alarm:
- B. Input/Output Schedule:
- 1. Point Description:
 - 2. Inputs:
 - a. Temperature:
 - b. Relative Humidity:
 - c. Pressure:
 - d. Flow:
 - e. Level:
 - f. Position:
 - g. Energy:
 - h. Power:
 - 3. Outputs:
 - a. Status:
 - b. Alarm:
 - c. Pneumatic Position:
 - d. Electronic Position:
 - e. Set Point Adjust:
 - f. Start/Stop:
 - g. Off/Low/High:
 - 4. Software Features:
 - a. PID Control (DDC):
 - b. High Limit:
 - c. Low Limit:
 - d. Run Time Totalization:
 - e. Consumption Totalization:

- f. Program Start/Stop:
- g. Load Shed:
- h. Duty Cycle:
- i. Enthalpy Switchover:
- j. Optimal Run Time:
- k. Supply Air Reset:
- l. O.A. Interlock:
- m. O.A. Temperature Reset:
- n. Free Cooling Mode:
- o. Warm-up Mode:
- p. Boiler Interlock:
- q. Chiller Sequencing:
- r. Energy Calculation:

- C. Alarm Schedule:
 - 1. High Limit: A1.
 - 2. Low Limit: A2.
 - 3. Run Time: A3.
 - 4. Maintenance: A4.
 - 5. Status: A5.
 - 6. Override: A6.
 - 7. Freeze: A7.
 - 8. Low Pressure: A8.

END OF SECTION

SECTION 23 09 93**SEQUENCE OF OPERATIONS FOR HVAC CONTROLS**

BUILDING AUTOMATION SYSTEM/CONTROLS PACKAGE PURCHASED UNDER SEPARATE CONTRACT. CONTRACTOR SHALL PROVIDE ALL CONTROLS AND INTERCONNECTING WIRING FOR THE VARIABLE REFRIGERANT FLOW (VRF) SYSTEM AS REQUIRED IN THE SPECIFICATIONS. ALL HEAD-END EQUIPMENT, CONTROLLERS, WIRING, LABOR, AND SOFTWARE REQUIRED TO INTEGRATE THE VRF SYSTEM INTO THE B.A.S. AND PROVIDE CONTROLS FOR THE ENERGY RECOVERY VENTILATORS (ERV) AND PACKAGED ROOF-TOP MOUNTED AIR HANDLING UNITS (RTU) SHALL BE PROVIDED UNDER SEPARATE CONTRACT. VRF SEQUENCES OF OPERATION ARE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR.

1.01 PART 1 GENERAL

1.02 This section defines the general operating parameters for the Building Automation System purchased under separate contract by the Owner. It further defines the expected operating parameters of the VRF system as defined in specification section 23 81 29.

1.03 SECTION INCLUDES

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.
- B. Sequence of operation for:
 - 1. Packaged Rooftop Outdoor Air Units with Energy Recovery
 - 2. Kitchen Exhaust Hoods / Kitchen Ventilation Systems
 - 3. Variable Refrigerant Flow (VRF) Heat Pump Systems
 - 4. Radiation and convectors.
 - 5. Energy Recovery Ventilators/Supply Air Units

1.04 RELATED SECTIONS

- A. Section 23 09 23 - Direct-Digital Control System for HVAC.
- B. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
- C. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.05 SYSTEM DESCRIPTION

- A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
 - 1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.

2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
 3. Include at least the following sequences:
 - a. Start-up.
 - b. Warm-up mode.
 - c. Normal operating mode.
 - d. Unoccupied mode.
 - e. Shutdown.
 - f. Capacity control sequences and equipment staging.
 - g. Temperature and pressure control, such as setbacks, setups, resets, etc.
 - h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - i. Effects of power or equipment failure with all standby component functions.
 - j. Sequences for all alarms and emergency shut downs.
 - k. Seasonal operational differences and recommendations.
 - l. Interactions and interlocks with other systems.
 4. Include initial and recommended values for all adjustable settings, setpoints 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.
 5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
 6. Include schedules, if known.
- C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
1. Label with settings, adjustable range of control and limits.
 2. Include flow diagrams for each control system, graphically depicting control logic.
 3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
 5. Include all monitoring, control and virtual points specified in elsewhere.
 6. Include a key to all abbreviations.
- D. Points List: Submit list of all control points indicating at least the following for each point.
1. Name of controlled system.
 2. Point abbreviation.
 3. Point description; such as dry bulb temperature, airflow, etc.
 4. Display unit.
 5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
 6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
 7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.

8. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.
- E. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.07 QUALITY ASSURANCE

- A. Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in DE.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 General System Design and Operation Standards

- A. The BAS shall control the mechanical systems within the site based upon a variable refrigerant flow (VRF) heat pump system with central energy recovery ventilators supplying outdoor air to the terminal units. Large assembly spaces are served by packed DX cooling / gas fired heating rooftop units with energy recovery and hot-gas reheat-based dehumidification controls.
- B. Each unit shall be controlled by an individual DDC Controller and all required sensors, control valves, and appurtenances required to complete the sequence of operation. Units shall include occupied/unoccupied control, night-setback, morning warm-up/cool-down, and enthalpy-based economizer functions.

3.02 Kitchen Exhaust Hoods / Kitchen Make-Up Air Units

- A. Exhaust fans service Hoods shall be controlled manually via a hood-mounted control system.
- B. Provide a current sensor for each fan (supply and exhaust) to show operational status.
- C. The following items shall be displayed at the Operator's Terminal:
 1. Operational status of fan via current sensor.

3.03 Variable Refrigerant Volume Heat Pump Systems

- A. The variable refrigerant split system shall have a BAS DDC interface wired to the manufacturer factory central system controller to provide operation, configuration, and monitoring of the system. The manufacturer factory central controller shall operate in BACnet protocol, and be connected to manufacturer factory space temperature sensors as specified.
- B. Sequence of operation:
 1. Cooling Mode: Cooling mode shall be selected based on outdoor air temperatures or manually enabled or scheduled from the workstation. During the programmed occupied mode, the supply fan shall run continuously. On a rise in space temperature above the setpoint (75 degrees, adjustable), the manufacturer central controller shall energize the central compressor to provide cooling. The internal capacity control valve in the evaporator unit shall modulate to control the flow of refrigerant to maintain space temperature. On a fall in space temperature the refrigerant capacity control valve shall modulate closed.
 2. Heating Mode: Heating mode shall be selected based on outdoor air temperatures or manually enabled or scheduled from the workstation. During the programmed occupied mode, the supply fan shall run continuously. On a drop in space temperature below the setpoint (68 degrees, adjustable), the manufacturer central controller shall energize the central compressor to with the requisite reversing valve to provide heating to the evaporator unit as required. The internal capacity control valve in the evaporator unit shall modulate to

control the flow of refrigerant to maintain space temperature. On a fall in space temperature the refrigerant capacity control valve shall modulate closed.

3. The following items shall be accessible and displayed at the Operator's Terminal:
 - a. Space temperature setpoint at each fan-coil unit (user adjustable).
 - b. Actual space temperature of each fan-coil unit space.
 - c. Operational status of each fan-coil unit (heating, cooling, off, user adjustable).
 - d. Factory error codes from each unit.
 - e. Remote space temperature sensor override for each fan-coil unit (user adjustable to limit temperature adjustment range, heat/cool selection, fan speed).
 - f. Compressor Status
 - g. Accumulated Power Consumption
- C. Each terminal unit (fan coil) shall be controlled by the factory-provided wall-mounted controller. The controller shall be capable of allowing space temperature adjustment of +1 / -1 degrees (user adjustable).

3.04 Packaged Rooftop Units with Natural Gas Heat

- A. Each unit shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to a space temperature sensor, space-level CO2 sensor, discharge air temperature sensor, return air temperature sensor, space differential pressure sensor, damper motors, and the contacts to the factory-mounted unit control system controlling the compressor(s), hot-gas bypass, hot-gas reheat, and gas train combustion equipment.
- B. Cooling Mode:
 1. During the programmed occupied mode, the supply fan, return fan, and energy recovery wheel shall run continuously with the outside air damper open to the minimum position (10% outdoor air, adjustable). The amount of outside air will be increased above the minimum setting on a rise in the space CO2 level above the setpoint of 1000 PPM (adjustable) up to the code required minimum O/A (see schedule). On a return to the CO2 level setpoint the reverse shall occur. On a rise in temperature above the programmed cooling setpoint (adjustable), the following shall occur, in order, and to the extent necessary:
 - a. The DX cooling system shall be engaged. The compressors and hot-gas bypass system shall modulate as necessary to meet the cooling demands of the space and the discharge air temperature setpoint (adjustable).
 - b. When dehumidification is required as sensed by the factory-provided humidistat (setpoint, 60% RH, adjustable), the hot-gas reheat system will be engaged and follow the factory-programmed sequence.
 - c. Upon a fall in space temperature the reverse shall occur.
 2. The factory-provided VFD shall modulate the speed of the energy recovery wheel as required to maintain optimal performance as the outdoor air levels vary with the CO2 levels within the space.
 3. For units equipped with an outdoor air economizer: The DDC Controller shall receive input from the Global Enthalpy Sensor. If the enthalpy of the outdoor air is lower than the defined minimum level (user adjustable) the economizer sequence shall be activated upon a call for cooling. This sequence shall include opening the outside air damper up to 100%, opening the outside air. This shall be done for each unit that is in operation. The outside air damper shall never close past the minimum position during the occupied period.
- C. Heating Mode:

1. During the programmed occupied mode, the supply fan and return fan (if equipped) shall run continuously with the outside air damper open to the minimum position (10% outdoor air, adjustable). The amount of outside air will be increased above the minimum setting on a rise in the space CO2 level above the setpoint of 1000 PPM (adjustable). On a return to setpoint the reverse shall occur. On a drop in temperature below the programmed heating setpoint, the following shall occur, in order, and to the extent necessary:
 - a. The factory-mounted controller shall command the gas-train to ignite and provide heating. The gas-train shall modulate from its lowest to highest setting depending on demand.
 - b. When dehumidification is required as sensed by the factory-provided humidistat (setpoint, 60% RH, adjustable), the hot-gas reheat system will be engaged and follow the factory-programmed sequence.
 - c. Upon a rise in space temperature the reverse shall occur.
 2. The factory-provided VFD shall modulate the speed of the energy recovery wheel as required to maintain optimal performance as the outdoor air levels vary with the CO2 levels within the space.
- D. Unoccupied Mode:
1. During the programmed un-occupied mode, the supply fan, compressor, gas train, and dampers shall be cycled / modulated to maintain the un-occupied setpoints (55 degrees in Heating mode, 80 degrees in Cooling mode, both adjustable). Unless required for economizer cycle, the outside air damper shall remain closed.
- E. All setpoints and shall be adjustable at the BAS workstation.
- F. Provide a current sensor on one phase of power feeding each supply fan, exhaust fan, heat wheel, and compressor for status indication at the Operator's Terminal.
- G. If the discharge temperature fails to rise to a programmed minimum temperature during a call for heating; a low temperature alarm shall be activated at the Operator's Terminal. If the discharge temperature fails to fall to a programmed minimum temperature on a call for mechanical cooling, a high temperature alarm shall be activated at the Operator's Terminal.
- H. The following items shall be displayed at the Operator's Terminal:
1. Space temperature.
 2. Space temperature setpoint.
 3. Space humidity.
 4. Space humidity setpoint.
 5. Low Space temperature alarm.
 6. High Space temperature alarm.
 7. Discharge air temperature.
 8. Discharge air temperature setpoint.
 9. Return air temperature.
 10. Outside air temperature, humidity and enthalpy.
 11. Economizer enthalpy setpoint.
 12. Space CO2 level.
 13. Space CO2 level setpoint.
 14. Space high CO2 level alarm: "1500 PPM", adjustable.
 15. Supply fan operational status via current sensor.
 16. Commanded status of supply fan.
 17. Exhaust fan operational status via current sensor.
 18. Commanded status of exhaust fan.

19. Heat Wheel operational status via current sensor.
20. Commanded status of heat wheel.
21. Commanded status of compressor(s).
22. Commanded status of gas-train.
23. Commanded position of dampers.
24. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

3.05 Electric Resistance Radiant and Convective Heating Units

- A. The electric-resistance radiant and convective heating units shall be controlled by a self contained, unit mounted controller with remote sensing element.

3.06 UNIT HEATERS

- A. Each unit shall be controlled by an individual DDC controller and space temperature sensor. Single temperature room temperature sensor maintains constant space temperature of 68 degrees F by cycling unit fan motor and gas train.
- B. The factory gas train shall control all integral combustion components and safeties for the system.
- C. Provide room temperature setpoint and actual space temperature readings at the BAS head-end.

3.07 Supply Air Units and Energy Recovery Ventilators (ERV)

- A. Supply air units and ERV's shall be scheduled for occupied and unoccupied cycles based on an operator adjustable time schedule. Units may also be manually enabled and disabled at the operator workstation. Fan status shall be monitored by the BAS via the fans current sensing relay.
- B. The variable frequency drives shall be set by the balancer to deliver the minimum outdoor air to each associated terminal unit under fully-occupied conditions.
- C. When any heat pump in the area served by the heat recovery unit is in the occupied mode the unit shall be energized.
 1. The unit exhaust and outside air isolation dampers shall open.
 2. Provide proof of airflow for each fan and provide fan failure alarms.
 3. Provide temperature indication of the supply and exhaust inlet and leaving air.
 4. For units over 2,000 cfm a duct smoke detector shall be provided by the electrical contractor. Provide the interlock wiring to shut down the units upon activation.
 5. The electric heating coil shall be energized when required to maintain a minimum discharge air (supply air) temperature of 60 degrees to the units.
- D. The following items shall be displayed at the operators workstation:
 1. Discharge temperature.
 2. Return air temperature.
 3. Outside air temperature, humidity and enthalpy.
 4. Fan operational status via current sensor.
 5. Commanded status of fan.
 6. Commanded status of heating coils (as applicable).
 7. Commanded status of gas-train (as applicable).
 8. Commanded position of dampers.
 9. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

END OF SECTION

SECTION 23 09 13**INSTRUMENTATION AND CONTROL DEVICES FOR HVAC****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Thermostats, Temperature Sensors.
- B. Automatic dampers.
- C. Damper operators.
- D. Miscellaneous accessories.

1.02 RELATED REQUIREMENTS

- A. Section 23 21 13 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, gage taps.
- B. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.
- C. Section 23 09 23 - Direct-Digital Control System for HVAC.
- D. Section 23 09 93 - Sequence of Operations for HVAC Controls.

1.03 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods for Testing Dampers for Rating; Air Movement and Control Association International, Inc..
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- C. ASTM B32 - Standard Specification for Solder Metal.
- D. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- E. ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Manufacturer's Instructions: Provide for all manufactured components.

- E. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - 1. Revise shop drawings to reflect actual installation and operating sequences.
- F. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Red Clay Consolidated School District's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in DE.

PART 2 PRODUCTS

2.01 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.02 CONTROL VALVES

- A. Globe Pattern:
 - 1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
 - a. Product:
 - 1) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
 - a. Product:
 - 1) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Hydronic Systems:
 - a. Rate for service pressure of 125 psig at 250 degrees F.
 - b. Replaceable plugs and seats of stainless steel.
 - c. Size for 3 psig maximum pressure drop at design flow rate.
 - d. Two way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two way valve operators to close valves against pump shut off head.
 - 4. Steam Systems:
 - a. Rate for service pressure of 125 psig at 250 degrees F.
 - b. Replaceable plugs and seats of stainless steel. Pressure drop across any steam valve at maximum flow shall be as shown on the Drawings.
 - c. Size for 10 psig inlet pressure and 5 psig pressure drop.
 - d. Valves shall have modified linear characteristics.
- B. Butterfly Pattern:
 - 1. Iron body, bronze disc, resilient replaceable seat for service to 180 degrees F wafer or lug ends, extended neck.
 - 2. Hydronic Systems:
 - a. Rate for service pressure of 125 psig at 250 degrees F.

- b. Size for 1 psig maximum pressure drop at design flow rate.
- C. Electronic Actuators:
 - 1. 24 V powered, 4-20 mA proportional signal electronic actuator for valves and dampers.
 - 2. Actuators shall spring return to normal open position as indicated on freeze, fire, or temperature protection.
 - 3. Select operator for full shut off at maximum pump differential pressure.

2.03 DAMPERS

- A. Performance: Test in accordance with AMCA 500-D.
- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage.
- C. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, attached to minimum 1/2 inch shafts with set screws.
- D. Blade Seals: Synthetic elastomeric inflatable mechanically attached, field replaceable.
- E. Jamb Seals: Spring stainless steel.
- F. Shaft Bearings: Oil impregnated sintered bronze.
- G. Linkage Bearings: Oil impregnated sintered bronze.
- H. Leakage: Less than one percent based on approach velocity of 2000 ft/min and 4 inches wg.
- I. Maximum Pressure Differential: 6 inches wg.
- J. Temperature Limits: -40 to 200 degrees F.

2.04 DAMPER OPERATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - 2. Provide one operator for maximum 36 sq ft damper section.
- B. Electric Operators:
 - 1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

2.05 INPUT/OUTPUT SENSORS

- A. Temperature Sensors:
 - 1. Sensor range shall provide a resolution of no worse than .4°F (unless noted otherwise).
 - 2. Room temperature sensor shall be an element contained within a ventilated cover, suitable for wall mounting with digital output. Sensors located in mechanical areas, plenums, garages, gymnasiums, or designated institutional locations shall be a flat plate sensor with no possible adjustment or shall be provided with aesthetically-pleasing lockable protective cover. Security screws shall be used in institutional settings as deemed necessary by the design engineer. ATC contractor shall coordinate requirements with the design engineer during the submittal process. Provide insulated base. Following sensing elements are acceptable:
 - a. Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

- b. Units shall be capable of +/- 2 degrees (F) adjustment by the occupant, with display showing current temperature and setpoint.
 3. Single point duct temperature sensor shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 316 stainless steel.
 - a. Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
 4. Averaging duct temperature sensor shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide enough sensors to give one lineal foot of sensing element for each square foot of cooling coil face area. Temperature range as required for resolution indicated in paragraph A.
 - a. Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
 5. Liquid immersion temperature sensor shall include stainless steel thermowell, sensor and connection head for wiring connections.
 - a. Sensing element for chilled water applications - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point. Temperature range shall be as required for resolution indicated in paragraph A.
 - b. Sensing element for non-chilled water applications - Platinum RTD, +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of no worse than 0.1°F.
- B. Equipment Operation Sensors:
 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 psi.
 3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- C. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.
- D. Carbon Dioxide Level Sensors:
 1. Wall or duct-mounted as required by control sequence or plans.
 2. Demand-control ventilation sensor for measuring and transmitting CO2 levels ranging from 0-2,000 ppm.
 3. Single-beam, dual-wavelength design with five-year stability for calibration..
 4. Proportional output, 4-20 mA signal.

2.06 THERMOSTATS

- A. Line Voltage Thermostats:
 1. Integral manual On/Off/Auto selector switch, single or two pole as required.
 2. Dead band: Maximum 2 degrees F.
 3. Cover: Locking with set point adjustment, with thermometer.
 4. Rating: Motor load.
- B. Outdoor Reset Thermostat:
 1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
 2. Scale range: -10 to 70 degrees F.
- C. Immersion Thermostat:

1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
- D. Airstream Thermostats:
1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 2. Averaging service remote bulb element: 7.5 feet.
- E. Electric Low Limit Duct Thermostat:
1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
 2. Bulb length: Minimum 20 feet.
 3. Provide one thermostat for every 20 sq ft of coil surface.
- F. Electric High Limit Duct Thermostat:
1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
 2. Bulb length: Minimum 20 feet.
 3. Provide one thermostat for every 20 sq ft of coil surface.
- G. Fire Thermostats:
1. UL labeled, factory set in accordance with NFPA 90A.
 2. Normally closed contacts, manual reset.
- H. Heating/Cooling Valve Top Thermostats:
1. Proportional acting for proportional flow, molded rubber diaphragm, remote bulb liquid filled element, direct and reverse acting at differential pressure to 25 psig, cast housing with position indicator and adjusting knob.

2.07 TRANSMITTERS

- A. Pressure Transmitters:
1. One pipe direct acting indicating type for gas, liquid, or steam service, range suitable for system, proportional electronic output.
- B. Temperature Transmitters:
1. One pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2 percent of range for 200 degree F span and plus or minus 1 percent for 50 degree F span, with 50 degrees F temperature range, compensated bulb, averaging capillary, or rod and tube operation on 20 psig input pressure and 3 to 15 psig output.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.

- G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches above floor. Align with lighting switches, CO2 sensors, and humidistats. Refer to Section 26 27 26.
- C. Mount freeze protection thermostats using flanges and element holders.
- D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- E. Provide separable sockets for liquids and flanges for air bulb elements.
- F. Provide thermostats in aspirating boxes in front entrances.
- G. Provide guards on thermostats in entrances.
- H. Provide valves with position indicators and with pilot positioners where sequenced with other controls.
- I. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
- J. Provide isolation (two position) dampers of parallel blade construction.
- K. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- L. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- M. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- N. Provide conduit and electrical wiring in accordance with Section 26 27 17. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.03 MAINTENANCE

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.

END OF SECTION

SECTION 23 23 00**REFRIGERANT PIPING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure relief valves.
- H. Filter-driers.
- I. Solenoid valves.
- J. Expansion valves.
- K. Receivers.
- L. Flexible connections.

1.02 RELATED REQUIREMENTS

- A. Section 08 31 00 - Access Doors and Panels.
- B. Section 09 90 00 - Painting and Coating.
- C. Section 22 07 19 - Plumbing Piping Insulation.
- D. Section 22 07 16 - Plumbing Equipment Insulation.
- E. Section 23 54 00 - Furnaces.
- F. Section 23 61 00 - Refrigerant Compressors.
- G. Section 23 62 13 - Packaged Air-Cooled Refrigerant Compressor and Condenser Units.
- H. Section 23 63 13 - Air Cooled Refrigerant Condensers.
- I. Section 23 81 24 - Computer Room Air Conditioners - Floor Mounted.
- J. Section 23 82 16 - Air Coils.
- K. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- L. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; Air-Conditioning, Heating, and Refrigeration Institute.

- B. AHRI 710 - Performance Rating of Liquid-Line Driers; Air-Conditioning, Heating, and Refrigeration Institute.
- C. AHRI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Driers; Air-Conditioning, Heating, and Refrigeration Institute.
- D. AHRI 750 - Standard for Thermostatic Refrigerant Expansion Valves; Air-Conditioning, Heating, and Refrigeration Institute.
- E. AHRI 760 - Standard for Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; Air-Conditioning, Heating, and Refrigeration Institute.
- F. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ANSI/ASHRAE Std 15).
- G. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..
- H. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers.
- I. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers.
- J. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- K. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes; The American Society of Mechanical Engineers.
- L. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers.
- M. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.9).
- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- P. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- Q. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- R. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- S. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- T. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- U. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- V. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

- W. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- X. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- Y. UL 429 - Electrically Operated Valves; Underwriters Laboratories Inc..

1.04 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with MSS SP-69 unless indicated otherwise.
- C. Liquid Indicators:
 - 1. Use line size liquid indicators in main liquid line leaving condenser.
 - 2. If receiver is provided, install in liquid line leaving receiver.
 - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
 - 1. Use service valves on suction and discharge of compressors.
 - 2. Use gage taps at compressor inlet and outlet.
 - 3. Use gage taps at hot gas bypass regulators, inlet and outlet.
 - 4. Use check valves on compressor discharge.
 - 5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
 - 1. Use line size strainer upstream of each automatic valve.
 - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 - 3. On steel piping systems, use strainer in suction line.
 - 4. Use shut-off valve on each side of strainer.
- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Filter-Driers:
 - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
 - 2. Use a filter-drier on suction line just ahead of compressor.
 - 3. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.
 - 4. Use sealed filter-driers in low temperature systems.
 - 5. Use sealed filter-driers in systems utilizing hermetic compressors.
 - 6. Use replaceable core filter-driers in lines of 1/2 inch outside diameter or greater.
 - 7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
 - 8. Use filter-driers for each solenoid valve.
- I. Solenoid Valves:
 - 1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
 - 2. Use in liquid line of single or multiple evaporator systems.

3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
- J. Receivers:
1. Use on systems five tons and larger, sized to accommodate pump down charge.
 2. Use on systems with long piping runs.
- K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.05 SUBMITTALS

- A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- C. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of leak test, acid test.
- E. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
- F. Submit welders certification of compliance with ASME (BPV IX) or AWS D1.1.
- G. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- H. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.
- B. Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work.
- C. Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in DE.

1.07 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME (BPV IX) or AWS D1.1.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.

- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

1.09 MAINTENANCE PRODUCTS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Provide two refrigeration oil test kits each containing everything required to conduct one test.
- C. Provide two filter-dryer cartridges of each type.

PART 2 PRODUCTS

2.01 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
 - 1. Fittings: ASME B16.26 cast copper.
 - 2. Joints: Flared.
- C. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Welded in accordance with AWS D1.1.
- D. Steel Pipe Sizes 12 Inch and Over: ASTM A53/A53M, 0.375 inch wall, black.
 - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
 - 2. Joints: Welded in accordance with AWS D1.1.
- E. Pipe Supports and Anchors:
 - 1. Conform to ASTM F 708, MSS SP-58, MSS SP-69, and MSS SP-89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
 - 10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
 - 11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.02 REFRIGERANT

- A. Refrigerant: See Schedules

2.03 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers:

1. Henry Technologies: www.henrytech.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan Valve Company: www.sporlan.com.
- B. Indicators: Single or Doubleport type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.04 VALVES

- A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com.
 2. Henry Technologies: www.henrytech.com.
 3. Danfoss Flomatic: www.flomatic.com.
- B. Diaphragm Packless Valves:
1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Packed Angle Valves:
1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- D. Ball Valves:
1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
- E. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.05 STRAINERS

- A. Straight Line or Angle Line Type:
1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.
- B. Straight Line, Non-Cleanable Type:
1. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of 500 psi.

2.06 CHECK VALVES

- A. Manufacturers:
1. Hansen Technologies Corporation: www.hantech.com.
 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 3. Sporlan Valve Company: www.sporlan.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Globe Type:
1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for

maximum temperature of 300 degrees F and maximum working pressure of 500 psi.

- C. Straight Through Type:
 - 1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.07 PRESSURE REGULATORS

- A. Manufacturers:
 - 1. Hansen Technologies Corporation: www.hantech.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sporlan Valve Company: www.sporlan.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

2.08 PRESSURE RELIEF VALVES

- A. Manufacturers:
 - 1. Hansen Technologies Corporation: www.hantech.com.
 - 2. Henry Technologies: www.henrytech.com.
 - 3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 425 psi, adjusted to meet system requirements.

2.09 FILTER-DRIERS

- A. Manufacturers:
 - 1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sporlan Valve Company: www.sporlan.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Performance:
 - 1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710.
 - 2. Flow Capacity - Suction Line: As indicated in schedule, minimum, rated in accordance with AHRI 730.
 - 3. Water Capacity: As indicated in schedule, rated in accordance with AHRI 710.
 - 4. Pressure Drop: 2 psi, As indicated in schedule, maximum, when operating at full connected evaporator capacity.
 - 5. Design Working Pressure: As indicated in schedule or 350 psi, minimum.
- C. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns; of construction that will not pass into refrigerant lines.
- D. Construction: UL listed.
 - 1. Replaceable Core Type: Steel shell with removable cap.
 - 2. Sealed Type: Copper shell.
 - 3. Connections: As specified for applicable pipe type.

2.10 SOLENOID VALVES

- A. Manufacturers:
 - 1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sporlan Valve Company: www.sporlan.com.
- B. Valve: AHRI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.
- C. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.
- D. Electrical Characteristics: per drawings.

2.11 EXPANSION VALVES

- A. Manufacturers:
 - 1. Flow Controls Division of Emerson Electric: www.emersonflowcontrols.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sporlan Valve Company: www.sporlan.com.
- B. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, mechanical pressure limit (maximum operating pressure MOP feature), adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.12 ELECTRONIC EXPANSION VALVES

- A. Manufacturers:
 - 1. Danfoss Automatic Controls: www.danfoss.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sporlan Valve Company: www.sporlan.com.
- B. Valve:
 - 1. Brass body with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
 - 2. Capacity: per drawings.
 - 3. Electrical Characteristics: per drawings.
- C. Evaporation Control System:
 - 1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
 - 2. Electrical Characteristics: per drawings.
- D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

2.13 RECEIVERS

- A. Manufacturers:
 - 1. Henry Technologies: www.henrytech.com.
 - 2. Parker Hannifin/Refrigeration and Air Conditioning: www.parker.com.
 - 3. Sherwood Valve/Harsco Corporation: www.sherwoodvalve.com.
- B. Internal Diameter 6 inch and Smaller:
 - 1. AHRI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- C. Internal Diameter Over 6 inch:
 - 1. AHRI 495, welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

2.14 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Circuit Hydraulics, Ltd: www.circuit-hydraulics.co.uk.
 - 2. Flexicraft Industries: www.flexicraft.com.
 - 3. Penflex: www.penflex.com.
- B. Corrugated stainless steel or bronze hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of or recessed into

and grouted flush with slab.

- G. Pipe Hangers and Supports:
 - 1. Install in accordance with ASTM F 708 and MSS SP-89.
 - 2. Support horizontal piping as scheduled.
 - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
 - 4. Place hangers within 12 inches of each horizontal elbow.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper plated hangers and supports for copper piping.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 31 00.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- N. Insulate piping and equipment; refer to Section 22 07 19 and Section 22 07 16.
- O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- T. Fully charge completed system with refrigerant after testing.
- U. Provide electrical connection to solenoid valves. Refer to Section 26 27 17.

3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using electronic leak detector. Test to no leakage.

3.04 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
 - 1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 3/8 inch.

2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 3/8 inch.
 3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
 9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- B. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. 4 inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.

END OF SECTION

SECTION 23 31 00**HVAC DUCTS AND CASINGS****PART 1 GENERAL****1.01 SPECIAL NOTE - This specification includes details for an ALTERNATE as defined in the Bid Form for this project. It is as follows:**

- A. BASE BID - Contractor shall provide KoolDuct fabricated ductwork systems for all CONCEALED DUCTWORK ONLY.
- B. ALTERNATE BID - Contractor shall provide metal ductwork with external insulation as indicated in the specifications.

1.02 SECTION INCLUDES

- A. Metal ductwork.
- B. Nonmetal ductwork.
- C. Casing and plenums.
- D. Kitchen hood ductwork.
- E. Duct cleaning.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 09 90 00 - Painting and Coating: Weld priming, weather resistant, paint or coating.
- C. Section 11 40 00 - Foodservice Equipment: Supply of kitchen range hoods for placement by this Section.
- D. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- E. Section 23 33 00 - Air Duct Accessories.
- F. Section 23 36 00 - Air Terminal Units.
- G. Section 23 37 00 - Air Outlets and Inlets.
- H. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.04 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

- E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- H. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
- I. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe [Metric].
- J. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- K. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
- L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- M. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.
- N. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.
- O. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association.
- P. SMACNA (DCS) - HVAC Duct Construction Standards.
- Q. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association.
- R. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc..

1.05 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for duct materials and duct connections.
- C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.
- E. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed

recommended fabrication and installation requirements.

- F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.08 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.

1.09 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

2.02 MATERIALS

- A. **ALTERNATE CONCEALED DUCT MATERIAL:** Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
- C. **BASE BID CONCEALED DUCT MATERIAL:** KoolDuct Fabricated Ductwork System:
 1. The panels used in the fabrication of ductwork from the Kingspan KoolDuct System shall be Kingspan KoolDuct rigid phenolic insulation panels of nominal dimensions 9.68 ft x 3.94 ft or 12.89 ft x 3.94 ft and minimum compressive strength 29 psi, as manufactured by Kingspan Insulation Ltd and detailed in App. A1.
 2. Kingspan KoolDuct rigid phenolic insulation panels shall comprise a 3.4-3.75 pcf nominal density CFC/HCFC-free rigid phenolic insulation core with zero Ozone Depletion Potential (ODP), autohesively bonded on both sides to a 1 mil low vapour permeability aluminium foil facing reinforced with a 0.2" glass scrim.
 3. Kingspan KoolDuct rigid phenolic insulation panels are available in thicknesses of 7/8", 1 3/16" and 1 5/16". For determination of the thickness required to achieve a specified thermal performance refer to App. A2.
 4. All other components required for the fabrication of ductwork from the Kingspan KoolDuct System including the silicone sealant, contact adhesive, aluminium tape, self-adhesive gasket, ductwork reinforcements, closures, connectors and flanges shall be as approved / supplied by Kingspan Insulation Ltd.
 5. Fire & Smoke Performance
 6. The rigid phenolic insulation panels used in the fabrication of ductwork and / or ductwork sections fabricated from the Kingspan KoolDuct System shall achieve the following fire and smoke performance requirements:
 - a. ASTM E 84-08a - unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke

Developed indices;

- b. UL 723 - unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke Developed indices; and
 - c. UL 181 - UL/ULC classification as a Class 1 Air Duct to NFPA Standards 90A & 90B.
 - d. Fabrication of Ductwork
7. All ductwork fabricated from the Kingspan KoolDuct System shall be fabricated in accordance with methods as approved Kingspan Insulation Ltd.
 8. Air Leakage
 9. Ductwork system air leakage shall be in accordance with the requirements of the relevant jurisdiction. (Consult the DOE (US Department of Energy) ComCheck / ResCheck or the relevant authority for applicable codes / standards).
 - a. Ductwork installations are required to be made sufficiently airtight to ensure quiet and economical operation of the system. The SMACNA HVAC Air Duct Leakage Test Manual, ANSI / ASHRAE / IESNA 90.1: 2007 and IECC 2003 & 2006 are referred to in many, but not all, specifications in order to determine the air leakage limits for ductwork systems.
 - b. Ductwork sections fabricated from the Kingspan KoolDuct System shall not exceed permitted air leakage limits as follows:
 - c. ANSI / ASHRAE / IESNA 90.1 and IECC 2003 & 2006 section 503.2.7
 - d. The maximum allowable air leakage for all Class 6 (CL6) rectangular ducts is 6 x P0.65 as defined by
 - e. SMACNA HVAC Air Duct Leakage Test Manual
 10. All internal seams must be fully sealed with an unbroken layer of silicone sealant.
 11. Each ductwork section must be duly connected with a jointing system approved Kingspan Insulation Ltd., and sufficient silicone sealant should be applied in order to seal the rigid phenolic insulation panel and ensure minimum air leakage.
 12. Ductwork reinforcement, if necessary, shall be applied to protect against side deformation from both positive and negative pressure.
 13. All external seams where two separate panels join must be taped to achieve a permanent bond and a smooth wrinkle free appearance.
 14. The design of ductwork fittings shall be in conformance with the The ASHRAE Design Fundamentals Handbook Chapter 35 or SMACNA HVAC Duct System Design Manual.
 - 15.
- D. Insulated Flexible Ducts:
1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
 - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - b. Maximum Velocity: 4000 fpm.
 - c. Temperature Range: -10 degrees F to 160 degrees F.
- E. **BASE BID:**All concealed ducts: Galvanized steel, unless otherwise indicated.
- F. **ALTERNATE PRICING** All Concealed Ducts: Galvanized steel, unless otherwise indicated.
- G. Low Pressure Supply (Heating Systems): 1/2 inch w.g. pressure class, galvanized steel or KoolDuct in concealed spaces.
- H. Low Pressure Supply (System with Cooling Coils): 1/2 inch w.g. pressure class, galvanized steel or KoolDuct in concealed spaces.
- I. Return and Relief: 1/2 inch w.g. pressure class, galvanized steel or KoolDuct.
- J. General Exhaust: 1/2 inch w.g. pressure class, galvanized steel or KoolDuct.

- K. Kitchen Cooking Hood Exhaust: 1/2 inch w.g. pressure class, stainless steel.
 - 1. Asphalt base.
 - 2. Construct of 18 gage stainless steel using continuous external welded joints in rectangular sections.
- L. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
- M. Grease Exhaust: 1/2 inch w.g. pressure class, stainless steel.
 - 1. Construct of ASTM A1011/A1011M 16 gage un-galvanized steel.
 - 2. Construction:
 - a. Liquid tight with continuous external weld for all seams and joints.
 - b. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
 - 3. Access Doors:
 - a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction.
 - b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.
 - 4. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.
- N. Outside Air Intake: 1/2 inch w.g. pressure class, galvanized steel or KoolDuct.
- O. Hanger Rod: ASTM A 36/A 36M; steel; threaded both ends, threaded one end, or continuously threaded.

2.03 METAL DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide turning vanes. .
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.
- F. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

- H. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Double Wall Insulated Round Ducts: Round spiral lockseam duct with paintable galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall. Provide paint in color selected by architect.
 - 1. Manufacture in accordance with SMACNA HVAC Duct Construction Standards.
 - 2. Insulation:
 - a. Thickness: 1 inch.
 - b. Material: Fiberglass, with mylar coating between insulation and perforated liner.
- C. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.
 - 1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 - 2. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 - 3. Maximum Velocity: 4000 fpm.
 - 4. Temperature Range: -10 degrees F to 160 degrees F.
- D. Transverse Duct Connection System: SMACNA "J" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.
 - 1. Manufacturers:

2.05 CASINGS

- A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- D. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
 - 1. Provide clear wire glass observation ports, minimum 6 X 6 inch size.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.
- B. Install in accordance with manufacturer's instructions.

- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- H. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- I. Use double nuts and lock washers on threaded rod supports.
- J. Tape joints of PVC coated metal ductwork with PVC tape.
- K. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- L. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- M. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- N. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- O. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.
- P. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- Q. At exterior wall louvers, seal duct to louver frame and install blank-out panels as required.
- R. KoolDuct installation - Additional Notes:
 - 1. Ductwork sections fabricated from the Kingspan KoolDuct System shall be installed in accordance with methods approved by Kingspan Insulation Ltd.
 - 2. The ductwork system shall be visually inspected before commencement of operation and ductwork sections fabricated from the Kingspan KoolDuct System shall be verified as having been installed correctly.
 - 3. Flexible connections shall be made between the ductwork and any item which is subject to vibration or movement.
 - 4. Support
 - a. It shall be the responsibility of the installer to ensure that the ductwork system is properly and adequately supported. A number of support systems are approved for use by Kingspan Insulation Ltd. It shall be the responsibility of the installer to ensure that the chosen method of support is compatible with ductwork fabricated from the Kingspan KoolDuct System.
 - b. With the exception of Tiger Supports, all metal support members in contact with the ductwork shall be separated by a soft gasket material.

- c. Supports on straight runs of ductwork fabricated from the Kingspan KoolDuct System shall be positioned at centres not exceeding 10 ft for ductwork sections fabricated in 10 ft lengths, and 13 ft for ductwork sections fabricated in 13 ft lengths.
 - d. Additionally, ductwork shall be supported at changes of direction, at branch duct connections, tee fittings and etc.
 - e. All ductwork accessories such as dampers shall be independently supported.
5. Internal Ductwork
- a. All internal and exposed to view ductwork fabricated from Kingspan KoolDuct System may be provided with a protective finish in addition to the factory applied reinforced aluminium facing. The finish shall be either:
 - 1) aluminium / zinc alloy coated sheet steel (0.024") which can be introduced during fabrication of the ductwork or installed in place; or
 - 2) a suitable paint finish (must not compromise factory applied reinforced aluminium facing or fire classification) applied in place.

3.02 RANGE HOOD EXHAUST DUCT INSTALLATIONS

- A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F temperature range.
- B. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.
- C. Install ducts without dips or traps that may collect residues, unless traps have continuous or automatic residue removal.
- D. Install access openings at each change in direction and at 50-foot intervals; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- E. Do not penetrate fire-rated assemblies.

3.03 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.04 SCHEDULES

- A. Ductwork Material:
 - 1. Low Pressure Supply (Heating Systems): Steel, Aluminum, KoolDuct.
 - 2. Low Pressure Supply (System with Cooling Coils): Steel, Aluminum, KoolDuct
 - 3. Return and Relief: Steel, Aluminum, KoolDuct.
 - 4. General Exhaust: Steel, Aluminum, KoolDuct.
 - 5. Outside Air Intake: Steel, KoolDuct.
 - 6. Exposed round ductwork in all areas: Double-walled spiral.
- B. Ductwork Pressure Class:
 - 1. Supply (Heating Systems): 1 inch
 - 2. Supply (System with Cooling Coils): 2 inch.
 - 3. Return and Relief: 1 inch.
 - 4. General Exhaust: 1 inch.
 - 5. Outside Air Intake: 1 inch.

END OF SECTION

SECTION 23 33 00**AIR DUCT ACCESSORIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Backdraft dampers.
- D. Combination fire and smoke dampers.
- E. Duct access doors.
- F. Duct test holes.
- G. Fire dampers.
- H. Flexible duct connections.
- I. Smoke dampers.
- J. Volume control dampers.

1.02 RELATED REQUIREMENTS

- A. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 23 31 00 - HVAC Ducts and Casings.
- C. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.
- D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- B. NFPA 92 - Standard for Smoke-Control Systems.
- C. NFPA 92A - Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences.
- D. SMACNA (DCS) - HVAC Duct Construction Standards.
- E. UL 33 - Heat Responsive Links for Fire-Protection Service; Underwriters Laboratories Inc..
- F. UL 555 - Standard for Fire Dampers; Underwriters Laboratories Inc..
- G. UL 555S - Standard for Leakage Rated Dampers for Use in Smoke Control Systems; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

1.05 PROJECT RECORD DOCUMENTS

- A. Record actual locations of access doors and test holes.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

1.08 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Provide two of each size and type of fusible link.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Krueger: www.krueger-hvac.com.
 - 2. Ruskin Company: www.ruskin.com.
 - 3. Titus: www.titus-hvac.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 BACKDRAFT DAMPERS - METAL

2.03 BACKDRAFT DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Greenheck Fan Corporation: www.greenheck.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

2.04 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Greenheck Fan Corporation: www.greenheck.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.
- E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- G. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- H. Electro Thermal Link: Fusible link melting at 165 degrees F; 24 volts, UL listed and labeled.

2.05 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Nailor Industries Inc: www.nailor.com.
 - 2. Ruskin Company: www.ruskin.com.
 - 3. SEMCO Incorporated: www.semcoinc.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less Than 12 inches Square: Secure with sash locks.
 - 2. Up to 18 inches Square: Provide two hinges and two sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.
- D. Access doors with sheet metal screw fasteners are not acceptable.

2.06 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.07 FIRE DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Greenheck Fan Corporation: www.greenheck.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
- D. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations or closure under air flow conditions. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.
- F. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- G. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.08 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
 - a. Net Fabric Width: Approximately 6 inches wide.
 - 2. Metal: 3 inches wide, 24 gage thick galvanized steel.
- C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.09 SMOKE DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Greenheck Fan Corporation: www.greenheck.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 multiple blade type fire damper, normally closed automatically operated by electric actuator.

- D. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

2.10 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc: www.louvers-dampers.com.
 - 2. Nailor Industries Inc: www.nailor.com.
 - 3. Ruskin Company: www.ruskin.com.
 - 4. Greenheck Fan Corporation: www.greenheck.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- C. Splitter Dampers:
 - 1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
 - 2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.
 - 3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .
- D. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.

- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
 - 1. Smoke dampers shall be integrated into the "smoke purge control system". Dampers in the return ductwork shall be overridden to the open position when the smoke purge is activated.
- G. Demonstrate re-setting of fire dampers to Red Clay Consolidated School District's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment; see Section 22 05 48.
- J. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.
- K. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- L. Use splitter dampers only where indicated.
- M. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 34 23**HVAC POWER VENTILATORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Kitchen Ventilation Systems / Roof exhausters.
- B. Ceiling exhaust fans.

1.02 RELATED REQUIREMENTS

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping Equipment.
- C. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.
- D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc..
- B. AMCA 204 - Balance Quality and Vibration Levels for Fans.
- C. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc. (ANSI/AMCA 210, same as ANSI/ASHRAE 51).
- D. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; Air Movement and Control Association International, Inc..
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc..
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc..
- G. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.
- I. UL 705 - Power Ventilators; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 5 years of documented experience.
- B. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 FIELD CONDITIONS

- A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

1.07 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Supply two sets of belts for each fan.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Greenheck: www.greenheck.com.
- B. Loren Cook Company: www.lorencook.com.
- C. PennBarry: www.pennbarry.com.
- D. American Coolair/ILG: www.coolair.com
- E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
- B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.
- D. Fabrication: Conform to AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.03 ROOF VENTILATORS, KITCHEN VENTILATION SYSTEMS

- A. Product Requirements:
 - 1. Performance Ratings: Determined in accordance with AMCA 210.
 - 2. Sound Ratings: AMCA 301, tested to AMCA 300.
 - 3. Fabrication: Conform to AMCA 99.
 - 4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- B. Performance and Model: As indicated on drawings.
 - 1. Motor: Refer to Section 23 05 13.

- C. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- D. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- E. Roof Curb: 20 inch high of galvanized steel with continuously welded seams, factory installed nailer strip.
- F. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
- G. Shunt Trip Breakers: Provide for each fan of 2,000 CFM or greater for interlock with Fire Alarm system.
- H. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- I. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- J. Make-up Air unit:
 - 1. Variable-volume direc-fired natural gas makeup air unit with spark ignition, discharge temperature control, and factory disconnect.

2.04 CABINET AND CEILING EXHAUST FANS

- A. Performance: As Indicated on drawings.
 - 1. Motor: Refer to Section 23 05 13.
- B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- C. Disconnect Switch: Cord and plug in housing for thermal overload protected motor.
- D. Grille: Molded white plastic or Aluminum with baked white enamel finish.
- E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof or wall exhausters with aluminum lag screws to roof curb or structure.
- C. Extend ducts to roof or wall exhausters into roof curb or structure. Counterflash duct to roof or wall opening.
- D. Hung Cabinet Fans:
 - 1. Install fans with resilient mountings and flexible electrical leads. Refer to Section 23 05 48.

2. Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
 - F. Install backdraft dampers on inlet to roof and wall exhausters.
 - G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

END OF SECTION

SECTION 23 37 00**AIR OUTLETS AND INLETS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Diffusers.
- B. Registers/grilles.
- C. Door grilles.
- D. Louvers.
- E. Goosenecks.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating: Painting of ducts visible behind outlets and inlets.

1.03 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc..
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute.
- C. ASHRAE Std 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc..
- D. SMACNA (DCS) - HVAC Duct Construction Standards.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Samples: Submit one of each required air outlet and inlet type.
- D. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.

1.07 MOCK-UP

- A. Provide mock-up of typical exterior or exterior ceiling module with supply and return air outlets.

- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Carnes Company HVAC: www.carnes.com.
- B. Krueger: www.krueger-hvac.com.
- C. Price Industries: www.price-hvac.com.
- D. Titus: www.titus-hvac.com.
- E. Tuttle and Bailey: www.tuttleandbailey.com.
- F. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 RECTANGULAR CEILING DIFFUSERS

- A. Type: Square, stamped, multi-core diffuser to discharge air in 360 degree, one way, two way, three way or four way pattern as shown on drawings and with sectorizing baffles where indicated.
- B. Frame: Surface mount or inverted T-bar as indicated on drawings. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Aluminum with baked enamel off-white finish.
- D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.03 PERFORATED FACE CEILING DIFFUSERS

- A. Type: Perforated face with fully adjustable pattern and removable face.
- B. Frame: Surface mount or Inverted T-bar as indicated on drawings. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Steel with steel or aluminum frame and baked enamel off-white finish.
- D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.04 CEILING SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.
- B. Frame: 1 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions with factory off-white enamel or prime coat finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.05 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, horizontal face.
- B. Frame: 1 inch margin with countersunk screw mounting.
- C. Fabrication: Aluminum extrusions, with factory off-white enamel, baked enamel, or prime coated finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.06 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvers.
- B. Fabrication: Acrylic plastic with off-white finish.
- C. Frame: Channel lay-in frame for suspended grid ceilings.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.07 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, horizontal face, double deflection.
- B. Frame: 1 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions, with factory off-white enamel, baked enamel, prime coat or clear lacquer finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.08 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, horizontal face.
- B. Frame: 1 inch margin with countersunk screw mounting.
- C. Fabrication: Aluminum extrusions, with factory off-white enamel, baked enamel, prime coated or clear lacquer finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

2.09 WALL GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvers.
- B. Fabrication: Aluminum with factory clear lacquer, off-white enamel or baked enamel finish as indicated on drawings or selected by architect.
- C. Frame: 1 inch margin with countersunk screw mounting.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.10 DOOR GRILLES

- A. Type: V-shaped louvers of 20 gage thick steel, 1 inch deep on 1/2 inch centers.
- B. Frame: 20 gage steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

2.11 LOUVERS

- A. Type: 4 inch or 6 inch deep as indicated on drawings with blades on 45 degree slope, heavy channel frame, 1/2 inch square mesh screen over exhaust and 1/2 inch square mesh screen over intake.
- B. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory prime coat, baked enamel, anodized or fluoropolymer spray finish as indicated on drawings or selected by architect.
- C. Mounting: Furnish with exterior angle flange, screw holes in jambs or masonry strap anchors for installation.

2.12 GOOSENECKS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards of minimum 18 gage galvanized steel.
- B. Mount on minimum 12 inch high curb base where size exceeds 9 x 9 inch.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 90 00.

3.02 AIR OUTLET AND INLET SCHEDULE

- A. See Drawings

END OF SECTION

SECTION 23 72 23**PACKAGED AIR-TO-AIR ENERGY RECOVERY UNITS****PART 1 GENERAL****1.01 REFERENCE STANDARDS**

- A. AHRI 1060 I-P - Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- C. ASHRAE Std 84 - Method of Testing Air to Air Heat Exchangers.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
- G. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Energy Recovery Ventilators:
 - 1. Renew Aire: www.renewaire.com.
 - 2. Innovent: www.innoventair.com
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ENERGY RECOVERY UNITS

- A. Energy Recovery Units: Fixed plate cross-flow energy exchange type (hydroscopic resin) type; prefabricated packaged system designed by manufacturer.
 - 1. Access: Hinged access panels on front. Pressure taps provided.
 - 2. Lifting holes at the unit base.
 - 3. Permanent name plate listing manufacturer mounted inside door near electrical panel.

2.03 CASING

- A. Wall, Floor, and Roof Panels:
 - 1. Construction: 1 inch thick, double wall box construction, with formed edges of exterior wall overlapping formed edges of interior wall.
 - 2. Exterior Wall: galvanized steel sheet.
 - a. 20 gage galvanized steel.
 - 3. Insulation:
 - a. 1 inch insulated fiberglass board insulation.
 - b. All insulation sealed with foil/scrim facing leaving no exposed insulation to the airstream.
 - c. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.
 - d. Smoke Developed Index: 50, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.

4. Panel Joints: 20 gauge steel with lapped corners and zinc-plated screws.
 5. Isolation and Seal: Form continuous, thermally isolated, weather tight seal between inner wall of panels and structural framing with closed cell PVC foam gasketing.
 6. Seams: Sealed, requiring no caulking at job site.
- B. Access Panels: Provide access to components through a large, tightly sealed and easily removable panel.
- C. Doors:
1. Construct doors of same construction and thickness as wall panels.
 2. Hardware:
 - a. Corrosion-resistant.

2.04 FANS

- A. Provide separate fans for exhaust and supply blowers.
- B. Fans:
1. Individually driven with a dedicated motor.
- C. Bearings:
1. Pillow block.
 2. Bearings: Permanently lubricated sealed ball bearings.
 3. Rated for not less than 200,000 hours of operation with accessible greased fittings.
- D. Housings: 12 gage aluminized steel with plenums integral to general housing and constructed to Class 1 fan standards.
- E. Motors:
1. Motors: Open drip proof or ECM direct drive as scheduled.
 2. Efficiency: Premium.
 3. Speed: Variable.
 4. Control: Variable Frequency Drive.
 5. Fan Motor: Thermal overload protected.
 6. Fan Motor: UL listed and labeled.
- F. Drives:
1. Fans: Belt driven or direct as scheduled.
 2. Sheaves: Variable.
 3. Service Factor: 1.2.

2.05 TOTAL ENERGY RECOVERY MEDIA

- A.
- B. Transfer heat and humidity from one air stream to the other with no carryover of the exhaust air into the supply air stream.
- C. Effectiveness: Rated in accordance with ASHRAE Std 84 and AHRI 1060.
- D. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.
- E. Smoke Developed Index: 50, maximum, when tested in accordance with ASTM E84, NFPA 255, and UL 723.
- F. Energy Recovery Media Facing:
1. Conform to NFPA 90A.

2.06 FILTERS

- A. Efficiency: 13 MERV.
- B. Exhaust and Fresh Air Streams: MERV 13 filters constructed to meet ASHRAE Std 52.2.
- C. Mount 1/2 inches thick permanent aluminum washable type filter in the outside air hood and in the return plenum air.

2.07 DAMPERS

- A. Motorized Dampers: Provide motorized dampers at outside air inlet, exhaust air outlet, and supply air outlet.
 - 1. Type: Motorized two position low-leak.
 - 2. Blades: Insulated, single blade damper.

2.08 VIBRATION ISOLATION

- A. Vibration Isolation: Provide whole unit vibration isolation with the energy recovery unit assembly.
- B. Construct with appropriately-sized, seismic-rated, corrosion-resistant captive-spring isolators.

2.09 POWER AND CONTROLS

- A. Motor Control Panels: UL listed.
- B. Include necessary motor starters, fuses, transformers and overload protection according to NFPA 70.
- C. Install wiring in accordance with NFPA 70.

2.10 SERVICE ACCESSORIES

- A. Switch: 2 type.
 - 1. Two Position Type: Service and Operate.
- B. Electrical Components: Factory wired for single point power connection.
 - 1. Protect all integral wires and connections.
 - 2. Electrical Components: UL Listed.

PART 3 EXECUTION**3.01 EXAMINATION****3.02 INSTALLATION**

- A. Provide openings for suitable ductwork connection.

3.03 SYSTEM STARTUP

- A. Provide services of manufacturer's authorized representative to provide start up of unit.

3.04 CLEANING

- A. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

END OF SECTION

SECTION 23 74 13**PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Packaged roof top unit.
- B. Unit controls.
- C. Remote panel.
- D. Mounting curb and base.
- E. Maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim.
- B. Section 23 05 13 - Common motor requirements for HVAC Equipment.
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- D. Section 23 40 00 - HVAC Air Cleaning Devices.
- E. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Control components, time clocks.
- F. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Installation of thermostats and other controls components.
- G. Section 26 27 17 - Equipment Wiring: Installation and wiring of thermostats and other controls components; wiring from unit terminal strip to remote panel.
- H. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. AHRI 270 - Sound Rating of Outdoor Unitary Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- C. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

- D. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Red Clay Consolidated School District's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.07 WARRANTY

- A. Provide a five year warranty to include coverage for refrigeration compressors and heat exchangers.

1.08 MAINTENANCE SERVICE

- A. Furnish service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
- B. Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
- C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
- D. Submit copy of service call work order or report, and include description of work performed.

1.09 EXTRA MATERIALS

- A. Provide two sets of filters.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Modine Corporation
- B. York/JCI
- C. Trane Corporation
- D. McQuay
- E. Valent Incorporated
- F. AAON Corporation.

2.02 AIR CONDITIONING UNITS

- A. General: Roof or ground mounted packaged units having gas burner as scheduled and electric refrigeration.
- B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, return fan, heat exchanger and burner,, energy recovery wheel (where noted in the schedule), factory-mounted controls, air filters, hot water heating coil, refrigerant cooling coil and variable-speed compressors and hot-gas reheat circuits, condenser coil and condenser fan as scheduled.
- C. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 27 17.

2.03 FABRICATION

- A. Cabinet: Galvanized steel with baked enamel finish, including access doors with piano hinges and locking handle. Structural members shall be minimum 18 gage, with access doors or panels of minimum 20 gage.
- B. Insulation: two inch thick minimum glass fiber or injected foam, double-walled unit construction.
- C. Supply and Return and Exhaust Fan as scheduled: Backward inclined or airfoil type, resiliently mounted with V-belt drive and adjustable variable pitch motor pulley, and rubber isolated hinge mounted high efficiency motor or direct drive as indicated. Isolate complete fan assembly. Provide factory-mounted variable-frequency drives for all fan motors.
- D. Air Filters: Minimum efficiency reporting value (MERV) of at least 10.
- E. Roof Mounting Curb: Custom side-discharge 40" high galvanized steel, channel frame with gaskets, nailer strips

2.04 BURNER

- A. Gas Burner: Forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot. Provide turndown ratio as indicated in the schedule. Provide condensing burners as indicated in schedule.
- B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
- C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, with provisions for continuous fan operation.

2.05 EVAPORATOR OR INDOOR COILS

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection for cooling coils.
- B. Provide thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

2.06 COMPRESSOR

- A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter drier.
- B. Five minute timed off circuit to delay compressor start.
- C. Outdoor thermostat to energize compressor above 35 degrees F ambient.
- D. Provide step capacity control by variable-speed scroll technology and/or adjusting variable-speed compressors.
- E. Provide hot-gas reheat coil for humidity control.

2.07 CONDENSER OR OUTDOOR COIL

- A. Provide copper tube aluminum or copper fin coil assembly with subcooling rows and coil guard.
- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.
- C. Provide refrigerant pressure switches to cycle condenser fans.

2.08 MIXED AIR CASING

- A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fall to closed position.
- B. Gaskets: Provide tight fitting dampers with edge gaskets.
- C. Damper Operator, Units 7.5 Ton Cooling Capacity and Larger: 24 volt with gear train sealed in oil with spring return on.
- D. Outdoor airflow monitoring station: Provided at intake of the unit.
- E. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating and above 70 degrees (F) ambient, or when ambient air enthalpy exceeds return air enthalpy.

2.09 OPERATING CONTROLS

- A. Provide factory controller and all necessary sensors and components for operation of refrigerant system, fan VFDs based on static-pressure feedback, energy recovery wheel, humidity control function, and economizer function. The humidity control (dehumidification sequence) shall be capable of being enabled when the unit is in both heating and cooling modes. The humidistat setpoint shall govern control of this sequence.
- B. Provide BACnet interface on unit for connection of operating controls for BAS control. Control shall allow for modulating heating via the gas-fired burner and modulating stages cooling, fan, and damper control. See section 23 09 93 for required data to be relayed to the BAS for monitoring and control.
- C. Provide remote mounted fan control switch for smoke-purge for each unit (on-auto) to activate only the exhaust fan at each unit, keep the outdoor air damper closed, and de-energe the energy wheel.

- D. See Specification Section 230993 - Sequence Of Operations, paragraphs 3.08 and 3.11 for required operating capabilities of the units.

2.10 HEAT RECOVERY

- A. The heat recovery module shall be provided as shown on the drawing and shall have a factory mounted and tested energy recovery wheel. The energy recovery wheel shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seats and bearings.
- B. The energy recovery cassette shall be rated in accordance with ARI Standard 1060 and shall bear the ARI certification symbol.
- C. The energy recovery cassette shall contain a total energy heat wheel constructed of a light weight polymer material with permanently bonded desiccant coating. The energy recovery wheel media shall be capable of removal from the cassette and be cleanable using hot water or light detergent without degrading the latent efficiency.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings or illustrated by the manufacturer.
- B. Verify that proper power supply is available.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 90A.
- C. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- D. Locate remote panels where identified in field coordination meeting.
- E. Tie unit into BAS as specified.

3.03 SYSTEM STARTUP

- A. Prepare and start equipment. Adjust for proper operation.

3.04 CLOSEOUT ACTIVITIES

- A. Demonstrate operation to Owner's maintenance personnel.

3.05 MAINTENANCE

- A. Provide service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
- B. Provide routine maintenance service with a three month interval as maximum time period between calls.
- C. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
- D. After each service call, submit copy of service call work order or report that includes

description of work performed.

END OF SECTION

SECTION 23 81 27**SMALL SPLIT-SYSTEM HEATING AND COOLING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Air cooled condensing units.
- B. Indoor ductless fan & coil units.
- C. Controls.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Mounting pad for outdoor unit.
- B. Section 22 10 05 - Plumbing Piping: Indoor coil condensate drain.
- C. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats, time clocks.
- D. Section 23 09 23 - Direct Digital Controls Systems for HVAC.
- E. Section 23 09 93 - Sequence of Operations for HVAC.
- F. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections and installation and wiring of thermostats and other controls components.

1.03 REFERENCE STANDARDS

- A. AHRI 270 - Sound Rating of Outdoor Unitary Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; Air-Conditioning, Heating, and Refrigeration Institute.
- C. AHRI 610 - Performance Rating of Central System Humidifiers for Residential Applications; Air Conditioning, Heating, and Refrigeration Institute.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ANSI/ASHRAE Std 15).
- E. ASHRAE Std 23.1 - Methods of Testing for Rating Positive Displacement Refrigerant Compressors and Condensing Units; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..
- F. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..
- G. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ANSI/AHSRAE/IESNA Std 90.1).
- H. ASHRAE Std 90.2 - Energy-Efficient Design of New Low-Rise Residential Buildings; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..

- I. ASHRAE Std 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..
- J. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- K. NFPA 31 - Standard for the Installation of Oil Burning Equipment; National Fire Protection Association.
- L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- M. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.
- N. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; National Fire Protection Association.
- O. UL 207 - Refrigerant-Containing Components and Accessories, Nonelectrical; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- F. Project Record Documents: Record actual locations of components and connections.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- H. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Red Clay Consolidated School District s name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 10 years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years of documented experience and approved by manufacturer.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturers warranty for heat exchangers, condensing units, and compressors.
- C. Provide five year manufacturers warranty for electronic air cleaners.

1.07 EXTRA MATERIALS

- A. See Section 01 60 00 - Project Requirements, for additional provisions.
- B. Provide two filters for each indoor unit.
- C. Provide two pilot thermocouples.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Sanyo:
- B. Mitsubishi:
- C. LG:
- D. Daikin.
- E. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Heating and Cooling: Air-source electric heat pump located in outdoor unit with evaporator coil in central ducted indoor unit.
 - 2. Heating: Natural gas fired; As scheduled.
 - 3. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit or coils in multiple .
 - 4. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.
 - 1. Efficiency: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1; seasonal efficiency to ASHRAE Std 103.

2.03 INDOOR UNITS FOR DUCTED SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
 - 1. Air Flow Configuration: Counterflow, with additional steel base; counterflow or horizontal as scheduled.
 - 2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
- B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
 - 1. Motor: NEMA MG 1; 1750 rpm single speed or multiple speed as scheduled permanently lubricated, hinge mounted.
 - 2. Motor Electrical Characteristics:
- C. Air Filters: 1 inch thick glass fiber, disposable type arranged for easy replacement.
- D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL listed.
 - 2. Manufacturers: System manufacturer.

2.04 INDOOR UNITS FOR DUCTLESS SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
 - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL listed.
 - 2. Manufacturer: System manufacturer.

2.05 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
 - 1. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 - 2. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL listed.
- B. Compressor: As scheduled ARI 520; hermetic, single or two speed 1800 and 3600 rpm, resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Air Cooled Condenser: ARI 520; Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
- D. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).
 - 1. Provide thermostatic expansion valves.
 - 2. Provide heat pump reversing valves.
- E. Operating Controls:
 - 1. Control by room thermostat to maintain room temperature setting.
 - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.
- F. Mounting Pad: Minimum square; minimum of two located under cabinet feet.

2.06 ACCESSORY EQUIPMENT

- A. Room Humidistat: Electric, adjustable, to energize humidifier when fan operating, to maintain setting.
- B. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
 - 1. System selector switch (heat-off-cool) and fan control switch (auto-on).
 - 2. Automatic switching from heating to cooling.
 - 3. Preferential rate control to minimize overshoot and deviation from setpoint.
 - 4. Set-up for four separate temperatures per day.
 - 5. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - 6. Short cycle protection.
 - 7. Programming based on every day of the week.

8. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.
9. Battery replacement without program loss.
10. Thermostat display:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indication: heating, cooling, fan auto, off, and on, auto or on, off.
11. Manufacturers:
 - a. Matching unit manufacturer or provided by Building Automation System vendor..

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.
- C. Verify that proper fuel supply is available for connection.
- D. Verify that water supply is available for humidifier.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Provide vent connections in accordance with NFPA 211.
- D. Install refrigeration systems in accordance with ASHRAE Std 15.
- E. Mount counterflow furnaces installed on combustible floors on additive base.

END OF SECTION

SECTION 26 05 19**LV ELEC. POWER CONDUCTORS AND CABLES (600V&LESS)****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Underground feeder and branch-circuit cable.
- C. Service entrance cable.
- D. Metal-clad cable.
- E. Wire and cable for 600 volts and less.
- F. Wiring connectors.
- G. Electrical tape.
- H. Wire pulling lubricant.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 01 - Minor Electrical Demolition: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 28 31 00 - Fire Detection and Alarm: Fire alarm system conductors and cables.
- F. Section 31 23 16 - Excavation.
- G. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- H. Section 31 23 23 - Fill: Bedding and backfilling.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.
- B. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
- C. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.
- D. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.

- F. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); National Electrical Contractors Association.
- G. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); National Electrical Contractors Association.
- H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; National Electrical Manufacturers Association (ANSI/NEMA WC 70/ICEA S-95-658).
- I. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- J. NFPA 70 - National Electrical Code; National Fire Protection Association.
- K. UL 44 - Thermoset-Insulated Wires and Cables.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables.
- M. UL 486A-486B - Wire Connectors.
- N. UL 486C - Splicing Wire Connectors.
- O. UL 486D - Sealed Wire Connector Systems.
- P. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables.
- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
- R. UL 1569 - Metal-Clad Cables.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the installation of direct burial cable with other trades to avoid conflicts with piping or other potential conflicts.
 - 3. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 4. Notify Architect and Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Product Data: Provide for each cable assembly type.
- D. Samples of Actual Product Delivered: Submit one 18 inch length of cable assembly from each reel.
 - 1. Select each length to include complete set of manufacturer markings.
 - 2. Attach tag indicating cable size and application information.
- E. Test Reports: Indicate procedures and values obtained.

- F. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Project Record Documents: Record actual locations of components and circuits.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Metal-clad cable is permitted only as follows:
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - 1) Maximum Length: 6 feet.
 - b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
 - 2. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Red Clay Consolidated School District.
 - b. Where not approved for use by the authority having jurisdiction.
 - c. Where exposed to view.
 - d. Where exposed to damage.
 - e. For damp, wet, or corrosive locations, .
 - f. For isolated ground circuits, unless provided with an additional isolated/insulated grounding conductor.

- D. Concealed Dry Interior Locations: Use only building wire in raceway or metal clad cable type THHN/THHW.
- E. Exposed Dry Interior Locations: Use only building wire in raceway type THHN/THHW.
- F. Above Accessible Ceilings: Use only building wire in raceway or metal clad cable type THHN.
- G. Wet or Damp Interior Locations: Use only building wire in raceway type THW.
- H. Exterior Locations: Use only building wire in raceway type THHW.
- I. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- J. Use solid conductors for control circuits.
- K. Use conductor not smaller than 12 AWG for power and lighting circuits.
- L. Use conductor not smaller than 16 AWG for control circuits.
- M. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.
- N. Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

2.02 CONDUCTOR AND CABLE MANUFACTURERS

- A. Cerro Wire LLC: www.cerrowire.com.
- B. Southwire Company: www.southwire.com.
- C. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ALL CONDUCTORS AND CABLES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- H. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- I. Conductor Material:
 - 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 - 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 3. Tinned Copper Conductors: Comply with ASTM B33.
- J. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.

- a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
- 2. Control Circuits: 14 AWG.
- K. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- L. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.
 - d. Isolated Ground, All Systems: Green with yellow stripe.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.04 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
 - 2. Control Circuits: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
- F. Conductor: Copper.
 - 1. For Sizes Smaller Than 4 AWG: Copper.
 - 2. For Sizes 4 AWG and Larger: Copper.
- G. Insulation Voltage Rating: 600 volts.

- H. Insulation: NFPA 70, Type THHW/THWN/THHN/THW.
- I. Insulation: Thermoplastic material rated 75/90 degrees C.

2.05 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

- A. Manufacturers:
 - 1. Cerro Wire LLC: www.cerrowire.com.
 - 2. Encore Wire Corporation: www.encorewire.com.
 - 3. Southwire Company: www.southwire.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
- C. Provide equipment grounding conductor unless otherwise indicated.
- D. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- E. Insulation Voltage Rating: 600 V.

2.06 SERVICE ENTRANCE CABLE

- A. Manufacturers:
 - 1. Copper Service Entrance Cable:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Conductor Stranding: Stranded.
- C. Insulation Voltage Rating: 600 V.

2.07 METAL-CLAD CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com.
 - 2. Encore Wire Corporation: www.encorewire.com.
 - 3. Southwire Company: www.southwire.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide dedicated neutral conductor for each phase conductor where indicated or required.
- G. Grounding: Full-size integral equipment grounding conductor.
 - 1. Provide additional isolated/insulated grounding conductor where indicated or required.

- H. Armor: Steel, interlocked tape.
- I. Insulation Temperature Rating: 75/90 degrees C.

2.08 SERVICE ENTRANCE CABLE

- A. Description: NFPA 70, Type USE.
- B. Conductor: Copper.
 - 1. For Sizes Smaller Than 4 AWG: Copper.
 - 2. For Sizes 4 AWG and Larger: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: Type XHHW.

2.09 METAL CLAD CABLE

- A. Description: NFPA 70, Type MC.
- B. Conductor: Copper.
 - 1. For Sizes Smaller Than 4 AWG: Copper.
 - 2. For Sizes 4 AWG and Larger: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Steel.
- G. Armor Design: Interlocked metal tape.
- H. Jacket: PVC.

2.10 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 - 3. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
 - 4. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. NSI Industries LLC: www.nsiindustries.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Mechanical Connectors: Provide bolted type or set-screw type.
 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.

2.11 WIRING ACCESSORIES

- A. Electrical Tape:
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. American Polywater Corporation: www.polywater.com.
 - c. Ideal Industries, Inc: www.idealindustries.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Split Bolt Connectors: Description: Connector suitable for copper to copper connection tested and listed to UL 486A requirements. Black burn type-H or equal.
 1. Product: Thomas R Betts or equal
 2. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Product: Thomas R Betts or equal
- D. Spring Wire Connectors: Description: Flame retardant thermoplastic shell with plated steel square wire spring gated for 105 degrees C, 600 volts, Thomas and Betts fixed spring wire connectors or equal.

1. Product: Ideal or equal

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that raceway installation is complete and supported.
- E. Verify that field measurements are as shown on the drawings.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

- A. Circuiting Requirements:
 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated and routing is not shown, determine exact routing required.
 3. Arrange circuiting to minimize splices.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.
- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
 1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

- I. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- Q. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- R. Route wire and cable as required to meet project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 - 3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.
- S. Use wiring methods indicated.
- T. Pull all conductors into raceway at same time.
- U. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- V. Protect exposed cable from damage.
- W. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system. Do not rest cable on ceiling panels.
- X. Use suitable cable fittings and connectors.

- Y. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- Z. Clean conductor surfaces before installing lugs and connectors.
- AA. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- AB. Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- AC. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
- AD. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- AE. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- AF. Trench and backfill for direct burial cable installation as specified in Sections 31 23 16 and 31 2323; Section 31 2316 13. Install warning tape along entire length of direct burial cable, within 3 inches of grade.
- AG. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Inspect and test in accordance with NETA STD ATS, except Section 4.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- E. Correct deficiencies and replace damaged or defective conductors and cables.
- F. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION

SECTION 26 05 26**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Grounding and bonding components.
- G. Provide all components necessary to complete the grounding system(s) consisting of:
 - 1. Existing metal underground water pipe.
 - 2. Metal frame of the building.
 - 3. Existing metal underground gas piping system.
 - 4. Metal underground gas piping system.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; National Electrical Manufacturers Association.
- C. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association.
- F. UL 467 - Grounding and Bonding Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Product Data: Provide for grounding electrodes and connections.
- D. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Field quality control test reports.
- G. Project Record Documents: Record actual locations of components and grounding electrodes.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding Electrode System:
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10

- feet at an accessible location not more than 5 feet from the point of entrance to the building.
- b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
- c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
- 3. Metal Building or Structure Frame:
 - a. Provide connection to metal building or structure frame effectively grounded in accordance with NFPA 70 at nearest accessible location.
- 4. Ground Ring:
 - a. Provide a ground ring encircling the building or structure consisting of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches.
 - b. Provide connection from ground ring conductor to:
 - 1) Perimeter columns of metal building frame.
 - 2) Ground rod electrodes located as indicated.
- 5. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
- E. Bonding and Equipment Grounding:
 - 1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 - 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
 - 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 - 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 - 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 - 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 - 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
- F. Isolated Ground System:
 - 1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
 - 2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
 - 3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in addition to requirements of Section 26 05 19:
 - 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- C. Connectors for Grounding and Bonding:
 - 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
 - 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
 - 4. Manufacturers - Mechanical and Compression Connectors:
 - a. Burndy: www.burndy.com.
 - b. Harger Lightning & Grounding: www.harger.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy: www.burndy.com.
 - b. Cadweld, a brand of Erico International Corporation: www.erico.com.
 - c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Ground Bars:
 - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 - 2. Size: As indicated.
 - 3. Holes for Connections: As indicated or as required for connections to be made.
 - 4. Manufacturers:
 - a. Erico International Corporation: www.erico.com.
 - b. Harger Lightning & Grounding: www.harger.com.
 - c. ThermOweld, a brand of Continental Industries, Inc: www.thermoweld.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Ground Rod Electrodes:
 - 1. Comply with NEMA GR 1.
 - 2. Material: Copper-bonded (copper-clad) steel.
 - 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 - 4. Manufacturers:
 - a. Erico International Corporation: www.erico.com.
 - b. Galvan Industries, Inc: www.galvanelectrical.com.
 - c. Harger Lightning & Grounding: www.harger.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MANUFACTURERS

- A. Cooper Power Systems: www.cooperpower.com.
- B. Framatome Connectors International: www.fciconnect.com.
- C. Lightning Master Corporation: www.lightningmaster.com.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Wire: Stranded copper.
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as shown on the drawings.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify existing conditions prior to beginning work.
- E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
- D. Make grounding and bonding connections using specified connectors.
 - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 05 53.

- F. Provide bonding to meet requirements described in Quality Assurance.
- G. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Each of branch circuits and feeder circuits shall have dedicated equipment grounding conductor, sharing this conductor with other grounding conductors is not permitted.

3.03 FIELD QUALITY CONTROL

- A. Perform inspection in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 05 29**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
- D. MFMA-4 - Metal Framing Standards Publication; Metal Framing Manufacturers Association.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

PART 2 PRODUCTS**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated, where applicable.
 - 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.

5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- D. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Comply with MFMA-4.
- E. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

2.02 MANUFACTURERS

- A. Thomas & Betts Corporation: www.tnb.com.
- B. Threaded Rod Company: www.threadedrod.com.
- C. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Supports: Fabricated of structural steel or formed steel members; galvanized.
- C. Anchors and Fasteners:
 1. Do not use powder-actuated anchors.
 2. Obtain permission from Architect before using powder-actuated anchors.
 3. Concrete Structural Elements: Use precast inserts.
 4. Steel Structural Elements: Use beam clamps.
 5. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
 6. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use hollow wall fasteners.
 7. Solid Masonry Walls: Use expansion anchors.
 8. Sheet Metal: Use sheet metal screws.
 9. Wood Elements: Use wood screws.
- D. Formed Steel Channel:
 1. Product: manufactured by [B-Line].
 2. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Secure fasteners according to manufacturer's recommended torque settings.
- I. Remove temporary supports.

END OF SECTION

SECTION 26 05 34**CONDUIT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Flexible metal conduit (FMC).
- C. Liquidtight flexible metal conduit (LFMC).
- D. Electrical metallic tubing (EMT).
- E. Rigid polyvinyl chloride (PVC) conduit.
- F. Conduit fittings.
- G. Accessories.
- H. Conduit, fittings and conduit bodies.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 84 00 - Firestopping.
- C. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC) and armored cable (Type AC), including uses permitted.
- D. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- E. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- F. Section 26 05 53 - Identification for Electrical Systems.
- G. Section 26 05 37 - Boxes.
- H. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- I. Section 26 27 01 - Electrical Service Entrance: Additional requirements for electrical service conduits.
- J. Section 27 10 05 - Structured Cabling for Voice and Data - Inside-Plant: Additional requirements for communications systems conduits.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT).
- C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.

- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); National Electrical Contractors Association.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association (ANSI/NEMA FB 1).
- H. UL 1 - Flexible Metal Conduit.
- I. UL 6 - Electrical Rigid Metal Conduit-Steel.
- J. UL 360 - Liquid-Tight Flexible Steel Conduit.
- K. UL 514B - Conduit, Tubing, and Cable Fittings.
- L. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings.
- M. UL 797 - Electrical Metallic Tubing-Steel.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
 - 1. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.
- E. Product Data: Provide for metallic conduit and flexible metal conduit.
- F. Samples of Materials Actually Delivered to Site:
 - 1. Two pieces each of conduit, 2 feet long.
- G. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.01 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use rigid PVC conduit.
 - 2. Exterior, Direct-Buried: Use rigid PVC conduit.
 - 3. Exterior, Embedded Within Concrete: Use rigid PVC conduit.
 - 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 - 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
 - 6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit.
- E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- H. Interior Mechanical room or boiler room: Use galvanized steel rigid metal conduit.
- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit.
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 10 feet, except within electrical and communication rooms or closets.
 - b. Where exposed below 20 feet in warehouse areas.

- J. Exposed, Exterior: Use galvanized steel rigid metal conduit.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit.

2.02 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Electrical Service Conduits: Also comply with Section 26 27 01.
- C. Communications Systems Conduits: Also comply with Section 27 10 05.
- D. Fittings for Grounding and Bonding: Also comply with Section 26 05 26.
- E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- F. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 - 3. Control Circuits: 1/2 inch (16 mm) trade size.
- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedeg.com.
 - 2. Republic Conduit: www.republic-conduit.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedtube.com.

2. Beck Manufacturing, Inc: www.beckmfg.com.
 3. Wheatland Tube Company: www.wheatland.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.05 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com.
 2. Electri-Flex Company: www.electriflex.com.
 3. International Metal Hose: www.metalhose.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. Thomas & Betts Corporation: www.tnb.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
- D. Description: Interlocked steel construction.
- E. Fittings: NEMA FB 1.

2.06 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
1. AFC Cable Systems, Inc; Model _____: www.afcweb.com.
 2. Electri-Flex Company; Model _____: www.electriflex.com.
 3. International Metal Hose; Model _____: www.metalhose.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.

2.07 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
1. Allied Tube & Conduit: www.alliedeg.com.

2. Republic Conduit: www.republic-conduit.com.
 3. Wheatland Tube Company: www.wheatland.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
 4. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.08 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
1. Cantex Inc: www.cantexinc.com.
 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com.
 3. JM Eagle: www.jmeagle.com.
 4. _____.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
1. Manufacturer: Same as manufacturer of conduit to be connected.
 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- E. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- F. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 - 3. Use suitable adapters where required to transition from one type of conduit to another.
 - 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 - 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 - 6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 - 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- G. Penetrations:
 - 1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
 - 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
 - 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
 - 4. Conceal bends for conduit risers emerging above ground.
 - 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 - 6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 - 7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 - 8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.

- H. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 - 2. Where conduits are subject to earth movement by settlement or frost.
- I. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
 - 1. Where conduits pass from outdoors into conditioned interior spaces.
 - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- J. Provide grounding and bonding in accordance with Section 26 05 26.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation specified in Section roofing section.

END OF SECTION

SECTION 26 05 35**SURFACE RACEWAYS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Surface raceway systems.
- B. Wireways.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
 - 1. Includes metal channel (strut) used as raceway.
- C. Section 26 05 34 - Conduit.
- D. Section 26 05 37 - Boxes.
- E. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 27 26 - Wiring Devices: Receptacles.
- G. Section 27 10 05 - Structured Cabling for Voice and Data - Inside-Plant: Voice and data jacks.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association.
- C. UL 5 - Surface Metal Raceways and Fittings.
- D. UL 111 - Outline of Investigation for Multioutlet Assemblies.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate rough-in locations of outlet boxes provided under Section 26 05 37 and conduit provided under Section 26 05 34 as required for installation of raceways provided under this section.
 - 3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install raceways until final surface finishes and painting are complete.
 - 2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
 - 1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS**2.01 RACEWAY REQUIREMENTS**

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.02 SURFACE RACEWAY SYSTEMS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Wiremold, a brand of Legrand North America, Inc: www.legrand.us.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Multioutlet Assemblies: Listed and labeled as complying with UL 111.
- D. Metal Channel (Strut) Used as Raceway: Comply with Section 26 05 29.
- E. Type DS-4000 - Surface Raceway System:
 - 1. Raceway Type: Two channel, painted steel.
 - 2. Size: 4 3/4" by 1 3/4 " inches.
 - 3. Length: As indicated on the drawings.
 - 4. Color: To be selected by Architect.

5. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
6. Integrated Device Provisions:
 - a. Receptacles:
 - 1) Comply with Section 26 27 26, except for finishes.
 - 2) Configuration: As indicated on the drawings.
 - 3) Color: Match raceway.
 - 4) Spacing: As indicated on the drawings.
 - b. Communications Outlets:
 - 1) Voice and Data Jacks: As specified in Section 27 10 05.
 - 2) Configuration: As indicated on the drawings.
 - 3) Spacing: As indicated on the drawings.
7. Products:
 - a. Pass & Seymour.
 - b. Wiremold.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
8. Applications:
 - a. Class rooms, Hallways and Labs.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install raceways in a neat and workmanlike manner in accordance with NECA 1.
- C. Install raceways plumb and level.
- D. Secure and support raceways in accordance with Section 26 05 29 at intervals complying with NFPA 70 and manufacturer's requirements.
- E. Close unused raceway openings.
- F. Provide grounding and bonding in accordance with Section 26 05 26.
- G. Identify raceways in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect raceways for damage and defects.

- C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.
- D. Correct wiring deficiencies and replace damaged or defective raceways.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 PROTECTION

- A. Protect installed raceways from subsequent construction operations.

END OF SECTION

SECTION 26 05 37**BOXES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Wall and ceiling outlet boxes.
- D. Floor boxes.
- E. Pull and junction boxes.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 27 26 - Wiring Devices:
 - 1. Wall plates.
- E. Section 26 27 16 - Electrical Cabinets and Enclosures.
- F. Section 26 27 26 - Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association (ANSI/NEMA FB 1).
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association (ANSI/NEMA OS 1).
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association (ANSI/NEMA OS 2).
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- J. UL 508A - Industrial Control Panels.

- K. UL 514A - Metallic Outlet Boxes.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 6. Coordinate the work with other trades to preserve insulation integrity.
 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
 8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

- A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use suitable concrete type boxes where flush-mounted in concrete.
 4. Use suitable masonry type boxes where flush-mounted in masonry walls.

5. Use raised covers suitable for the type of wall construction and device configuration where required.
 6. Use shallow boxes where required by the type of wall construction.
 7. Do not use "through-wall" boxes designed for access from both sides of wall.
 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 12. Wall Plates: Comply with Section 26 27 26.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

2.02 MANUFACTURERS

- A. Appleton Electric: www.appletonelec.com.
- B. Steel City
- C. Substitutions: Reco, Inc. See Section 01 60 00 - Product Requirements.

2.03 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
 2. Concrete Ceiling Boxes: Concrete type.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- D. Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.04 FLOOR BOXES

- A. Floor Boxes: NEMA OS 1, fully adjustable, 4 inches deep.
- B. Material: Cast metal.
- C. Shape: Rectangular.
- D. Service Fittings: As specified in Section 26 27 26.

2.05 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 26 27 16.

- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron; Cast Aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
 - 1. Material: Galvanized cast iron; Cast Aluminum.
 - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: "ELECTRIC".

PART 3 EXECUTION

3.01 EXAMINATION

3.02

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- E. Install boxes plumb and level.
- F. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- G. Install boxes as required to preserve insulation integrity.

- H. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- I. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- J. Close unused box openings.
- K. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- L. Provide grounding and bonding in accordance with Section 26 05 26.
- M. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- N. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
- O. Coordinate installation of outlet boxes for equipment connected under Section 26 27 17.
- P. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- Q. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
 - 1. Adjust box locations up to 10 feet if required to accommodate intended purpose.
- R. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- S. Maintain headroom and present neat mechanical appearance.
- T. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- U. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- V. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- W. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- X. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- Y. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- Z. Use flush mounting outlet box in finished areas.
- AA. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- AB. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.
- AC. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- AD. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- AE. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- AF. Use adjustable steel channel fasteners for hung ceiling outlet box.
- AG. Do not fasten boxes to ceiling support wires.

- AH. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- AI. Use gang box where more than one device is mounted together. Do not use sectional box.
- AJ. Use gang box with plaster ring for single device outlets.
- AK. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- AL. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- AM. Set floor boxes level.
- AN. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.04 ADJUSTING

- A. Adjust floor boxes flush with finish flooring material.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

3.05 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.06 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 05 53**IDENTIFICATION FOR ELECTRICAL SYSTEMS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Warning signs and labels.
- F. Field-painted identification of conduit.

1.02 RELATED REQUIREMENTS

- A. Section 09 90 00 - Painting and Coating.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association.
- D. UL 969 - Marking and Labeling Systems.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.06 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements for additional requirements.

PART 2 PRODUCTS**2.01 IDENTIFICATION REQUIREMENTS**

- A. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
- B. Identification for Conductors and Cables:
 - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.

2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

2.02 MANUFACTURERS

- A. Brady Corporation: www.bradycorp.com.
- B. Seton Identification Products: www.seton.com/aec.
- C. HellermannTyton: www.hellermanntyton.com.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 1. Materials:
 2. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Identification Labels:
 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- D. Locations:
 1. Each electrical distribution and control equipment enclosure.
 2. Communication cabinets.
 3. Disconnect switches, and starters.
- E. Letter Size:
 1. Use 1/8 inch letters for identifying individual equipment and loads.
 2. Use 1/4 inch letters for identifying grouped equipment and loads.

2.04 WIRE AND CABLE MARKERS

- A. Manufacturers:
 1. Panduit Corp.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.

- G. Color: Black text on white background unless otherwise indicated.
- H. Description: split sleeve type wire markers.
- I. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
- J. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - 2. Control Circuits: Control wire number indicated on shop drawings.

2.05 VOLTAGE MARKERS

- A. Manufacturers: Panduit Corp
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Minimum Size:
 - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
 - 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 - 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 - 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- C. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
 - 2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
 - b. Other Systems: Type of service.
- D. Color: Black text on orange background unless otherwise indicated.
- E. Location: Furnish markers for each conduit longer than 6 feet.
- F. Spacing: 20 feet on center.
- G. Color:
 - 1. 480 Volt System: Brown.
 - 2. 208 Volt System: Yellow.
 - 3. Fire Alarm System: Red.
- H. Legend:
 - 1. 480 Volt System: brown.
 - 2. 208 Volt System: yellow.
 - 3. Fire Alarm System: red.

2.06 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - 2. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester, or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.
- B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 1. Surface-Mounted Equipment: Enclosure front.
 2. Flush-Mounted Equipment: Inside of equipment door.
 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 4. Elevated Equipment: Legible from the floor or working platform.
 5. Interior Components: Legible from the point of access.
 6. Conductors and Cables: Legible from the point of access.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing, or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

END OF SECTION

SECTION 26 05 73**OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Performance requirements for overcurrent protective devices.
- B. Short circuit study.
- C. Coordination study and analysis.

1.02 RELATED REQUIREMENTS

- A. Section 26 28 17 - Enclosed Circuit Breakers.
- B. Section 26 24 13 - Switchboards: Overcurrent protective devices in switchboards.
- C. Section 26 24 16 - Panelboards: Overcurrent protective devices in panelboards.
- D. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
- B. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis.
- C. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Study Report: Submit protective device studies as specified, prior to submission of product data submittals or ordering or fabrication of protective devices.
 - 1. Include stamp or seal and signature of preparing engineer.
- C. Field Engineer Qualifications.
- D. Field Inspection Report: Show final adjusted settings of protective devices.

1.05 PROTECTIVE DEVICE STUDY

- A. Analyze the specific electrical and utilization equipment (according to NEC definition), the actual protective devices to be used, and the actual feeder lengths to be installed.
 - 1. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
 - 2. Report: State the methodology and rationale employed in making each type of calculation; identify computer software package(s) used.
- B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with all electrical equipment and wiring to be protected by the protective devices; identify nodes on the diagrams for reference on report that includes:
 - 1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at the main switchboard bus and all downstream devices containing protective devices.

2. Breaker and fuse ratings.
 3. Generator kW and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 4. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
 5. Identification of each bus, with voltage.
 6. Conduit materials, feeder sizes, actual lengths, and X/R ratios.
- C. Short Circuit Study: Calculate the fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
1. Show fault currents available at key points in the system down to a fault current of 7,000 A at 480 V and 208 V.
 2. Include motor contributions in determining the momentary and interrupting ratings of the protective devices.
 3. Primary Fault Level Assumptions: Obtain data from utility company.
 4. Report: Include all pertinent data used in calculations and for each device include:
 - a. Device identification.
 - b. Operating voltage.
 - c. Protective device.
 - d. Device rating.
 - e. Calculated short circuit current, asymmetrical and symmetrical, and ground fault current.
- D. Coordination Study: Perform an organized time-current analysis of each protective device in series from the individual device back to the primary source, under normal conditions, alternate operations, and emergency power conditions.
1. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.
 2. Plot the specific time-current characteristics of each protective device on log-log paper.
 3. Organize plots so that all upstream devices are clearly depicted on one sheet.
 4. Also show the following on curve plot sheets:
 - a. Device identification.
 - b. Voltage and current transformer ratios for curves.
 - c. 3-phase and 1-phase ANSI damage curves for each transformer.
 - d. No-damage, melting, and clearing curves for fuses.
 - e. Cable damage curves.
 - f. Transformer inrush points.
 - g. Maximum short circuit cutoff point.
 - h. Simple one-line diagram for the portion of the system that each curve plot illustrates.
 - i. Software report for each curve plot, labeled for identification.
- E. Analysis: Determine ratings and settings of protective devices to minimize damage caused by a fault and so that the protective device closest to the fault will open first.
1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
 2. Identify any equipment that is underrated as specified.
 3. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve a change to the contract sum.

4. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Red Clay Consolidated School District, provide a discussion of alternatives and logical compromises for best achievable coordination.
 5. Do not order, furnish, or install protective devices that do not meet performance requirements unless specifically approved by Architect.
- F. Protective Device Rating and Setting Chart: Summarize in tabular format the required characteristics for each protective device based on the analysis; include:
1. Device identification.
 2. Relay CT ratios, tap, time dial, and instantaneous pickup.
 3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
 4. Fuse rating and type.
 5. Ground fault pickup and time delay.
 6. Input level and expected response time at two test points that are compatible with commonly available test equipment and the ratings of the protective device.
 7. Highlight all devices that as furnished by Contractor will not achieve required protection.

1.06 QUALITY ASSURANCE

- A. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
1. Acceptable Software Products:
 - a. Operation Technology, Inc; ETAP: www.etap.com.
 - b. SKM Systems Analysis, Inc; Power Tools for Windows: www.skm.com.
- B. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.
- C. Red Clay Consolidated School District's Responsibility: Provide data on relevant Red Clay Consolidated School District power distribution equipment.

PART 2 PRODUCTS

2.01 PROTECTIVE DEVICES

- A. Provide protective devices of ratings and settings as required so that the protective device closest to the fault will open first.
- B. In addition to requirements specified elsewhere, provide overcurrent protective devices having ratings and settings in accordance with results of this analysis.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Provide the services of a qualified field engineer and necessary tools and equipment to test, calibrate, and adjust the installed protective devices to conform to requirements determined by the coordination analysis.
- B. Adjust installed protective devices having adjustable settings to conform to requirements determined by the coordination analysis.
- C. Adjust solid-state protective modules for motors prior to applying load to motor.
- D. Submit report showing final adjusted settings of all protective devices.

END OF SECTION

SECTION 26 09 19**ENCLOSED CONTACTORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. General purpose contactors.
- B. Lighting contactors.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association.
- B. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; National Electrical Manufacturers Association.
- C. NEMA ICS 6 - Industrial Control and Systems: Enclosures; National Electrical Manufacturers Association.
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association.
- E. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide dimensions, size, voltage ratings and current ratings.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Allen-Bradley/Rockwell Automation: www.ab.com.
- B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL PURPOSE CONTACTORS

- A. Description: NEMA ICS 2, AC general purpose magnetic contactor.
- B. Coil operating voltage: 120 volts, 60 Hertz.
- C. Poles: As required to match circuit configuration and control function.
- D. Enclosure: NEMA ICS 6, Type 1.
- E. Accessories:
 - 1. Selector Switch: ON/OFF/AUTOMATIC.
 - 2. Indicating Light: RED.
 - 3. Auxiliary Contacts: One, normally open.

2.03 LIGHTING CONTACTORS

- A. Description: NEMA ICS 2, magnetic lighting contactor.
- B. Configuration: Mechanically held, 3 wire control.
- C. Coil operating voltage: 120 volts, 60 Hertz.
- D. Poles: As required to match circuit configuration and control function.
- E. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
- F. Enclosure: NEMA ICS 6, Type 1.
- G. Accessories:
 - 1. Selector Switch: ON/OFF/AUTOMATIC.
 - 2. Indicating Light: RED.
 - 3. Auxiliary Contacts: One, normally open.

2.04 ACCESSORIES

- A. Auxiliary Contacts: NEMA ICS 2, 2 normally open contacts in addition to seal-in contact.
- B. Cover Mounted Pilot Devices: NEMA ICS 5, oiltight type.
- C. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
- D. Pushbuttons: Lockable type.
- E. Indicating Lights:, LED type.

- F. Selector Switches: Rotary type.
- G. Relays: NEMA ICS 2,.
- H. Control Power Transformers: 120 volt secondary, 50 VA minimum, in each enclosed contactor. Provide fused primary and secondary, and bond unfused leg of secondary to enclosure.

2.05 DISCONNECTS

- A. Combination Contactors: Combine contactor with disconnect in common enclosure.
- B. Disconnects: Thermal magnetic circuit breaker with integral thermal and instantaneous magnetic trip in each pole; UL listed.
- C. Disconnects: Fusible switch assembly; NEMA KS 1, enclosed knife switch with externally operable handle. Fuse clips: Designed to accommodate Class R fuses.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed contactors where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 ft to operating handle.
- D. Provide fuses for fusible switches; refer to Section 26 28 13 for product requirements.
- E. Provide engraved plastic nameplates; refer to Section 26 05 53 for product requirements and location.

3.02 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform applicable inspections and tests listed in NETA STD ATS, Section 7.16.1.

END OF SECTION

SECTION 26 22 00**LOW-VOLTAGE TRANSFORMERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. General purpose transformers.
- B. K-factor transformers rated for nonlinear loads.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 05 34 - Conduit: Flexible conduit connections.
- E. Section 26 24 16 - Panelboards.

1.03 REFERENCE STANDARDS

- A. IEEE C57.94 - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers.
- B. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers.
- E. NEMA ST 1 - Specialty Transformers (Except General Purpose Type); National Electrical Manufacturers Association.
- F. NEMA ST 20 - Dry-Type Transformers for General Applications; National Electrical Manufacturers Association.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- H. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- I. NFPA 70 - National Electrical Code; National Fire Protection Association.
- J. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors required for mounting of transformers.
- B. NEMA TR-1/ANSI 57.12.51 and 57.12.50
- C. Federal Register - US department of Energy, Office of Energy Efficiency and Renewable Energy, 10 CFR Part 30, July 29, 2004. Energy Conservation Program for Commercial and Industrial Equipment, Energy Conservation Standards for Distribution Transformers, Proposed Rule.

- D. ANSI/ASHRAE/IESNA 90.1 - Energy Efficient Design on New Buildings Except Low- Rise Residential Buildings.
 - 1. Transformer selection based on optimizing the combination of no-load, part-load, and full-load losses without compromising operational and reliability requirements for the building.
- E. ANSI/NEMA TP-1 - Guide for Determining Energy Efficiency for Distribution Transformers.
 - 1. For Reference only. US DOE does not consider NEMA TP-1 efficiency levels to reflect low life cycle cost.
- F. ANSI/NEMA TP-2 - Standard Test Method for Measuring Energy Consumption of Distribution Transformers.
- G. IEEE C57.110-1998 - IEEE Recommended Practice for establishing transformer capability when feeding nonsinusoidal load currents.
 - 1. Transformers losses increase in proportion to the mix of electronic equipment in the overall load fed from transformer.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
- C. Provide linear load efficiency data at 25 %, 35%, 50 %, 75 % , and 100 % full load.
 - 1. Vibration Isolators: Include attachment method and rated load and deflection.
 - 2. K-factor Rated Transformers: Include K-factor ratings.
 - 3. Shielded Transformers: Include shielding method and noise attenuation performance.
- D. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
- F. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, core and coil material and rated temperature rise.
- G. Test Reports: Indicate loss data, efficiency at 0, 25, 50, 75 and 100 percent rated load, and sound level.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Project Record Documents: Record actual locations of transformers.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed 86 degrees F average or 104 degrees F maximum measured during any 24 hour period during and after installation of transformers.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric; Square D Products; Premium 30 energy efficient: www.schneider-electric.us.
- B. Eaton Electrical/Cutler-Hammer: www.eatonelectrical.com.
- C. Powersmiths International Corp.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ALL TRANSFORMERS

- A. Description: High performance, energy efficient, copper wound transformer with 30 % less losses than NEMA TP_1 , K-13 rated. Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet.
 - 2. Ambient Temperature: Not exceeding 86 degrees F average or 104 degrees F maximum measured during any 24 hour period.
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with epoxy copolymer build 72 Mils@3.2 kv/mil(dielectric) to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.

- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.03 K-FACTOR TRANSFORMERS RATED FOR NONLINEAR LOADS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 1561, and designed to supply nonlinear loads to the degree designated by the UL defined K-factor; ratings as indicated on the drawings.
- B. Primary Voltage: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 phase.
- D. Impedance: 5 % max
- E. Minimum efficiency: 99.04 % at 35 % loading of nameplate with linear /resistive load.
- F. Temp Rise: 115 deg cent. (full linear load)
- G. Impregnation: Epoxy copolymer build 72 mils@ 3.2kv/mil (dielectric)
- H. K-factor Rating: K-13, or higher.
- I. Insulation System and Allowable Average Winding Temperature Rise: Class 220 degrees C insulation system with 115 degrees C average winding temperature rise.
- J. Coil Conductors: Continuous copper windings with terminations brazed internal connections. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.
- K. Winding Taps: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
- L. Neutral Bus: Sized to accommodate twice the rated secondary current.
- M. Energy Efficiency: Premium efficiency complying with CSL-3 efficiency requirements of DOE 10 CFR Part 431.
- N. Sound Levels: Standard sound levels complying with NEMA ST 20.
 - 1. 151-300 kVA: 55 dB.
- O. Mounting Provisions:
 - 1. Up to 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 2. Larger than 75 kVA: Suitable for floor mounting.
- P. Electrostatic Shield: Provide grounded copper electrostatic shield between primary and secondary windings to attenuate electrical noise.
- Q. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 2.
 - 2. Construction: Heavy gage steel, ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.

4. Provide lifting eyes or brackets.
- R. Accessories:
1. Mounting Brackets: Provide manufacturer's standard brackets.
 2. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.04 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.
- B. Production test each unit according to NEMA ST 20.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- B. Install transformers in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 05 34, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Set transformers plumb and level.
- G. Mount floor-mounted transformers on properly sized 4 inch high concrete pad constructed in accordance with Section 03 30 00.
- H. Mount floor-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.
- I. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- J. Mount trapeze-mounted transformers as indicated.
- K. Provide seismic restraints.
- L. Provide grounding and bonding in accordance with Section 26 05 26.
- M. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- N. Where not factory-installed, install lugs sized as required for termination of conductors as

shown on the drawings.

- O. Identify transformers in accordance with Section 26 05 53.
- P. Install transformer identification nameplate in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.

3.04 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 24 13**SWITCHBOARDS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Switchboards.
- B. Switchboard accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for supporting foundations and pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 27 01 - Electrical Service Entrance.
- E. Section 26 28 13 - Fuses.
- F. Section 26 43 00 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

- A. ANSI C12.1 - American National Standard Code for Electricity Metering.
- B. ANSI C39.1 - American National Standard Requirements for Electrical Analog Indicating Instruments.
- C. IEC 60051-1 - Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 1: Definitions and General Requirements Common To All Parts;.
- D. IEC 60051-2 - Direct Acting Indicating Analogue Electrical Measuring Instruments and Their Accessories - Part 2: Special Requirements for Ammeters and Voltmeters.
- E. IEEE C12.1 - American National Standard Code for Electricity Metering; Institute of Electrical and Electronic Engineers.
- F. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; Institute of Electrical and Electronic Engineers.
- G. NECA 400 - Standard for Installing and Maintaining Switchboards (ANSI); National Electrical Contractors Association.
- H. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association.
- I. NEMA PB 2 - Deadfront Distribution Switchboards; National Electrical Manufacturers Association.
- J. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less; National Electrical Manufacturers Association.
- K. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.

- L. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.
- C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and switchboard instrument details.
- D. Test Reports: Indicate results of factory production tests.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Project Record Documents: Record actual locations of switchboards.
- G. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Enclosure Keys: Two of each different key.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in 48 inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Siemens Industry, Inc: www.sea.siemens.com.
- B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ←←SWITCHBOARDS

- A. Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.
- B. Ratings:
 - 1. Voltage: 120/208; 277/480 volts.
 - 2. Configuration: Three phase, four wire, grounded.
 - 3. Main Bus: 2000 amps.277/480 v, 2000 amps, 208/120v .
 - 4. Integrated Equipment Rating: 100000 rms amperes symmetrical.
- C. Main Section Devices: Individually mounted and compartmented.
- D. Distribution Section Devices: _Group mounted- double row sections.
- E. Bus Material: Copper with tin plating, standard size.
- F. Bus Connections: Bolted, accessible from front for maintenance.
- G. Fully insulate load side bus bars
- H. Ground Bus: Extend length of switchboard.
- I. Insulated Ground Bus: Extend length of switchboard.
- J. Molded Case Circuit Breakers: Integral thermal and instantaneous magnetic trip in each pole.
 - 1. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 - 2. Include shunt trip where indicated.
- K. Solid-State Molded Case Circuit Breakers: With electronic sensing, timing and tripping circuits for adjustable current settings; UL listed.
 - 1. Ground fault trip, ground fault sensing integral with circuit breaker.
 - 2. Instantaneous trip.
 - 3. Adjustable short time/ long time trip.
 - 4. Stationary mounting.
 - 5. Include shunt trip where indicated.
- L. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and sizes indicated.
- M. Ground Fault Sensor: Zero sequence type.
- N. Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay seconds. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.
- O. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.
- P. Enclosure: Type _NEMA 1-Indoors.
 - 1. Align sections at front and rear.
 - 2. Switchboard Height: 91.5 inches, excluding floor sills, lifting members and pull boxes.
 - 3. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.
 - 4. Structure: Free standing, self supporting, totally front accessible.

2.03 SURGE PROTECTIVE DEVICES

- A. See Section 26 43 00 for factory-installed, internally mounted surge protective devices. List and label switchboards containing surge protective devices as a complete assembly including surge protective device.

2.04 POWER METERS

- A. Manufacturers:
 - 1. Square D - Powerlogic Series 800 power meters or equal.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Watt-Hour Meters and Wattmeters: ANSI C12.1, three phase induction type with two stators, each with current and potential coil, rated 5 amperes and 120 volts at 60 Hertz.
 - 1. Meter suitable for connection to 3- and 4-wire circuits.
 - 2. Potential indicating lamps.
 - 3. Adjustments for light and full load, phase balance, and power factor.
 - 4. Digital register.
 - 5. Integral demand indicator.
 - 6. Ratchets to prevent reverse rotation.
 - 7. Removable meter with draw-out test plug.
 - 8. Semi-flush mounted case with matching cover.
- C. Provide meters with appropriate multiplier tags.

2.05 METERING TRANSFORMERS

- A. Manufacturers:
 - 1. Square D or equal.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Current Transformers: IEEE C57.13, 5 ampere secondary, wound; bushing; bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.
- C. Potential Transformers: IEEE C57.13, 120 volt single secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.

2.06 SOURCE QUALITY CONTROL

- A. Shop inspect and test switchboard according to NEMA PB 2.
- B. Make completed switchboard available for inspection at manufacturer's factory prior to packaging for shipment. Notify Red Clay Consolidated School District at least 7 days before inspection is allowed.

PART 3 EXECUTION

3.01 PREPARATION

- A. Provide concrete housekeeping pad under the provisions of Section 03 30 00.
- B. Verify that field measurements are as instructed by manufacturer.

3.02 INSTALLATION

- A. Install switchboard in locations shown on drawings, according to NEMA PB 2.1.

- B. Install in a neat and workmanlike manner, as specified in NECA 400.
- C. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- D. Identify switchboards in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.1.

3.04 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Tighten bolted bus connections in accordance with manufacturer's instructions.
- C. Adjust circuit breaker trip and time delay settings to values indicated.
- D. Adjust circuit breaker trip and time delay settings to values as instructed by Architect.

3.05 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 26 24 16**PANELBOARDS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 28 13 - Fuses: Fuses for fusible switches and spare fuse cabinets.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; National Electrical Contractors Association.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC; National Electrical Manufacturers Association.
- F. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association.
- G. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association.
- H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association.
- I. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- J. NFPA 70 - National Electrical Code; National Fire Protection Association.
- K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- M. UL 67 - Panelboards.

- N. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.
- O. UL 869A - Reference Standard for Service Equipment.
- P. UL 943 - Ground-Fault Circuit-Interrupters.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 - 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

1.09 MAINTENANCE MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two of each panelboard key.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
- B. General Electric Company: www.geindustrial.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ALL PANELBOARDS

- A. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- C. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
 - 3. Label equipment utilizing series ratings as required by NFPA 70.
- D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- G. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 3. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
 5. Metal frame for type written directory
 - 6.
- J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2.03 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase and Neutral Bus Material: Copper.
 2. Ground Bus Material: Copper.
- D. Circuit Breakers:
1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
- E. Enclosures:
1. Provide surface-mounted enclosures unless otherwise indicated.
 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide metal circuit directory holder mounted on inside of door.
- F. Manufacturers:
1. S.Q.D or Equal.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Description: NEMA PB 1, circuit breaker type.

- H. Service Conditions:
 - 1. Altitude: 1000 feet.
 - 2. Temperature: 55 degrees F.
- I. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- J. Minimum integrated short circuit rating: As indicated.
 - 1. 240 Volt Panelboards: 14,000 amperes rms symmetrical.
 - 2. 480 Volt Panelboards: 21,000 amperes rms symmetrical.
- K. Molded Case Circuit Breakers: With integral thermal and instantaneous magnetic trip in each pole; UL listed. For air conditioning equipment branch circuits provide circuit breakers UL listed as Type HACR.
- L. Molded Case Circuit Breakers with Current Limiters: With replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole; UL listed.
- M. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- N. Enclosure: NEMA PB 1, Type 1, 5 3/4" deep, 20" wide, cabinet box. With continued hinge and lock.
- O. Cabinet Front: Surface type, fastened with, hinged door with flush lock, finished in manufacturer's standard gray enamel.

2.04 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Products:
 - 1. SQD.
 - 2. Eaton Cutler Hammer.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Conductor Terminations:
 - 1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 - 2. Main and Neutral Lug Type: Mechanical.
- D. Bussing:
 - 1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 - 2. Phase and Neutral Bus Material: Copper.
 - 3. Ground Bus Material: Copper.
- E. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- F. Enclosures:
 - 1. Provide surface-mounted or flush-mounted enclosures as indicated.
 - 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 - 3. Provide metal circuit directory holder mounted on inside of door.
- G. Manufacturers:
 - 1. SQD or Equal.

2. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
- I. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
- J. Minimum Integrated Short Circuit Rating: As indicated.
 1. 240 Volt Panelboards: 14,000 amperes rms symmetrical.
 2. 480 Volt Panelboards: 21,000 amperes rms symmetrical.
- K. Molded Case Circuit Breakers: Thermal magnetic trip circuit breakers, bolt-on type, with common trip handle for all poles; UL listed.
 1. Type SWD for lighting circuits.
 2. Type HACR for air conditioning equipment circuits.
 3. Class A ground fault interrupter circuit breakers where scheduled.
 4. Do not use tandem circuit breakers, or miniature circuit breakers.
- L. Enclosure: NEMA PB 1, Type 1.
- M. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.
- N. Cabinet Front: Flush or Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.05 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 14000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 21000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Copper, suitable for terminating copper conductors only.
 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide interchangeable trip units where indicated.
 5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.

- 2) Long time delay.
- 3) Short time pickup and delay.
- 4) Instantaneous pickup.
- 5) Ground fault pickup and delay where ground fault protection is indicated.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
10. Do not use tandem circuit breakers.
11. Do not use handle ties in lieu of multi-pole circuit breakers.

2.06 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install panelboards plumb.
- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- H. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 30 00.
- I. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- J. Provide grounding and bonding in accordance with Section 26 05 26.

1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- K. Install all field-installed branch devices, components, and accessories.
- L. Install panelboards in accordance with NEMA PB 1.1 and NECA 1.
- M. Install panelboards plumb. Install recessed panelboards flush with wall finishes, where installed surface mounted secure or anchor panelboard to brick or cinder block wall.
- N. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- O. Provide filler plates to cover unused spaces in panelboards.
- P. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
1. Emergency and night lighting circuits.
 2. Fire detection and alarm circuits.
 3. Communications equipment circuits.
 4. Intrusion detection and access control system circuits.
 5. Video surveillance system circuits.
- Q. Identify panelboards in accordance with Section 26 05 53.
- R. Provide computer-generated circuit directory for each lighting and appliance panelboard, and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces.
- S. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- T. Provide identification nameplate for each panelboard in accordance with Section 26 05 53.
- U. Provide arc flash warning labels in accordance with NFPA 70.
- V. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling. Identify each as SPARE.
1. Minimum spare conduits: 5 empty 1 inch.
- W. Ground and bond panelboard enclosure according to Section 26 05 26.

3.03 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Inspect and test in accordance with NETA STD ATS, except Section 4.
- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA STD ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 400 amperes. Tests listed as optional are not required.
- E. Test GFCI circuit breakers to verify proper operation.

- F. Correct deficiencies and replace damaged or defective panelboards or associated components.
- G. Perform inspections and tests listed in NETA STD ATS, Section 7.5 for switches, Section 7.6 for circuit breakers.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 27 01**ELECTRICAL SERVICE ENTRANCE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Service racks.
- B. Metering transformer cabinets.
- C. Meter bases.

1.02 RELATED REQUIREMENTS

- A. Section 26 24 13 - Switchboards: Metering transformer compartment.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SYSTEM DESCRIPTION

- A. System Characteristics: 480Y/277 volts, three phase, four-wire, 60 Hertz.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide ratings and dimensions of transformer cabinets and meter bases.
- C. Submit utility company-prepared drawings.

1.07 QUALITY ASSURANCE

- A. Utility Company: City of Seaford dept of Electric
- B. Perform work in accordance with utility company written requirements and NFPA 70.
 - 1. Maintain one copy of each document on site.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.08 PRE-INSTALLATION MEETING

- A. Convene one week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. GE Industrial: www.geindustrial.com.

- B. Milbank Manufacturing: www.milbankmfg.com.
- C. Square D: www.squared.com.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

- A. Metering Transformer Cabinets: Sheet metal cabinet with hinged door, conforming to utility company requirements, with provisions for locking and sealing.
 - 1. Size: As required by utility.
- B. Meter Base: Furnished by utility company.
- C. Utility Transformer Pad: sized as indicated on drawings or size as required by Delmarva Power.
- D. Other Components: As required by utility company.

PART 3 EXECUTION

3.01 PREPARATION

- A. Arrange with utility company to obtain permanent electric service to the Project.
- B. Verify that field measurements are as indicated on utility company drawings.

3.02 INSTALLATION

- A. Install service rack, transformer pad, metering transformer cabinets, and meter base as required by utility company.
- B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

END OF SECTION

SECTION 26 27 17
EQUIPMENT WIRING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 34 - Conduit.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
- C. Section 26 05 37 - Boxes.
- D. Section 26 27 26 - Wiring Devices.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 COORDINATION

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
 - 4. Product:
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Disconnect Switches: As specified in Section and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 34.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 37.

2.02 EQUIPMENT CONNECTIONS

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION

SECTION 26 27 26**WIRING DEVICES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.
- E. Floor box service fittings.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 35 - Surface Raceways: Surface raceway systems, including multioutlet assemblies.
- C. Section 26 05 37 - Boxes.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 09 23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- F. Section 26 27 17 - Equipment Wiring: Cords and plugs for equipment.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.
- E. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association.
- G. UL 20 - General-Use Snap Switches.
- H. UL 498 - Attachment Plugs and Receptacles.
- I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.
- J. UL 943 - Ground-Fault Circuit-Interrupters.
- K. UL 1472 - Solid-State Dimming Controls.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

1.08 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two of each style, size, and finish wall plate.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Hubbell Incorporated; : www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc; : www.leviton.com.
- C. Lutron Electronics Company, Inc: www.lutron.com.
- D. Pass & Seymour, a brand of Legrand North America, Inc; : www.legrand.us
- E. Cooper Wiring Devices: www.cooperwiringdevices.com.
- F. Leviton Manufacturing, Inc: www.leviton.com.
- G. Substitutions: See Section 01 60 00 - Product Requirements.

- H. Source Limitations: Where possible, for each type of wiring device furnish products produced by a single manufacturer and obtained from a single supplier.

2.02 APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.
- D. Provide GFI protection for all receptacles installed within 6 feet of sinks.
- E. Unless noted otherwise, do not use combination switch/receptacle devices.
- F. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.03 ALL WIRING DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.04 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated; : www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc; : www.leviton.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc; : www.legrand.us
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Wall Switches: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Commercial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- D. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.
 - 1. Body and Handle: White plastic with toggle handle.
 - 2. Ratings:
 - a. Voltage: 120 - 277 volts, AC.
 - b. Current: 20 amperes.
 - 3. Ratings: Match branch circuit and load characteristics.
- E. Switch Types: Single pole, double pole, 3-way, and 4-way.

2.05 WALL DIMMERS

- A. Manufacturers:
 - 1. Leviton Manufacturing Company, Inc; _____: www.leviton.com.
 - 2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. All Wall Dimmers: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- C. Control: Slide control type with separate on/off switch.

2.06 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated; : www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc; : www.leviton.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc; : www.legrand.us
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. GFI Receptacles:
 - 1. All GFI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.
- D. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.
 - 1. Device Body: Black plastic.
 - 2. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacles: Type 5 - 20.
- F. Single Convenience Receptacles.
- G. Duplex Convenience Receptacles.
- H. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.07 TELEPHONE JACKS

- A. Product: AMP manufacturing
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 WALL PLATES

- A. Manufacturers:
 - 1. Hubbell Incorporated; : www.hubbell-wiring.com.
 - 2. Leviton Manufacturing Company, Inc; : www.leviton.com.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc; : www.legrand.us
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Standard; .
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.

- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Decorative Cover Plates: stainless steel.
- E. Jumbo Cover Plates: stainless steel.
- F. Weatherproof Cover Plates: Gasketed cast metal with hinged cover.

2.09 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
 - 1. Hubbell Incorporated; : www.hubbell-wiring.com.
 - 2. Thomas & Betts Corporation; : www.tnb.com.
 - 3. Wiremold, a brand of Legrand North America, Inc; : www.legrand.us
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Service fittings compatible with floor boxes provided under Section 26 05 37 with all components, adapters, and trims required for complete installation.
- C. Flush Floor Service Fittings:
 - 1. Dual Service Flush Combination Outlets:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 - 2) Communications: _____.
 - 2. Accessories:
 - a. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that openings in access floor are in proper locations.
- H. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1, including mounting heights specified in that standard unless otherwise indicated.
- C. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of wiring devices provided under this section.
- D. Install wiring devices in accordance with manufacturer's instructions.
- E. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- F. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- G. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- H. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- I. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- P. Install receptacles with grounding pole on top.
- Q. Connect wiring device grounding terminal to outlet box with bonding jumper.
- R. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- S. Connect wiring devices by wrapping conductor around screw terminal.
- T. Use jumbo size plates for outlets installed in masonry walls.
- U. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 37 to obtain mounting heights.

- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above backsplash of counter.
- E. Install telephone jack 18 inches above finished floor.
- F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.
- G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.
- H. Coordinate installation of access floor boxes with access floor system provided under Section 09 69 00.
- I. Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 26 05 40.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, adjusting, and balancing in accordance with Section 01 40 00.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Operate each wall switch with circuit energized and verify proper operation.
- E. Verify that each receptacle device is energized.
- F. Test each receptacle to verify operation and proper polarity.
- G. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- H. Correct wiring deficiencies and replace damaged or defective wiring devices.
- I. Verify that each telephone jack is properly connected and circuit is operational.

3.06 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.07 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 28 13**FUSES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Fuses.

1.02 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.04 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 MAINTENANCE MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two fuse pullers.
- C. Furnish three of each size and type fuse installed.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Cooper Bussmann, a division of Cooper Industries: www.cooperindustries.com.
- B. Mersen (formerly Ferraz Shawmut): ferrazshawmut.mersen.com.
- C. Littelfuse, Inc: www.littelfuse.com.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FUSES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Power Load Feeder Switches: Class RK1 (time delay).
- H. Motor Load Feeder Switches: Class RK1 (time delay).
- I. Other Feeder Switches: Class RK1 (time delay).
- J. General Purpose Branch Circuits: Class RK1 (time delay).
- K. Motor Branch Circuits: Class L time delay.
- L. Lighting Branch Circuits: Class G.

2.03 CLASS RK1 (TIME DELAY) FUSES

- A. Manufacturers:
 - 1. Bussman Corp.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction: Current limiting, dual-element fuse, 10 seconds minimum at 500% rated amps, with copper fuse element.

2.04 CLASS G FUSES

PART 3 EXECUTION

3.01 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 28 17**ENCLOSED CIRCUIT BREAKERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Enclosed circuit breakers.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain one copy of each document on site.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
- B. General Electric Company: www.geindustrial.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
 - 2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
 - 3. Label equipment utilizing series ratings as required by NFPA 70.
- E. Conductor Terminations: Suitable for use with the conductors to be installed.
- F. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- G. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
- H. Provide externally operable handle with means for locking in the OFF position.

2.03 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - 3. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

- C. Conductor Terminations:
 - 1. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- E. Molded Case Circuit Breakers: UL listed for the following service conditions:
 - 1. Temperature: 95 degrees F.
 - 2. Altitude: 1000 feet.

2.04 TRIP UNITS

- A. Field-Adjustable Trip Circuit Breakers: Provide circuit breakers with frame sizes 200 amperes and larger with mechanism for adjusting long time continuous current, short time pickup current setting for automatic operation. Range of Adjustment: amperes.
- B. Field-Changeable Ampere Rating Circuit Breaker: Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.
- C. Current Limiting Circuit Breaker: Provide circuit breaker as indicated with automatically-resetting current limiting elements in each pole. Let-through Current and Energy: Less than permitted for same size Class RK-5 fuse.
- D. Solid-State Circuit Breaker: Provide circuit breaker as scheduled with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip with zero sequence type ground fault sensor; instantaneous trip.

2.05 CURRENT LIMITERS

- A. Current Limiters: Designed for application with molded case circuit breaker.
- B. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
- C. Provide interlocks to trip circuit breaker and to prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.

2.06 ACCESSORIES

- A. Enclosures:
 - 1. Fabricate enclosures from steel.
 - 2. Finish: Manufacturer's standard enamel finish, gray color.
- B. Provide accessories as scheduled.
- C. Handle Lock: Include provisions for padlocking.
- D. Provide mechanical trip device.
- E. Provide grounding lug in each enclosure.
- F. Provide products suitable for use as service entrance equipment where so applied.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions.
- B. Install enclosed circuit breakers securely, in a neat and workmanlike manner in accordance with NECA 1.

- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install enclosed circuit breakers plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Height: 5 feet to operating handle.
- I. Provide identification nameplates for each enclosed circuit breaker in accordance with Section 26 05 53.
- J. Provide arc flash warning labels in accordance with NFPA 70.

3.02 FIELD QUALITY CONTROL

- A. Perform inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect and test in accordance with manufacturer's instructions and NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than 400 amperes. Tests listed as optional are not required.
- D. Correct deficiencies and replace damaged or defective enclosed circuit breakers.
- E. Perform field inspection and testing in accordance with Section 01 40 00.
- F. Inspect and test each circuit breaker.
- G. Inspect each circuit breaker visually.
- H. Perform several mechanical ON-OFF operations on each circuit breaker.
- I. Verify circuit continuity on each pole in closed position.
- J. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements.
- K. Include description of testing and results in test report.

3.03 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

END OF SECTION

SECTION 26 28 18**ENCLOSED SWITCHES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Fusible switches.
- B. Nonfusible switches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association.
- C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association.
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Project Record Documents: Record actual locations of enclosed switches.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Eaton Corporation; Cutler-Hammer Products; Model : www.eaton.com.
- B. General Electric Company; Model : www.geindustrial.com.
- C. Schneider Electric; Square D Products; Model : www.schneider-electric.us.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
 - 1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 - 2. Handle lockable in OFF position.
 - 3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
- B. Nonfusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
 - 1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 - 2. Handle lockable in OFF position.
- C. Enclosures: NEMA KS 1.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install enclosed switches in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide identification nameplate for each enclosed switch in accordance with Section 26 05 53.
- I. Provide arc flash warning labels in accordance with NFPA 70.
- J. Install fuses in fusible disconnect switches.
- K. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.02 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

END OF SECTION

SECTION 26 29 23**VARIABLE-FREQUENCY MOTOR CONTROLLERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Variable frequency controllers.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems; National Electrical Manufacturers Association.
- B. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives; National Electrical Manufacturers Association.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- C. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- D. Test Reports: Indicate field test and inspection procedures and test results.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Manufacturer's Field Reports: Indicate start-up inspection findings.
- G. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Reliance Electric/Rockwell Automation: www.reliance.com.
- B. Schneider Electric; Square D Products: www.schneider-electric.us.
- C. _Danfoss.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DESCRIPTION

- A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
 - 1. Employ pulse-width-modulated inverter system.
 - 2. Design for ability to operate controller with motor disconnected from output.
 - 3. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
- B. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public.
- C. Finish: Manufacturer's standard enamel.

2.03 OPERATING REQUIREMENTS

- A. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
- B. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
- C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
- D. Operating Ambient: 0 degrees C to 40 degrees C.
- E. Minimum Efficiency at Full Load: 85 percent.
- F. Time to Stop: 5 seconds.
- G. Volts Per Hertz Adjustment: Plus or minus 0 percent.
- H. Current Limit Adjustment: 60 to 110 percent of rated.
- I. Acceleration Rate Adjustment: 0.5 to 30 seconds.
- J. Deceleration Rate Adjustment: 1 to 30 seconds.
- K. Input Signal: 4 to 20 mA DC.

2.04 COMPONENTS

- A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
- B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
- C. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.
- D. Include undervoltage release.
- E. Control Power Source: Integral control transformer.
- F. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.
- G. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.
- H. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.
- I. Emergency Stop: Use dynamic brakes for emergency stop function.
- J. Disconnecting Means: Include integral fused disconnect switch on the line side of each controller.
- K. Wiring Terminations: Match conductor materials and sizes indicated.
- L. Line Reactor: Furnish line reactor (s) for harmonics mitigation.

2.05 SOURCE QUALITY CONTROL

- A. Shop inspect and perform standard production tests for each controller.
- B. Make completed controller available for inspection at manufacturer's factory prior to packaging for shipment. Notify Red Clay Consolidated School District at least 7 days before inspection is allowed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface is suitable for controller installation.
- B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.
- C. Verify that field measurements are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Provide fuses in fusible switches; refer to Section 26 28 13 for product requirements.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Identify variable frequency controllers in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. Provide the service of the manufacturer's field representative to prepare and start controllers.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Inspect and test in accordance with NETA STD ATS, except Section 4.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.17.

3.04 ADJUSTING

- A. Make final adjustments to installed controller to assure proper operation of load system.
Obtain performance requirements from installer of driven loads.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of controllers in automatic and manual modes.

3.06 MAINTENANCE

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of controllers for one year from Date of Substantial Completion.

END OF SECTION

SECTION 26 32 13**ENGINE GENERATORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Packaged engine generator system and associated components and accessories:
 - 1. Engine and engine accessory equipment.
 - 2. Alternator (generator).
 - 3. Generator set control system.
 - 4. Generator set enclosure.
- B. Packaged engine generator set.
- C. Heat exchanger.
- D. Exhaust silencer, emissions controls, and fittings.
- E. Remote control panel.
- F. Battery and charger.
- G. Sound enclosure.

1.02 RELATED REQUIREMENTS

- A. Section 26 36 00 - Transfer Switches: Automatic transfer switch.

1.03 REFERENCE STANDARDS

- A. NECA/EGSA 404 - Recommended Practice for Installing Generator Sets; National Electrical Contractors Association.
- B. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- D. NFPA 30 - Flammable and Combustible Liquids Code; National Fire Protection Association.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association.
- F. NFPA 99 - Standard for Health Care Facilities; National Fire Protection Association.
- G. NFPA 110 - Standard for Emergency and Standby Power Systems; National Fire Protection Association.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.

5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
 1. Include generator set sound level test data.
 2. Include characteristic trip curves for overcurrent protective devices upon request.
 3. Include alternator thermal damage curve upon request.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Specimen Warranty: Submit sample of manufacturer's warranty.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- F. Manufacturer's factory emissions certification.
- G. Manufacturer's certification that products meet or exceed specified requirements.
- H. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:
 1. Certified prototype tests.
 2. Torsional vibration compatibility certification.
 3. NFPA 110 compliance certification.
 4. Certified rated load test at rated power factor.
- I. Manufacturer's detailed field testing procedures.
- J. Field quality control test reports.
- K. Maintenance contracts.
- L. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
- M. Maintenance Materials: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Extra Fuses: One of each type and size.
 3. Extra Filter Elements: One of each type, including fuel, oil and air.
- N. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

- O. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and remote radiator.
- P. Test Reports: Indicate results of performance testing.
- Q. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- R. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- S. Manufacturer's Field Reports: Indicate procedures and findings.
- T. Operation Data: Include instructions for normal operation.
- U. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.
- V. Maintenance Materials and Tools: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 - 1. Extra Filter Elements: One of each type, including fuel, oil and air.
 - 2. Tools: One set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 - 1. Authorized service facilities located within 200 miles of project site.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.
- E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
 - 1. Contract maintenance office located within 200 miles of project site.
- F. Products: Listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
- G. Conform to requirements of NFPA 70.
 - 1. Maintain one copy of each document on site.
- H. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.
- I. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.

- J. Products: Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- C. Accept unit on site on skids. Inspect for damage.
- D. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Packaged Engine Generator Set - Basis of Design: Kohler Power Systems
- B. Packaged Engine Generator Set - Other Acceptable Manufacturers:
 - 1. Caterpillar Inc: www.cat.com/power-generation.
 - 2. Cummins Power Generation Inc: www.cumminspower.com.
- C. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- E. Source Limitations: Furnish engine generator sets and associated components and accessories produced by a single manufacturer and obtained from a single supplier.
- F. Caterpillar Inc: www.caterpillar.com.
- G. Cummins Engine Company, I: www.cummins.com.
- H. Kohler Power Systems: www.kohler.com.
- I. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

- A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. System Description:
 - 1. Application: _Stand by.
 - 2. Configuration: Single packaged engine generator set operated independently (not in parallel).
- C. Description: NFPA 110, engine generator system to provide source of power for Level 1 applications conforming to NFPA 99.
- D. System Capacity: 50 kW, 63 kVA at elevation of 100 feet above sea level, continuous rating using engine-mounted radiator.

2.03 ENGINE

- A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.
- B. Engine Fuel System - Gaseous (Spark Ignition):
 - 1. Fuel Source: Natural gas.
 - 2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
 - 3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
 - a. Carburetor.
 - b. Gas pressure regulators.
 - c. Fuel shutoff control valves.
 - d. Low gas pressure switches.
- C. Engine Starting System:
 - 1. System Type: Electric, with DC solenoid-activated starting motor(s).
 - 2. Battery(s):
 - a. Battery Type: Lead-acid.
 - b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
 - c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
 - 3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
 - 4. Battery Charger:
 - a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
 - b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
 - c. Recognized as complying with UL 1236.
 - d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.

- e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
- f. Provide alarm output contacts as necessary for alarm indications.
- 5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.
- D. Engine Speed Control System (Governor):
 - 1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
 - 2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
- E. Engine Lubrication System:
 - 1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.
 - 2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions.
- F. Engine Cooling System:
 - 1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
 - 2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
- G. Engine Air Intake and Exhaust System:
 - 1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
 - 2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
 - 3. Exhaust Silencer: Provide critical grade or better exhaust silencer with sound attenuation not less than basis of design; select according to manufacturer's recommendations to meet sound performance requirements, where specified.
- H. Type: Water-cooled inline or V-type, four stroke cycle, electric ignition natural-gas internal combustion engine.
- I. Rating: Sufficient to operate under 10 percent overload for one hour in an ambient of 90 degrees F at elevation of 1000 feet.
- J. Fuel System: Natural gas. Include manufacturer's approved regulator for pressure reduction from supply pressure.
- K. Engine speed: 1800 rpm.
- L. Governor: Isochronous type to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.
- M. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.
- N. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
- O. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 volts AC.

- P. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.
- Q. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.
- R. Mounting: Provide unit with suitable spring-type vibration isolators and mount on structural steel base.

2.04 GENERATOR

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.
- B. Exciter:
 - 1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
 - 2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
 - 3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.
- C. Temperature Rise: Comply with UL 2200.
- D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.
- E. Enclosure: NEMA MG 1, drip-proof.
- F. Total Harmonic Distortion: Not greater than five percent.
- G. Alternator Heater: Provide strip heater to prevent moisture condensation on alternator windings.

2.05 GENERATOR SET CONTROL SYSTEM

- A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.
- B. Control Panel:
 - 1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
 - 2. Generator Set Control Functions:
 - a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
 - b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
 - c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
 - d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
 - e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
 - f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
 - g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
 - 3. Generator Set Status Indications:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.

- b. Current (Amps): For each phase.
 - c. Frequency (Hz).
 - d. Real power (W/kW).
 - e. Reactive power (VAR/kVAR).
 - f. Apparent power (VA/kVA).
 - g. Power factor.
 - h. Duty Level: Actual load as percentage of rated power.
 - i. Engine speed (RPM).
 - j. Battery voltage (Volts DC).
 - k. Engine oil pressure.
 - l. Engine coolant temperature.
 - m. Engine run time.
 - n. Generator powering load (position signal from transfer switch).
4. Generator Set Protection and Warning/Shutdown Indications:
- a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
 - 1) Overcrank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (shutdown).
 - 6) Overspeed (shutdown).
 - 7) Low fuel level (warning).
 - 8) Low coolant level (warning/shutdown).
 - 9) Generator control not in automatic mode (warning).
 - 10) High battery voltage (warning).
 - 11) Low cranking voltage (warning).
 - 12) Low battery voltage (warning).
 - 13) Battery charger failure (warning).
 - b. Provide contacts for local and remote common alarm.
- C. Remote Annunciator:
- 1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
 - 2. Generator Set Status Indications:
 - a. Generator powering load (via position signal from transfer switch).
 - 3. Generator Set Warning/Shutdown Indications:
 - a. Comply with NFPA 110 for Level 1 systems including but not limited to the following indications:
 - 1) Overcrank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (shutdown).
 - 6) Overspeed (shutdown).
 - 7) Low fuel level (warning).
 - 8) Low coolant level (warning/shutdown).
 - 9) Generator control not in automatic mode (warning).
 - 10) High battery voltage (warning).
 - 11) Low cranking voltage (warning).
 - 12) Low battery voltage (warning).
 - 13) Battery charger failure (warning).
 - b. Provide audible alarm with silence function.

- c. Provide lamp test function that illuminates all indicator lamps.

2.06 GENERATOR SET ENCLOSURE

- A. Enclosure Type: Sound attenuating, weather protective.
- B. Enclosure Material: Aluminum.
- C. Hardware Material: Stainless steel.
- D. Color: Manufacturer's standard.
- E. Access Doors: Lockable, with all locks keyed alike.
- F. Openings: Designed to prevent bird/rodent entry.
- G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.
- H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.
- I. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.
- J. Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

2.07 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.
- C. Generator Set production testing to include, at a minimum:
 - 1. Operation at rated load and rated power factor.
 - 2. Single step load pick-up.
 - 3. Transient and steady state voltage and frequency performance.
 - 4. Operation of safety shutdowns.
- D. Generator: NEMA MG 1, single phase, four pole, reconnectable brushless synchronous generator with brushless exciter.
- E. Rating: 50 kW, 63 kVA, at 0.8 power factor, 480Y-277 volts, 60 Hz at 1800 rpm.
- F. Insulation Class: F.
- G. Temperature Rise: 105 degrees C Continuous.
- H. Enclosure: NEMA MG 1, open drip proof.
- I. Voltage Regulation: Include generator-mounted volts per hertz exciter-regulator to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Include manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain.

2.08 ACCESSORIES

- A. Heat Exchanger: Engine or base-mounted heat exchanger and expansion tank of type and capacity recommended by engine manufacturer. Include solenoid shut-off valve for installation on the cooling water inlet, and connected to open when engine runs.
- B. Exhaust Silencer: Residential type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.
- C. Batteries: Heavy duty, diesel starting type lead-acid storage batteries, 170 ampere-hours minimum capacity. Match battery voltage to starting system. Include necessary cables and clamps.
- D. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.
- E. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall-mounted enclosure to meet NEMA 250, Type 1 requirements.
- F. Line Circuit Breaker: Molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized in accordance with NFPA 70; UL listed. Include battery-voltage operated shunt trip, connected to open circuit breaker on engine failure. Unit mount in enclosure to meet NEMA 250, Type 1 requirements.
- G. Engine-Generator Control Panel: NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
 - 1. Frequency Meter: 45-65 Hz. range, 3.5 inch dial.
 - 2. AC Output Voltmeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.
 - 3. AC Output Ammeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.
 - 4. Output voltage adjustment.
 - 5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
 - 6. Engine start/stop selector switch.
 - 7. Engine running time meter.
 - 8. Oil pressure gage.
 - 9. Water temperature gage.
 - 10. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
 - 11. Additional visual indicators and alarms as required by NFPA 110.
 - 12. Remote Alarm Contacts: Pre-wire SPDT contacts to terminal strip for remote alarm functions required by NFPA 110.
- H. Remote Annunciator Panel: Surface mounted panel with brushed stainless steel. Provide audible and visible indicators and alarms required by NFPA 110.
- I. Emissions controls: Catalyst based, meeting State of Delaware Department of Natural Resources and Environmental Controls standards for stand-by generators.
- J. Sound Enclosure: Lift based steel construction with hinged doors. Acoustic insulation meeting UL94HF1 flammability classification and repels moisture absorption. Maximum sound level shall be 69 dB at 23.1 ft.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.

- B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive equipment.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1.
- B. Install in accordance with manufacturer's instructions.
- C. Install securely, in a neat and workmanlike manner, as specified in NECA/EGSA 404.
- D. Arrange equipment to provide minimum clearances and required maintenance access.
- E. Unless otherwise indicated, mount generator set on properly sized 6 inch high concrete pad constructed in accordance with Section 03 30 00. Provide suitable vibration isolators, where not factory installed.
- F. Provide required support and attachment in accordance with Section 26 05 29.
- G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.
- H. Provide gas piping in accordance with Section 22 10 05.
- I. Provide grounding and bonding in accordance with Section 26 05 26.
- J. Identify system wiring and components in accordance with Section 26 05 53.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- C. Notify Red Clay Consolidated School District and Architect at least two weeks prior to scheduled inspections and tests.
- D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.
- F. Preliminary inspection and testing to include, at a minimum:
 - 1. Inspect each system component for damage and defects.
 - 2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 - 3. Check for proper oil and coolant levels.
- G. Prepare and start system in accordance with manufacturer's instructions.
- H. Inspection and testing to include, at a minimum:
 - 1. Verify compliance with starting and load acceptance requirements.
 - 2. Verify voltage and frequency; make required adjustments as necessary.

3. Verify phase sequence.
 4. Verify control system operation, including safety shutdowns.
 5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).
- I. Provide field emissions testing where necessary for certification.
 - J. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.
 - K. Submit detailed reports indicating inspection and testing results and corrective actions taken.
 - L. Provide the services of manufacturer's representative to prepare and start system.
 - M. Perform field inspection and testing in accordance with Section 01 40 00.
 - N. Provide full load test utilizing portable test bank, if required, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal.
 - O. Record in 20 minute intervals during four hour test:
 1. Kilowatts.
 2. Amperes.
 3. Voltage.
 4. Coolant temperature.
 5. Room temperature.
 6. Frequency.
 7. Oil pressure.
 - P. Test alarm and shutdown circuits by simulating conditions.
 - Q. Field-verify emissions levels to meet manufacturer's documented criteria per submittals.

3.04 ADJUSTING

- A. Adjust generator output voltage and engine speed.

3.05 CLEANING

- A. Clean engine and generator surfaces. Replace oil and fuel filters.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. Demonstration: Demonstrate proper operation of system to Red Clay Consolidated School District, and correct deficiencies or make adjustments as directed.
- C. Training: Train Red Clay Consolidated School District's personnel on operation, adjustment, and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of four hours of training.
 3. Instructor: Manufacturer's authorized representative.
 4. Location: At project site.

3.07 PROTECTION

- A. Protect installed engine generator system from subsequent construction operations.

- B. Demonstrate operation to Red Clay Consolidated School District's operating personnel:
 - 1. Describe loads connected to emergency system and restrictions for future load additions.
 - 2. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency power.

3.08 MAINTENANCE

- A. Provide to Red Clay Consolidated School District a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
- B. Provide trouble call-back service upon notification by Red Clay Consolidated School District:
 - 1. Provide on-site response within 4 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Red Clay Consolidated School District.
 - 3. Red Clay Consolidated School District will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- C. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.
- D. Provide a separate maintenance contract for specified maintenance service.
- E. Provide service and maintenance of engine generator for one year from Date of Substantial Completion.

END OF SECTION

SECTION 26 36 00**TRANSFER SWITCHES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Automatic Transfer Switch.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 32 13 - Engine Generators: Testing requirements.

1.03 REFERENCE STANDARDS

- A. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment; National Electrical Manufacturers Association.
- B. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation Data: Instructions for operating equipment under emergency conditions when engine generator is running.
- E. Maintenance Data: Routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.05 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three years documented experience.
- D. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ASCO Power Technologies, LP: www.asco.com.
- B. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
- C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 AUTOMATIC TRANSFER SWITCH

- A. Description: NEMA ICS 10, automatic transfer switch.225amp,4 pole, in NEMA1 enclosure.
- B. Configuration: Electrically operated, mechanically held transfer switch.
- C. Interrupting Capacity:42000 amp minimum ,rms .

2.03 SERVICE CONDITIONS

- A. Service Conditions: NEMA ICS 10.
- B. Temperature: 105 deg F.
- C. Altitude: 3,300 feet.

2.04 COMPONENTS

- A. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE.
- B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
- C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate source to normal source.
- D. Transfer Switch Auxiliary Contacts: 1 normally open; 1 normally closed.
- E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 percent from rated nominal value.
- F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent from rated nominal value.
- G. In-Phase Monitor: Inhibit transfer until source and load are within zero electrical degrees.
- H. Switched Neutral: Overlapping contacts.
- I. Enclosure: ICS 10, Type 1, finished with manufacturer's standard gray enamel.

2.05 AUTOMATIC SEQUENCE OF OPERATION

- A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
- B. Time Delay To Start Alternate Source Engine Generator: 0 to 6 seconds, adjustable.
- C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
- D. Time Delay Before Transfer to Alternate Power Source: 0 to 60 seconds, adjustable.
- E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

- F. Time Delay Before Transfer to Normal Power: 0 to 60 seconds, adjustable; bypass time delay in event of alternate source failure.
- G. Time Delay Before Engine Shut Down: 0 to 1 minutes, adjustable, of unloaded operation.
- H. Engine Exerciser: Start engine every 15days run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface is suitable for transfer switch installation.

3.02 PREPARATION

- A. Provide 6" housekeeping pads.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Identify transfer switches in accordance with Section 26 05 53.
- C. Provide engraved plastic nameplates under the provisions of Section 26 05 53.

3.04 FIELD QUALITY CONTROL

- A. Provide the services of the manufacturer's technical representative to check out transfer switch connections and operation and place in service.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Inspect and test in accordance with NETA STD ATS, except Section 4.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.22.3.

3.05 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of transfer switch in bypass, normal, and emergency modes.

3.06 MAINTENANCE

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of transfer switches for one year from Date of Substantial Completion.

END OF SECTION

SECTION 26 51 00**INTERIOR LIGHTING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts.
- E. Lamps.
- F. Luminaire accessories.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 37 - Boxes.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 09 23 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- D. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.
- E. Section 26 56 00 - Exterior Lighting.

1.03 REFERENCE STANDARDS

- A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns.
- B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast.
- C. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type).
- D. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.
- E. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- G. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association.
- H. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association.

- I. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association.
- J. NFPA 70 - National Electrical Code; National Fire Protection Association.
- K. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association.
- L. UL 924 - Emergency Lighting and Power Equipment.
- M. UL 935 - Fluorescent-Lamp Ballasts.
- N. UL 1598 - Luminaires.
- O. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution
- C. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- D. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
- E. Field Quality Control Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

- H. Maintenance Materials: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
 - 3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
 - 4. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
- I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 70 and NFPA 101.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty for all linear fluorescent ballasts.

1.10 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two of each plastic lens type.
- C. Furnish one replacement lamps for each lamp type.
- D. Furnish two of each ballast type.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acuity Brands, Inc; : www.acuitybrands.com.
- B. Cooper Lighting, a division of Cooper Industries; _____: www.cooperindustries.com.
- C. Hubbell Lighting, Inc; : www.hubbellighting.com.

- D. Philips Lighting: www.usa.philips.com
- E. Lithonia Lighting: www.lithonia.com.
- F. Columbia Lighting.
- G. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LUMINAIRES

- A. Manufacturers:
 - 1. Acuity Brands, Inc; : www.acuitybrands.com.
 - 2. Cooper Lighting, a division of Cooper Industries; : www.cooperindustries.com.
 - 3. Hubbell Lighting, Inc; : www.hubbellighting.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. LED Luminaires: Listed and labeled as complying with UL 8750.
- I. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.03 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Acuity Brands, Inc; : www.acuitybrands.com.
 - 2. Cooper Lighting, a division of Cooper Industries; : www.cooperindustries.com.
 - 3. Hubbell Lighting, Inc; : www.hubbellighting.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924. Emergency and Exit light combination unit with (2) unit mounted lamps and LED exit light with battery backup. This combination unit shall have spare capacity to power remote emergency lamp heads.
- C. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

- D. Battery:
 - 1. Sealed maintenance-free nickel cadmium unless otherwise indicated.
 - 2.
 - 3. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- G. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- H. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
 - 3. Provide compatible accessory wire guards where indicated.
 - 4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.04 LUMINAIRES

- A. Furnish products as indicated in Schedule attached to this section.
- B. Substitutions: See Section 01 60 00 - Product Requirements.
 - 1. Input Voltage: 120 or 277 volts.

2.05 EXIT SIGNS

- A. Manufacturers:
 - 1. Acuity Brands, Inc; : www.acuitybrands.com.
 - 2. Cooper Lighting, a division of Cooper Industries; : www.cooperindustries.com.
 - 3. Hubbell Lighting, Inc; : www.hubbellighting.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.
- C. Self-Powered Exit Signs:
 - 1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 - 2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
 - 3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 - 4. Provide low-voltage disconnect to prevent battery damage from deep discharge.
 - 5. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test

and diagnostic status.

- D. Accessories:
 1. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
 2. Provide compatible accessory wire guards where indicated.
- E. Manufacturers: As indicated on lighting fixture schedule.
 1. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Exit Signs: Exit sign fixture.
 1. Housing: Plastic.
 2. Face: Translucent glass face with red letters on white background.
 3. Face: Aluminum stencil face with red letters.
 4. Directional Arrows: Universal type for field adjustment.
 5. Mounting: Universal, for field selection.
 6. Battery: 12 volt, nickel-cadmium type, with 1.5 hour capacity.
 7. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
 8. Lamps: Manufacturer's standard.
 9. Input Voltage: 120/277 volts.

2.06 BALLASTS

- A. Manufacturers:
 1. General Electric Company/GE Lighting; : www.gelighting.com.
 2. Osram Sylvania; : www.sylvania.com.
 3. Philips Lighting Electronics/Advance; : www.advance.philips.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
 5. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
- B. All Ballasts:
 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- C. Fluorescent Ballasts:
 1. All Fluorescent Ballasts: Unless otherwise indicated, provide high frequency electronic ballasts complying with ANSI C82.11 and listed and labeled as complying with UL 935.
 - a. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
 - b. Total Harmonic Distortion: Not greater than 10 percent.
 - c. Power Factor: Not less than 0.95.
 - d. Thermal Protection: Listed and labeled as UL Class P, with automatic reset for integral thermal protectors.
 - e. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
 - f. Lamp Compatibility: Specifically designed for use with the specified lamp, with no visible flicker.
 - g. Lamp Operating Frequency: Greater than 20 kHz, except as specified below.
 - 1) Do not operate lamp(s) within the frequencies from 30 kHz through 40 kHz in order to avoid interference with infrared devices.
 - h. Lamp Current Crest Factor: Not greater than 1.7.
 - i. Provide automatic restart capability to restart replaced lamp(s) without requiring resetting of power.

- j. Provide end of lamp life automatic shut down circuitry for T5 and smaller diameter lamp ballasts.
 - k. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
 - l. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 18, for Class A, non-consumer application.
 - m. Provide high efficiency T8 lamp ballasts certified as NEMA premium where indicated.
 - n. Ballast Marking: Include wiring diagrams with lamp connections.
2. Non-Dimming Fluorescent Ballasts:
- a. Lamp Starting Method:
 - 1) T8 Lamp Ballasts: Programmed start unless otherwise indicated.
 - 2) T5 Lamp Ballasts: Programmed start unless otherwise indicated.
 - 3) Compact Fluorescent Lamp Ballasts: Programmed start unless otherwise indicated.
 - b. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of 0 degrees F, and energy saving lamp(s) at a minimum of 60 degrees F unless otherwise indicated.

2.07 LAMPS

- A. Manufacturers:
- 1. General Electric Company/GE Lighting; : www.gelighting.com.
 - 2. Osram Sylvania; : www.sylvania.com.
 - 3. Philips Lighting Company; : www.lighting.philips.com.
 - 4. Philips Lighting Co of NA: www.lighting.philips.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Lamps:
- 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
 - 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
 - 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
 - 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.
- C. Compact Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
- 1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
 - 2. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
 - 3. Color Rendering Index (CRI): Not less than 80.
 - 4. Average Rated Life: Not less than 10,000 hours for an operating cycle of three hours per start.
- D. Linear Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
- 1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
 - 2. T8 Linear Fluorescent Lamps:
 - a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.

- b. Color Rendering Index (CRI): Not less than 80.
- c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
- 3. T5 Linear Fluorescent Lamps:
 - a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
 - b. Color Rendering Index (CRI): Not less than 80.
 - c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
- E. Lamp Types: As specified for each luminaire.
- F. Fluorescent Lamps:
 - 1. Product: Phillips Lighting - Type T5 or T8.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- G. High Intensity Discharge (HID) Lamps:
 - 1. Product: Match Lighting Fixture Type
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- D. Tube Guards for Linear Fluorescent Lamps: Provide clear virgin polycarbonate sleeves with endcaps where indicated.
- E. Product: As indicated in lighting fixture schedule.
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of luminaires provided under this section.

- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure pendant-mounted luminaires to building structure.
 - 4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Suspended Luminaires:
 - 1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 2. Install canopies tight to mounting surface.
- H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- I. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- J. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- K. Support luminaires independent of ceiling framing.
- L. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- M. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- N. Exposed Grid Ceilings: Support surface mounted luminaires in grid ceiling directly from building structure.
- O. Exposed Grid Ceilings: Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
- P. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- Q. Install recessed luminaires to permit removal from below.

- R. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- S. Install clips to secure recessed grid-supported luminaires in place.
- T. Install wall mounted luminaires, emergency lighting units, and exit signs at height as scheduled.
- U. Install accessories furnished with each luminaire.
- V. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- W. Bond products and metal accessories to branch circuit equipment grounding conductor.
- X. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- Y. Air Handling Luminaires: Interface with air handling accessories furnished and installed under Section 23 36 00.
- Z. Emergency Lighting Units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- AA. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- AB. Install lamps in each luminaire.
- AC. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
- D. Operate each luminaire after installation and connection to verify proper operation.
- E. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- F. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.
- D. Aim and adjust luminaires as indicated.
- E. Position exit sign directional arrows as indicated.

3.06 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

3.07 CLOSEOUT ACTIVITIES

- A. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

3.09 PROTECTION

- A. Relamp luminaires that have failed lamps at Substantial Completion.

3.10 SCHEDULE - Attached

END OF SECTION

SECTION 26 56 00**EXTERIOR LIGHTING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Exterior luminaires.
- B. Ballasts.
- C. Lamps.
- D. Poles and accessories.
- E. Luminaire accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 37 - Boxes.

1.03 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals; American Association of State Highway and Transportation Officials.
- B. ANSI O5.1 - American National Standard for Wood Poles -- Specifications and Dimensions.
- C. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information.
- D. IESNA LM-64 - Photometric Measurements of Parking Areas.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- F. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association.
- H. UL 1598 - Luminaires.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution .
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
 - 2. Lamps: Include rated life and initial and mean lumen output.
 - 3. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- G. Maintenance Materials: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
- H. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acuity Brands, Inc; : www.acuitybrands.com.

- B. Hubbell Lighting, Inc; : www.hubbellighting.com.
- C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the Drawings.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 LUMINAIRES

- A. Manufacturers:
 - 1. Acuity Brands, Inc; : www.acuitybrands.com.
 - 2. Hubbell Lighting, Inc; : www.hubbellighting.com.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- E. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- F. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- I. LED Luminaires: Listed and labeled as complying with UL 8750.
- J. Exposed Hardware: Stainless steel.

2.04 BALLASTS

- A. Manufacturers:
 - 1. General Electric Company/GE Lighting; : www.gelighting.com.
 - 2. Osram Sylvania; : www.sylvania.com.
 - 3. Philips Lighting Electronics/Advance; : www.advance.philips.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Ballasts:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

2.05 LAMPS

- A. Manufacturers:
 - 1. General Electric Company/GE Lighting; : www.gelighting.com.
 - 2. Osram Sylvania; : www.sylvania.com.
 - 3. Philips Lighting Company; : www.lighting.philips.com.

4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Lamps:
1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

2.06 POLES

- A. Manufacturers:
1. Acuity Brands, Inc; : www.acuitybrands.com.
 2. Hubbell Lighting, Inc; : www.hubbellighting.com.
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Poles:
1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
 2. Structural Design Criteria:
 - a. Comply with AASHTO LTS.
 - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
 - 1) Design Wind Speed: 100 miles per hour, with gust factor of 1.3.
 3. Material: Steel, unless otherwise indicated.
 4. Shape: Square straight, unless otherwise indicated.
 5. Finish: Match luminaire finish, unless otherwise indicated.
 6. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Handhole.
 - c. Anchor bolts with leveling nuts or leveling shims.
 - d. Anchor base cover.
 - e. Pole-top tenon, size as required for installed luminaire or bracket.
- C. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.07 ACCESSORIES

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Install accessories furnished with each luminaire.
- F. Bond products and metal accessories to branch circuit equipment grounding conductor.
- G. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.06 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 27 10 00

STRUCTURED CABLING

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These standards are adopted by the Department of Technology and Information (DTI), through the Technology and Architecture Standards Committee (TASC), and are applicable to all Information Technology use throughout the State of Delaware. Any questions or comments should be directed to dti_tasc@state.de.us.

PART 1 SCOPE

- A. **Areas Covered:** This specification covers the practices and installation requirements for Voice, Data, CATV cabling and support structures including conduits and raceways, Voice and Data rooms and closets. With respect to all of the above mentioned items covered in this document, this document shall be considered the specification that shall be followed. If it appears to contradict any other part(s) of the bidding/construction documents the most stringent requirements shall be adhered to unless otherwise authorized by the Architect/Engineer in writing.
- B. **Environments:** This specification applies to all State owned and leased building and office spaces. It is concerned with all Data, Voice and CATV cabling projects, whether they are for new construction or revisions additions and upgrades to existing systems.

PART 2 PROCESS

- A. **Adoption:** These specifications have been adopted by the Department of Technology and Information (DTI) through the Technology and Architecture Standards Committee (TASC) and are applicable to all Information Technology use throughout the State of Delaware.
- B. **Contractors:** Contractors or other third parties are required to comply with these specifications when proposing technology solutions to DTI or other State entities. Failure to do so could result in rejection by the Delaware Technology Investment Council. For further guidance, or to seek review of a component that is not rated below, contact the TASC at dti_tasc@state.de.us.
- C. **Contact us:** Any questions or comments should be directed to dti_tasc@state.de.us.

PART 3 EXECUTIVE SUMMARY

Because of ever-advancing industry standards and new alliances between cable and hardware manufactures and vendors this document is issued to enhance and clarify the State of Delaware's wiring and cabling standards and specifications for structured cabling systems. Approved contractors under State of Delaware Contract # 05-441-TL are required to adhere to these specifications and standards.

The structured cabling system will support voice, data, and imaging applications within State owned and leased public school facilities. This document describes the structured cabling system requirements to be met in the proposals for communications cabling by vendors and contractors. These requirements encompass all materials, design, engineering, installation, supervision, and training services for a structured cabling system.

The following are approved manufacturers of the structured cabling systems that can be bid for new construction and whole building renovations where all building structured cabling wiring is replaced.

- Hubbell Premise Wiring
- Ortronics
- Panduit
- Systemax

A. Terms and Conditions of Bids/quotes

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1. An approved Contractors bid should be based on the materials, systems, equipment, Standards and Specifications described in this document and in the bid response format of the attached example. Refer to Appendix G. All bids must be submitted in accordance with the specifications and information contained herein, as well as with any addenda, if required.
2. The bid package shall be accompanied by a presale warranty commitment, binding the Installation Contractor and Manufacturer to the customer-selected extended warranty package as described in State Contract # 05-441-TL page 21 section 3) paragraph b).
3. At any point in time, should you require clarification or have any questions pertaining to the content of this document, please call The State of Delaware Department of Technology and Information (DTI). 302-739-9500

PART 4 OBJECTIVE

To maximize the usefulness of this document, access to the various TIA/EIA (Telecommunications Industry Association/Electronic Industries Alliance), IEEE (Institute of Electrical and Electronics Engineers), BICSI, (Building Industry Consulting Service International), NEC (National Electrical Code), NFPA (National Fire Protection Association) Communications Standards, and implementation and installation Manuals for further reference is required. This document assumes that users have communications knowledge and training in all aspects of design, implementation, installation, and testing of a Voice/Data communications system.

This document does not address safety issues associated with use. It is the individual contractors' responsibility to use established and appropriate safety and health practices and to determine the applicability of all regulations.

PART 5 CREDITS

Communications Cabling Construction

Developed by:

State of Delaware Department of Technology & Information
801 Silver Lake Blvd. Dover, DE
19904

The content of this document is drawn from experience, as well as other documents and manuals, including the following:

- NEC 2011 Code book
- NFPA-70 Publications
- TIA/EIA Communications Building Wiring Standards
- IEEE Publications & Standards
- BICSI Communications Distribution Design and Installation Publications
- MOTOROLA R56 Standards and Guideline for Communications
- Various Manufactures Publications and Requirements

PART 6 INTRODUCTION

The Structured Universal Cabling System installed for the Delaware Center for Educational Technology (DCET) of the State of Delaware is designed to meet known and anticipated technology needs within the school system. An advanced building cabling system provides for more than communication services; it provides an infrastructure for an institution's entire communications network. Instead of being a basic utility, it is as important as the high-tech systems that transmit signals over it and is an integral component of the State's overall information network.

These designs provide a universal and flexible cabling system for workstations, conference rooms, and

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laboratories. Today's cabling system must be multi-functional and provide service for telephones, computers, fax machines, LANs, WANs, broad band fiber optic and coaxial systems (CATV, SATV, CCTV.), Data Centers, computer-aided design workstations, Audio Video systems (AV), and other technologies. For a cabling system to be capable of meeting today's technology and institutional demands, it must have high bandwidth capacity and transmission speed while being extremely flexible.

This wiring architecture incorporates the applicable ANSI/EIA/TIA standards, BICSI guidelines and the latest technologies. This cabling distribution plan can integrate all types of systems from a variety of vendors. The design uses a subsystem approach, which allows for changes in the system without affecting other parts of the system. The Main Distribution Frame (MDF) and Intermediate Distribution Frame (IDF) Room equipment racks are designed to allow for growth, and the cable routing is accomplished through the provision of cable trays, conduits, sleeves, raceways, and cable hangers where required. Ease of administration and recordkeeping for moves and changes is readily apparent, as is the flexibility that a structured cabling system provides.

The wiring medium for the Communications Cable Network consists of Category 6 24AWG Unshielded Twisted Pair (UTP) for station cabling and multi pair twisted copper for backbone cabling to support low-speed voice or Data, Category 6 for high speed LAN technologies, and 62.5/125 micron multi-mode fiber optic cable and 50/125 micron multi-mode for even higher bandwidth requirements. The unshielded twisted pair (UTP) Category 6 LAN cables can support Data transmission rates of 100, 250 and 500 Mb/Sec respectively according to EIA/TIA Standards and manufacturers' specifications. These leading edge components, combined with the open wiring architecture, provide the technology, flexibility, and modularity that allow the system to grow and change to meet changing needs.

The central distribution location of the system is the Fiber Optic, coaxial and Copper Main Distribution Frame (MDF) located within the centrally located MDF/IDF Room of each building. Various fiber optic, coaxial and copper riser cables terminate on the MDF and extend to the Communications Rooms/Closets (IDFs) located throughout the buildings. Each building typically has one MDF/IDF Room and a varying number of IDF rooms/closets dictated by the horizontal station cabling limitation of 100 meters for high performance cable. The distance from the information outlet to the termination within the IDF is limited to 90 meters (the permanent link). The IDF room/closet houses the Intermediate Distribution Frame (IDF), Copper and Fiber Optic IDF Patch Panels, Local Area Network (LAN) equipment, and other electronics. Both the riser cables and the horizontal station cables feeding the floor's workstations information outlets terminate in the IDF on Data patch panels, Voice 110 hardware, and Fiber Optic Patch Panels. These termination points act as the cross-connect point between the MDF and the floor that is being served. Large floors are divided into zones, via an imaginary line, with each zone being served by its respective IDF room/closet. (See figure 1)

Each work area and workstation is served by an information outlet, which provides the jacks for plugging in telephones, computers, broad band coaxial systems, fax machines, modems, and other devices at the desktop. The information outlets are served by varying sets of cables consisting of fiber optic and copper technologies, which originate in the IDF Room. IDF outlets are typically displayed as varying types of triangles (shaded, half-shaded, etc.) on project drawings. (See figure 2)

A subsystem architectural approach, using the latest technologies, provides a comfortable level of assurance that the system will support new applications and industry standards as they emerge.

FIGURE 1 – Example only

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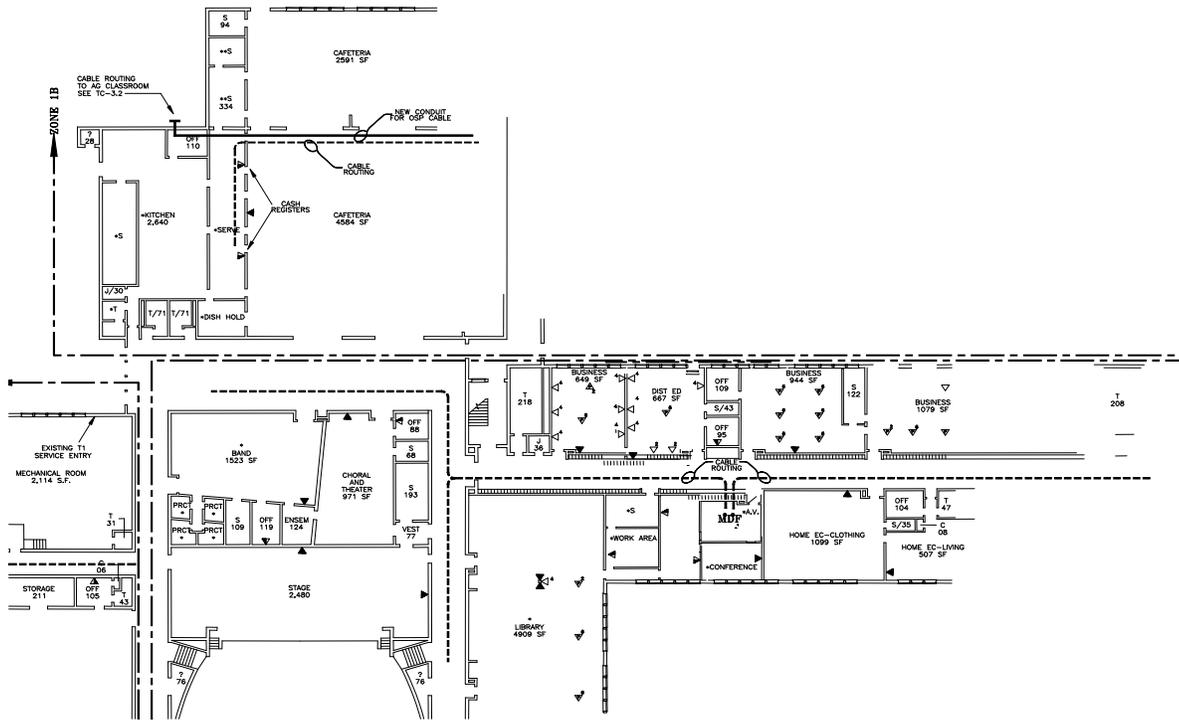
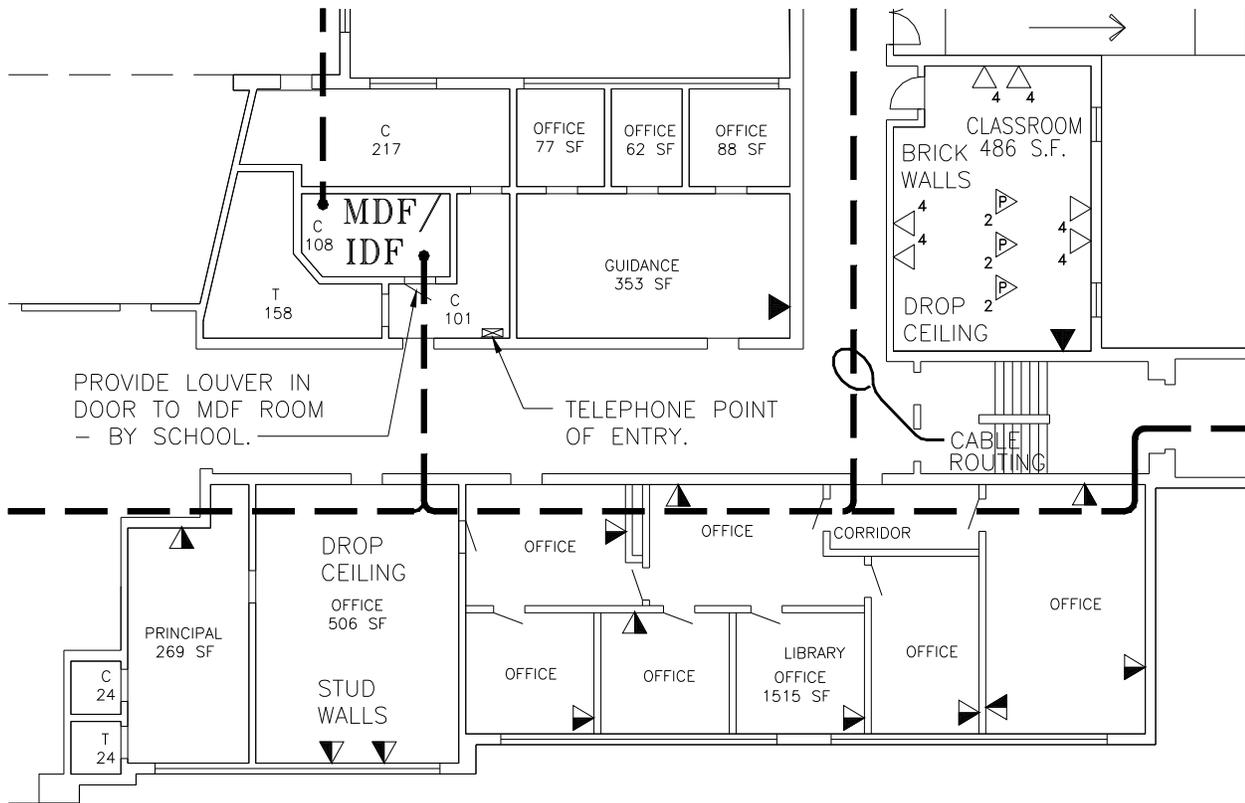


FIGURE 2 - Example Only
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PART 7 PROCEDURES

Not used.

PART 8 HORIZONTAL DISTRIBUTION SYSTEM

The horizontal structured cable plant is the portion of the communications wiring system that extends from the information outlet to the Communications/Data room/closet.

A. Horizontal Distribution System General

1. The horizontal distribution system includes the:
 - Information outlet at the workstation
 - Cables connecting the workstation to the Communications/Data room/closet
 - Intermediate routing and distribution systems
2. The horizontal distribution system shall be configured in a star topology. All communications outlets within a work area shall be connected to a single Communications/Data room/closet, as defined by the zone concept.
3. This infrastructure must serve all of the Communications requirements of the Owner.
4. Communications applications served by the horizontal system shall include:

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- Voice (e.g., telephones)
 - Data (e.g., terminal connectivity, etc.)
 - Local area networks (e.g. Ethernet)
 - Audio & Video (e.g., CATV and video conferencing)
 - Graphics & Imaging
5. All Horizontal Workstation Communications and broad band coaxial system cabling shall be "home-run" from the information outlet location to the termination point within the corresponding IDF or MDF/IDF room.
 6. Horizontal cable paths will be in a "streets and avenues" manner, typically following main walkways.
 7. Horizontal cables are to be fastened onto hangers five feet apart with all cables bundled with tie wraps, and are to have a small amount of slack visible.
 8. Cables shall not rest on any structures or the hung ceiling. Cables shall not to be fastened to ducts, pipes, conduits, or any other structures. Cable bundles shall be secured to the slab overhead to avoid any conflict with or EMI from flexible electrical conduits, transformers, motors, etc.
 9. Cabling shall be run to workstation and other outlets through cavities in the dry wall and openings in sheet metal or wooden studs within the dry wall construction. The sheet metal studs will not have gaskets for this purpose, so it is the Contractor's responsibility to exercise extreme care in snaking cable through these areas, so as to avoid damage to the cable jacketing.
 10. The building's horizontal wiring plan is to be installed on all floors from the information outlet to the termination point within the associated IDF/MDF Room.
 11. Horizontal cable will be installed onto "J" hooks or equivalent in the ceiling or tops of walls near ceiling. Cables are to be fastened to "J" hooks or equivalent every 5 feet. The cable contractor is to provide and furnish the "J" hooks.
 12. All cabling provided for this project under this specification and associated drawings shall be plenum-rated.
 13. Outside of the MDF/IDF and IDFs, all cabling is to be run within walls and above ceilings in a concealed fashion. In rare instances where cabling cannot be run in a concealed fashion, it shall be run in appropriately sized EMT conduit in as inconspicuous a manner as possible and or where directed on drawings. All outlets shall be provided with recessed, rigid metal boxes when installed within ceilings and walls. In cases where exposed EMT is used, the rigid metal boxes shall be surface mounted. In the case of cabling to be run in CMU walls, it shall be run in appropriately sized EMT within the CMU walls.

B. Horizontal Communications Cable Specification

1. For each type of information outlet indicated on the drawings attached to the work order, the contractor shall furnish, install, and test all of the following equipment.
2. All Category 6 cabling is to be handled and terminated in accordance with the Manufacturer's Premises Communications Application Bulletin titled "High Performance UTP Installation Guide."
3. All Fiber Optic Cabling is to be handled and terminated in accordance with the Manufacturer's Application Bulletin titled "Premise Wiring Fiber Optic Cable Installation Guidelines."

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4. In addition to the above manufacturer's standards, all applicable EIA/TIA Category 6 and Fiber Optic Cable standards are to be strictly adhered to.
5. The fiber optic cable is to be connectorized on both ends with an SC type connector.
6. The contractor is to use Plenum cable for all station four-pair copper, coaxial, and two-strand fiber cabling. Plan routes to ensure that the proposed route on the plans falls within the EIA/TIA distance limitations (90 meters after termination) for horizontal cabling.
7. Contractor will provide all raceway fittings to allow for level and plumb routes from ceiling to information outlet. Proper fill ratios must be observed. Contractor may reference the manufacturer's catalogs or specifications for correct fittings and fill ratios. Contractor must use all accessory fittings required in order to build a neat and functional installation. This same method will apply to routing horizontal cables to classroom outlets where ceilings are not accessible.

C. Termination of Coaxial Cables

The RG-6U Plenum Cable and the RG11U Plenum Cable is to be terminated with F type connector or connectors.

D. Horizontal IDF Station Cable Terminations For Classrooms and Offices

1. The IDF Room side of the Category 6 four pair cables serving voice jacks will be punched down on the corresponding IDF Room wall-mounted frame on 110 Cat 6 field terminated 300-pair cross-connect terminal blocks.
2. The IDF Room side of the Category 6 four-pair cables serving data jacks will be punched down on individual 110 (Category 6) 24 and 48 Port RJ45 modular patch panels, 568B wired. The CAT 6 patch panels will be mounted in the relay racks within the IDF rooms.
3. In locations that have wall-mounted racks, the contractor is to use the Cat 6 "hinged down" patch panels with associated cable management. In cases where the "hinged down" series is required, the contractor is to take care to dress the cables neatly and allow for future access to the rear of the panel.
4. The drawings indicate which patch panel is to be used at each location.
5. The RG6U Coaxial Station cable serving coaxial jacks will be terminated onto a wall mounted "F" Connector Patch Panel located in the IDF/MDF Rooms.
6. The IDF Room side of the two-strand Fiber Optic cables serving fiber optic jacks shall be terminated on Fiber Optic Patch Panels as shown in the drawings.
7. The Contractor will provide Fiber patch panels and mount them in relay racks within the IDF rooms as indicated on the drawings.
8. The contractor is to provide wire management panels where and as shown on the drawings. The drawings indicate which patch panel is to be used at each location. Contractor is to label both the front and the rear of the patch panels. The terminations are to follow this sequence: Workstation Room#-Outlet#. Example (B101-01, B101-02, B101-03, B102-01, B102-02, etc.)

E. Zones

1. A zone is a contiguous area in which all horizontal wiring is homed to a single communications closet.
2. To maintain an orderly, understandable wiring system, it is imperative that the horizontal distribution system be structured in zones.
3. Within a zone, all communications wiring is run to a single communications closet.
4. Other zones use different Communications/Data rooms/closets. Cross-zone horizontal wiring is prohibited. Connections between zones are provided via the vertical distribution system.

PART 9 COMMUNICATIONS/DATA ROOMS/CLOSETS (GENERAL)

The Communications/Data room/closet is a concentration point for communications and LAN services. In this room, premise wiring and cabling are terminated and cross-connected. In addition, active networking devices such as LAN hubs or switches are placed here. Communications/Data rooms/closets provide a safe area for housing distribution cabling, premise equipment, and termination fields. These rooms/closets are a focal point for communications services.

In addition to supporting in-house connectivity, the MDF Communications/Data room/closet often provides a termination point for the local telephone company. The entrance facility, or demarcation point (de-mark), is the location where outside communications services, such as copper telephone lines, fiber optic Data circuits, and CATV, are delivered to the building. Typically, distribution of communications services within the building originates at this point.

The following section details the basic requirements for a Communications/Data rooms/closets.

A. Design Guidelines

Not Used

B. General Room Requirements**1. Grounding**

- Most Communications and Data equipment requires bounding and grounding of equipment cabinets. Do not use plumbing or conduit (EMT) fixtures as a ground source. Grounding shall meet the NEC and EIA/TIA requirements and practices except where other authorities or codes impose more stringent requirements or practices. (Refer to NEC Chapter 2 article 250 and Chapter 8 Communications Systems, TIA/EIA Standard J-STD-607-A and Motorola R56 Standards and Guideline for Communication site).
- In addition to protecting personnel and equipment from hazardous voltages, the grounding system may reduce the effect of electromagnetic interference (EMI) throughout the structured cable plant. Improper grounding can result in induced currents that disrupt Communications circuits.
- Ensure that the installation conforms with applicable regulations and practices
- Ensure that each Communications/Data room/closet has an appropriate ground buss bar
- Ensure that grounding is available for cross-connect frames, patch panel racks, Telephone and Data equipment, as well as testing and maintenance equipment

2. Space

- A distance of three feet is the preferred clearance from the front, back, and side of a relay rack.
- If there are space constraints, it is acceptable to provide a minimum of two feet of clearance on one rack side for access and a minimum of two feet of front and back clearance for cross-connect fields, patch panels, etc. If possible, locate sleeves, cores, slots, and/or conduits together in one area to maximize usable wall space.

3. Rooms/Closets Sizing

- Not used

4. Structural Walls

- Extend from the floor to the deck above (fire wall)
- Be securely fastened to the floor and the deck above
- Conform to national and local construction guidelines

5. Wall Linings

- Each Communications/Data room/closet will contain a minimum of one furred-out or flush sheet of plywood (4' X 8') mounted on the wall. Refer to drawings for actual quantities.
- Securely fasten the plywood to wall framing members to ensure that it can support any attached equipment.
- The plywood is to be 3/4", A/C grade, and fire-retardant.
- All plywood backboards are to be mounted smooth side out and painted white at time of installation, prior to installation of equipment onto the plywood.

6. Floor Finish

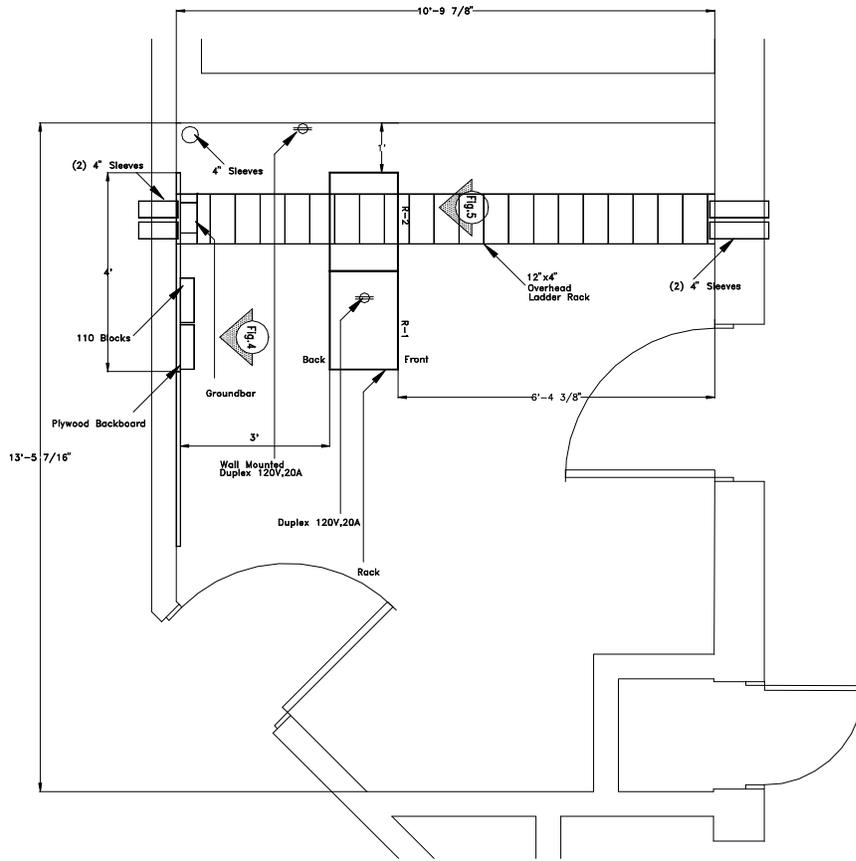
- Keep dust to a minimum in Communications/Data rooms/closets.

C. MDF Requirements

An MDF Room is a specialized communications closet that may house major communications systems, such as a PBX (private branch exchange), communications processor, and routing equipment. The MDF Room is generally considered to be distinct from an IDF Room because of the complexity of the equipment it contains.

A typical Main Distribution Frame (MDF) Room is composed of a wall-mounted plywood backboard or backboards and relay racks designed for mounting termination equipment and electronics (see **Error! Reference source not found.**). Most MDFs within the building cabling system also serve as an IDF. This is accomplished by providing separate relay racks for each and delineating the wall-mounted frame's 110 blocks for Station cabling (see **Figure 3 and Figure 4**).

FIGURE 3 – Sample Layout



Main Distribution Frame Room Layout
NOT TO SCALE

FIGURE 4 – Sample Elevation

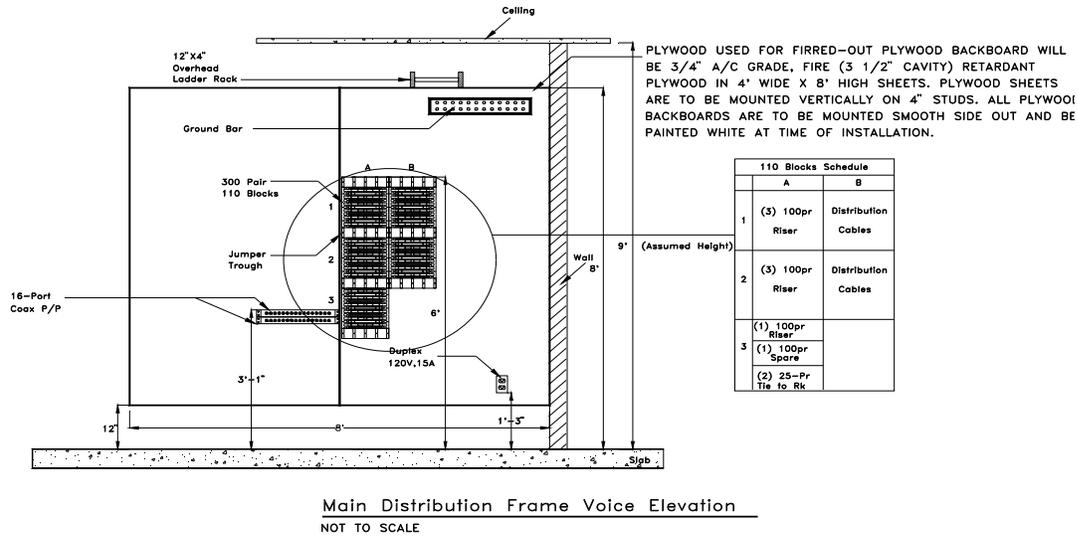
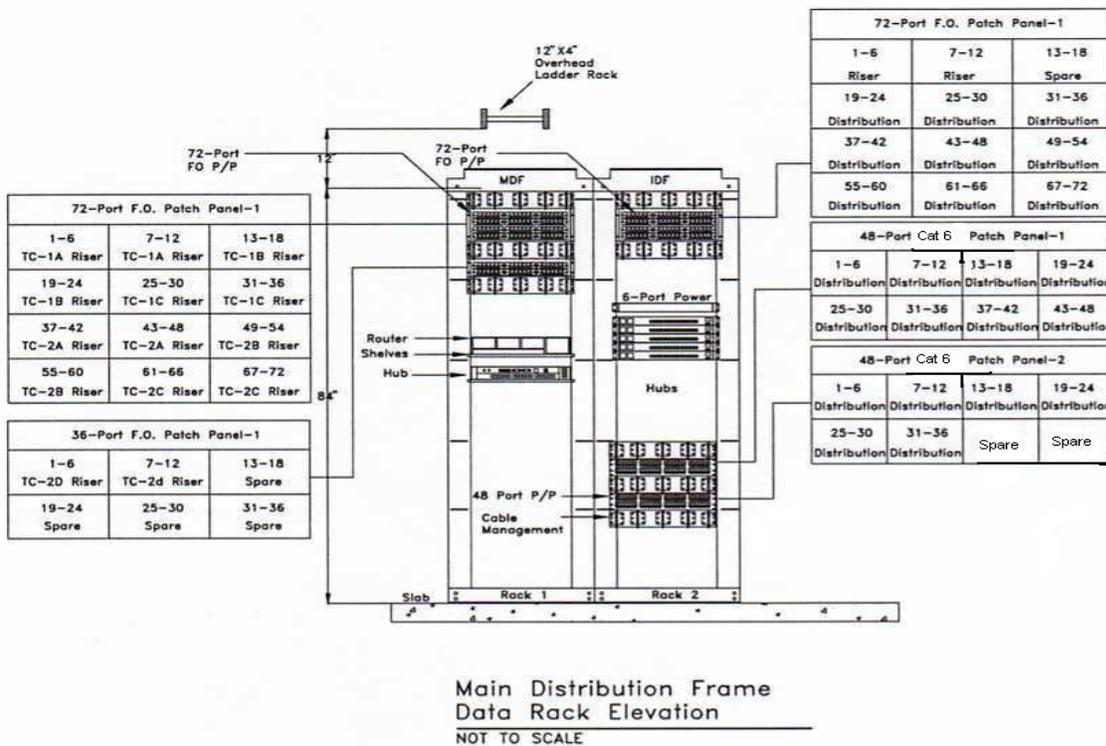


FIGURE 5 – Sample Elevation



1. Local Exchange Carrier (LEC)

- Placement of Communications equipment may be influenced by vendors and service providers. For instance, the LEC (local phone company) may decide to terminate the Central Office (CO) service directly into the equipment space provided or request termination space other than that offered by the customer. If they request termination at a point other than that requested by the customer, the LEC should provide reasonable explanation.

- The LEC, CATV, and most service providers will require a conduit entrance in to the building to provide their service. The minimum requirements are two (2) four- inch conduits for the LEC and one (1) four-inch conduit for each other service provider, unless they specify otherwise in writing.
- It is critical that the high speed Data line (T1), TLS, and CSU/DSU be located in the MDF room. This will ensure security and simplify troubleshooting.
- The LEC may also need space for distribution systems terminations (either horizontal or vertical) and patch cable terminations.

2. Relay Racks

- The MDF will contain a minimum of one 19"W X 7"H Relay Rack onto which the fiber optic/copper patch panels and Data electronics are mounted.
- The relay racks shall have a minimum of 42 rack units of mounting space on standard 19" wide rails.
- All racks are to be grounded and bolted to each other as well as to the slab or wall.
- The rack shall have vertical and horizontal cable management to accommodate routing of patch cords as shown on the drawings.
- The rear of the rack is to face the plywood backboard and a distance of 48" is to be maintained from the foot of the relay rack.
- The side of the rack should have a minimum 6" clearance to an adjacent wall.
- The relay rack specifications and associated components shall meet the requirements of the equipment that will be installed in it.
- It shall be at a minimum 84" tall with 6" rails, with 19" equipment mounting space and vertical and horizontal wire management.

3. Data Equipment Cabinets

- Data equipment cabinets should conform to the State Data Center Standard as follows:

Cabinet size	24"Wx48"Dx72"H
Rack units	42 rack units for equipment mounting
Mounting rails	two pair 19" adjustable depth universal mounting
Mesh steel doors	single front and split rear with locking handles
Vertical cable management	trough, rings or Velcro tie downs or combination of, mountable left or right side
PDU mounting	space to mount two vertical PDU closest to equipment mountable left or right side
Side panels	removable, solid, both sides
Top	solid with cabling access opening capabilities
Bottom if required	solid with cabling access opening capabilities

- Cabinet shall have grounding, bounding and anti-tip capabilities that can be added when required.
- Approved cabinet Manufacturer: Cooper B-Line part #V422448ACXXSSSB or approved equal

4. Cable Trays

- Between the relay rack and the wall-mounted frame, a 12" cable tray (center-rail systems are not permitted), with a 4" load depth and 6" rung spacing is to be installed suspended from a ceiling support structure, mounted to the relay rack and the wall.
- Do not attach any cable tray to a suspended ceiling grid.
- An open wire basket cable tray system is acceptable for cable support.
- Approved manufacturer: Cooper B-Line part # FT4X12X10

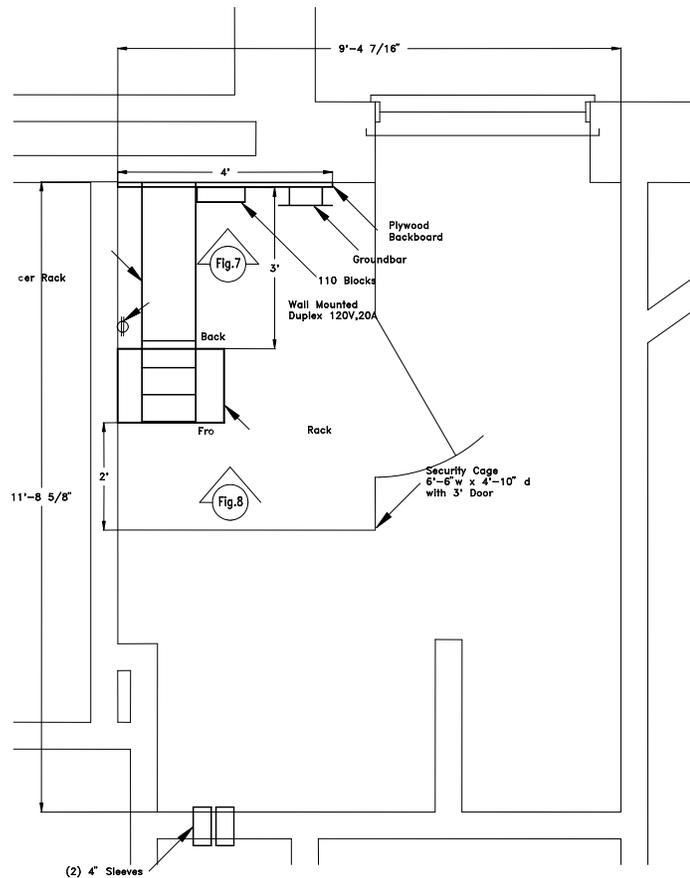
D. IDF Room Requirements

Each IDF Rooms within a building supports all connections in single, contiguous area (zones). Cross-zone wiring is not to be installed from user workstations. Connections between zones are made through backbone wiring systems, which link the IDF Rooms to the MDF. A typical Intermediate

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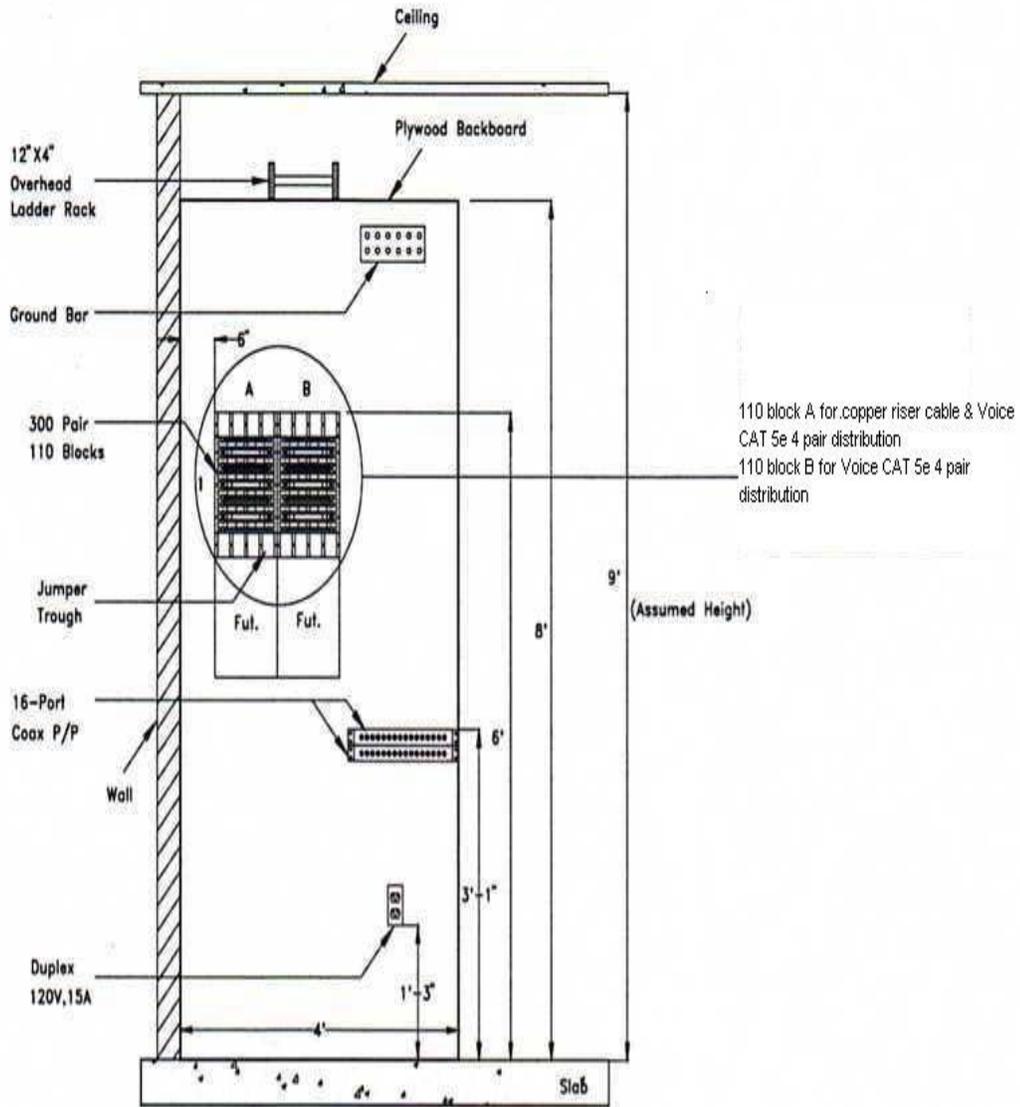
Distribution Frame (IDF) Room is composed of a wall-mounted plywood backboard and relay racks designed for mounting termination equipment and electronics.

FIGURE 6 – Sample Layout



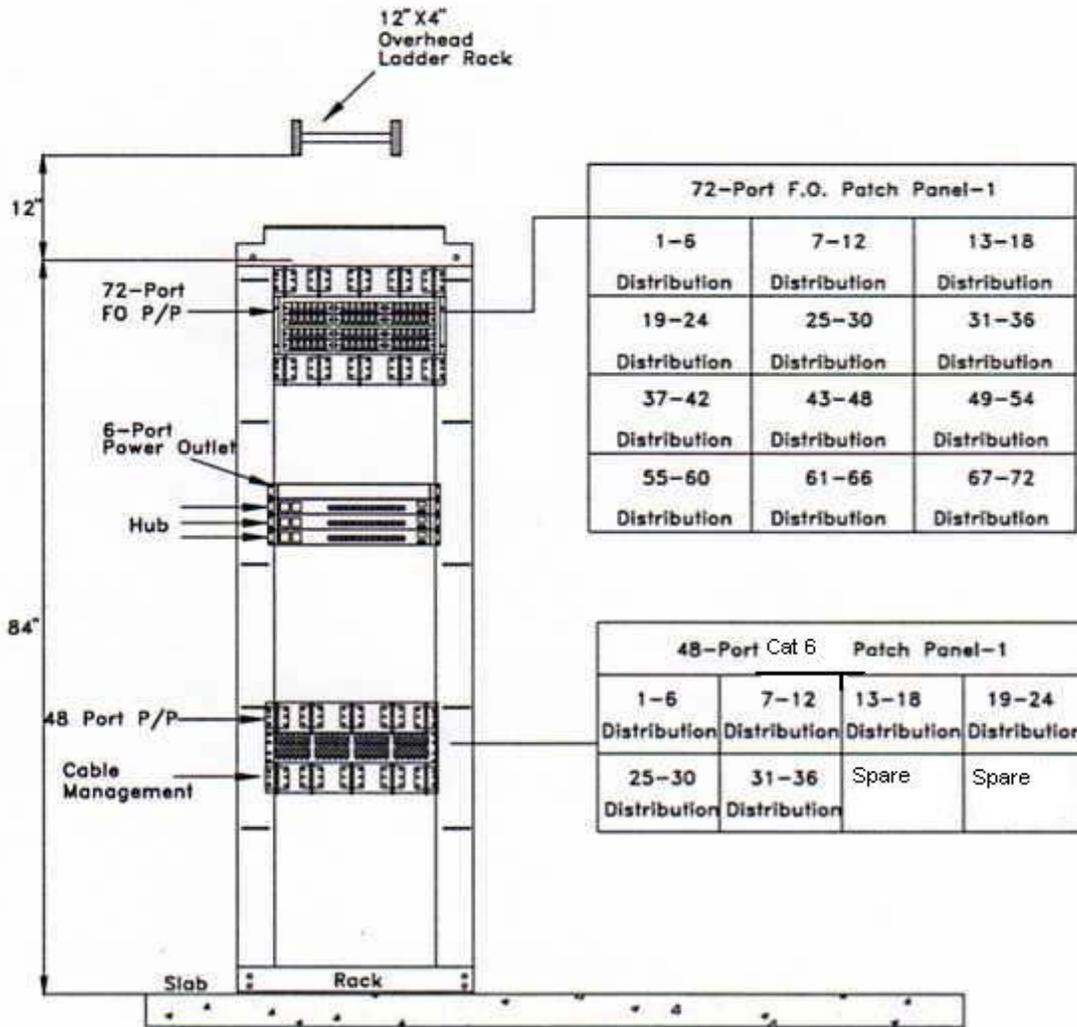
Sample IDF - TELECOMMUNICATIONS CLOSET LAYOUT
NOT TO SCALE

FIGURE 7 – Sample Elevation



Sample IDF –Telecommunications Closet Elevation
 NOT TO SCALE

FIGURE 8 – Sample Elevation



**Sample IDF –Telecommunications Closet
Data Rack Elevation**

NOT TO SCALE

1. Plywood Backboard

- Each IDF Room will contain a minimum of one 4' X 8' sheet of plywood flush-mounted on the wall.
- Securely fasten the plywood to wall-framing members to ensure that it can support attached equipment.
- The plywood is to be 3/4", A/C grade and fire retardant.
- All plywood backboards are to be mounted smooth side out and painted with white fire retardant paint at time of installation and prior to installation of equipment onto the plywood.

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2. Relay Racks

- Each MDF will contain a minimum of one 19"W X 7"H Relay Rack onto which the fiber optic/copper patch panels and Data electronics are mounted.
- The relay racks shall have a minimum of 42 rack units of mounting space on standard 19" wide rails.
- manufacturer's requirements, and space allocated.
- All racks are to be grounded and bolted to each other as well as to the slab or wall.
- The rack shall have vertical and horizontal cable management to accommodate routing of patch cords as shown on the drawings
- The rear of the rack is to face the plywood backboard and a distance of 48" is to be maintained from the foot of the relay rack.
- The side of the rack should have a 6" clearance to an adjacent wall.
- The relay rack specifications and associated components shall meet the requirements of the equipment that will be installed in it.
- It shall be at a minimum 84" tall with 6" rails, with 19" equipment mounting space and vertical and horizontal wire management.

3. Cable Trays

- Between the relay rack and the wall-mounted frame, a 12" cable tray (no center rail systems), with a 4" load depth and 6" rung spacing is to be installed suspended from a ceiling support structure, mounted to the relay rack and the wall.
- Do not attach cable trays to the suspended ceiling grid.
- An open wire basket cable tray system is acceptable for cable support.

PART 10 MDF & IDF PRODUCT SPECIFICATIONS

- **Category 6 Patch Panels**

The default cabling infrastructure shall be Category 6 unless specified otherwise.

1. Category 6 Patch Panel Requirements

- Category 6 patch panels shall be standard 8-position, RJ-45 style, un-keyed, in 48-port configurations.
- Panel frames shall be 14-gage steel with rolled edges top and bottom for proper stiffness.
- Panel design shall incorporate plastic push-fasteners to permit hands-free positioning onto standard EIA-310-D 19" mounting rails.
- Panels shall accommodate a minimum of 24 ports for each rack mount unit (1 RMU = 1.75 in.).
- Panels shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
- Panels shall terminate 26-22 AWG solid conductors, with maximum insulation diameter of 0.050 in.
- Panels shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.
- Panels shall have individual port identification numbers on the front and rear of the panel.
- Panel adapter modules shall be 110-style termination with tin lead solder plated IDC contacts.
- Printed circuit boards shall be fully enclosed front and rear for physical protection.
- Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
- Panel contacts shall be constructed of Beryllium copper for maximum spring force and durability.
- Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.
- Panel termination method shall follow the industry standard 110 IDC punch-down, using a standard 110 impact termination tool.
- Panels shall be compatible with a 4-pair multi-punch impact termination tool designed specifically for the purpose. Bending or other damage to the panel using a multi-pair punch tool shall not occur.
- IDC contact termination towers shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist.
- IDC contacts shall be Phosphor Bronze with 100 micro-inch tin lead 60/40 plating over nickel.
- Panels shall not require special cords, specialty tools or special installation requirements.
- Panel ports shall accept optional hinged dust covers and port identification icon buttons.

- Space above the adapter ports shall be available for additional labeling per ANSI/TIA/EIA-606-A.
- Panels shall accept a clip-on rear cable management support bar to provide cable strain relief.

2. Category 6 Patch Panel Performance Requirements

- All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
- Category 6 panels shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1, Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.
- The manufacturer shall provide Category 6 component compliance certificates from third party testing organizations upon request.
- Panels shall be UL LISTED 1863 and CSA certified.
- Panels shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
- Panel contacts shall withstand a minimum of 2000 mating cycles with an FCC 8-position RJ-45 plug, without degradation of electrical or mechanical performance.
- Panels shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
- Category 6 panels shall meet the current draft 10 Gb/s performance requirements of IEEE 802.3an and TSB-155, for a maximum 55-meter channel length. Conditions of requirement No. 10 above apply.

3. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
P6E48U	NEXTSPEED® Category 6 Patch Panel, 48-Ports
PCBLMGT	Rear Cable Management Bar

- Or approved equal of: Ortronics, Panduit, Systemax

4. Category 6 Patch Panel Installation Requirements

- Horizontal and backbone cabling of the proper category shall be fully deployed into the TR, TE, or ER according to applicable codes and standards.
- Cable slack, service loops, bend radii, and pathway fill ratio shall comply with applicable codes and standards.
- Racks, cabinets, enclosures, and metallic cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607-A.
- Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.
- Properly mount patch panels into the designated rack, cabinet, or bracket locations with the #12-24 screws provided.
- Terminate cables into the patch panel according to manufacturer's instructions.
- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.
- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).
- Horizontal or backbone cables extending from the panel terminations shall maintain a minimum bend radius of at least 4 times the cable diameter.
- Cable terminations shall have no tensile or bending strain on panel IDC contacts in each installed location.
- Panels shall be properly labeled on front and back with the cable number and port connections for each port.

• Fiber Enclosures, Adapter Plates, Connectors

1. Fiber Adapter Enclosure Requirements

- Enclosure design shall be a modular, rack-mounted, powder coated formed cold rolled steel enclosure with a removable front cover, rear panel, top panel, and slide-out inner tray.

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- Each basic unit delivered shall consist of: (1) enclosure assembly, (2) mounting brackets, (6) cable ties, (5) snap-in cable clips (4) #12-24 mounting screws, (1) adhesive grid label, (4) adhesive cable clips, (2) Velcro cable ties, (3) label holders, and (1) splice tray stud, wing nut, and spacer.
- Material shall be as follows:
 - a. Enclosure, panels and tray: 16 gage cold rolled steel (CRS)
 - b. Mounting brackets: 14 gage CRS
 - c. Front cover: Acrylic (Plexiglas) with smoke tint
- Basic dimensions of the enclosures shall be approximately 17" wide by 12" deep.
- Enclosures shall be available in heights of 3.5" (2 RMU), 5.25" (3 RMU), and 7" (4 RMU) versions.
- Finish shall be black durable powder coat on all surfaces.
- Front door shall be smoke-tinted Lexan plastic, hinged at the bottom, with a cap-plugged hole to accept an optional lock. Front door shall also be removable in the fully open position by sliding left off the mounting pins.
- Front door shall be secured in the closed position with lever-action quick-release latches.
- Top cover shall be removable in the forward direction, without fasteners, to provide access to the connector field. Top panel shall also have knockouts for backbone cable entry.
- Rear panel shall be removable without fasteners.
- Enclosure shall be equipped with panel-mounting brackets assembled for 19" rack mounting, compliant to ANSI/EIA-310-D.
- Panel mounting brackets shall be configurable to either 19" or 23" racks.
- Enclosure chassis shall have two mounting bracket locations for either flush mount or center mount on the rack.
- Rear of enclosure shall have two knockouts, top and bottom, for backbone cable entry and internal routing.
- Front of enclosure chassis shall have side cutouts for patch cord entry into, and exit from the enclosure.
- Inner tray shall slide out in the forward direction by releasing the lever-action quick-release latches. Tabs in the chassis shall engage with slots in the inner tray in the outward position to prevent tray from falling out.
- Inner tray shall have rear-located knockouts to match rear chassis knockouts.
- Inner tray panel mounting posts shall accept modular adapter panels, in high- or low-density versions. Adapter panels shall be available in ST multimode OM4/singlemode.
- Splice tray mounting boss shall also accept a stud for mounting blown fiber adapter brackets.
- Inner tray shall have clips for cable ties, and holes to accept snap-in cable clips, front and rear, for complete cable management of patch cords and distribution cable strands.
- Inner tray shall have rear cable tie-down features to accept various diameter backbone cables entering the enclosure.

2. Fiber Adapter Panels Requirements

- Fiber adapter panels shall be a modular, quick-fastening steel plate, powder coated to match the enclosure finish.
- Fiber adapter panels shall have pre-installed LC fiber adapters, available in low- or high-density multi-mode or single-mode applications.
- Each individually bagged unit delivered shall consist of: (1) fully assembled adapter panel, with push-pull fasteners pre-installed.
- Adapter panels shall be constructed of 16 gage cold rolled steel.
- Finish shall be black durable powder coat on all surfaces.
- Basic dimensions of the FSP panels shall be 5.10" length by 1.10" wide.
- Panels shall have two pre-installed, push-pull type quick-release fasteners for quick snap-in installation. Push-pull fasteners shall have an industry standard center distance of 4.65".
- Panels shall be suitable for mounting either vertically or horizontally.
- Panels shall be available in with LC adapters with precision ceramic alignment sleeves.
- All fiber adapters installed in FSP panels shall have dust caps installed.
- Panels shall be available in low-density and high-density adapter patterns.

3. Fiber Connector Requirements

- Connector basic design shall be a factory pre-polished LC optical fiber connector with a zirconium ceramic ferrule. Integral with the connector body is a wedge-activated fiber clamping mechanism to secure the inserted fiber into a mechanical splice with the factory installed cleaved fiber stub. Index-matching gel is

supplied factory-injected into the cleaved fiber stub splice to optimize transmission performance. Connector attachment is achieved without tools, by inserting a field-cleaved optical fiber and then extracting the disposable clamp wedges from the connector body.

- Each basic connector unit delivered shall consist of: (1) connector body with disposable clamp wedge, (1) strain relief boot, and (1) plastic dust cap.
- LC multimode factory pre-polished connectors shall be 50 micron laser optimized pre-installed fiber.
- Connector termination method shall utilize an industry standard multi-layer strip tool and bare fiber cleave tool as the only field tools required.
- LC connectors shall have features to enable field verification using a Visual Fault Locator (VFL) during termination.
- Connector materials shall be designed with thermal stability to comply with environmental requirements of ANSI/TIA/EIA-568-B.3 and Telcordia GR-1081-CORE.
- Multimode OM4 and singlemode pre-polished fiber connector materials shall be as follows:
 - a. Ferrule: zirconium ceramic
 - b. LC inner body: thermally stable injection molded thermoplastic
 - c. Dust Cap: nylon or PVC
 - d. Strain relief boot: UL94-V0 molded PVC
- Pre-polished LC connectors shall require no field polishing.
- Pre-polished MM LC connector body shall be industry standard aqua for 50 micron multimode OM4, laser optimized.
- colors for specific applications, as designated below:
- Pre-polished MM LC connectors shall require no adhesives for termination.
- LC connector internal fiber clamping mechanism shall firmly secure both the inserted glass fiber and the 900 micron buffer layer of the inserted fiber for maximum strain relief.
- All standard mating and interface dimensions for LC connectors shall comply with ANSI/TIA/EIA-604-10 (FOCIS 10).
- Ferrule outside diameter for LC multimode connectors shall be 1.2467mm to 1.2497mm.
- Ferrule outside diameter for LC singlemode connectors shall be 1.2483mm to 1.2497mm.
- LC ferrule tip shall have a PC spherical radius of approximately 7.0 mm radius for multimode and singlemode versions.
- Delivered connectors shall be individually bagged with the dust cap installed to protect from contamination.
- Delivered connectors shall have the disposable clamp activation wedge element pre-installed onto the connector body.
- Connector design and termination technique shall be independent of cable type or manufacturer, and shall be compatible for either 900 micron buffer or 250 micron buffer distribution cables.
- LC connector strain relief boot shall be a Telcordia style slotted design for maximum flexural strain relief.
- Strain relief boot shall be black for multimode, and yellow for singlemode.
- LC connectors shall be available individually bagged in packs of 12.
- Pre-polished LC fiber connectors, when properly installed onto qualified cable, shall meet the 10 Gb/s Ethernet performance requirements of IEEE802.3.
- Pre-polished LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of ANSI/TIA/EIA-568-C.3, Annex 'A'.
- Pre-polished LC fiber connectors, properly installed onto qualified cable, shall exceed the mechanical and environmental performance requirements of Telcordia GR-1081-CORE.
- Qualification test data shall be available from the manufacturer upon request.

4. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
FCR350SP36R	Fiber Enclosure - 2U Rack Mount Fiber Enclosure, Accepts 6 Adapter Panels
FCR350SP54R	Fiber Enclosure - 2U Rack Mount Fiber Enclosure, Accepts 9 Adapter Panels
FCR525SPR	Fiber Enclosure - 3U Rack Mount Fiber Enclosure, Accepts 12 Adapter Panels
FCR700SP	Fiber Enclosure - 4U Rack Mount Fiber Enclosure, Accepts 15 Adapter Panels

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FSPLCDM6AQ	Fiber Adapter Panel - 6 LC Duplex, Aqua for MM – Phosphor Bronze Sleeves
FSPLCQM6AQ	Fiber Adapter Panel - 6 LC Quad, Aqua for Multimode – Phosphor Bronze Sleeves
FSPLCDS6	Fiber Adapter Panel - 6 LC Duplex, Blue for SM – Zirconia Ceramic Sleeves
FSPLCQS3	Fiber Adapter Panel - 6 LC Quad Blue for SM – Zirconia Ceramic Sleeves
FCLC900K50GM12	Fiber Connector - LC, MM, 50/125um, OM3 – Aqua, Box of 12
FCLC900K50GM12	Fiber Connector - LC, SM, 9/125 UPC – Blue Box of 12

- Or approved equal of: Ortronics, Panduit, Systemax

5. Fiber Installation Requirements

- For FCR-series enclosures, remove top and rear covers, and front door.
- Punch out the desired knockouts for cable entry.
- Using proper method, pull cables into cabinet through the desired knockout entry location.
- Strip the outer sheath and sub sheaths of the fiber cable to provide at least (2) meters service loop of the individual buffered fiber strands.
- Anchor the outer cable sheath into the rear channel of the inner tray using the cable ties provided. Note: in FCR-series enclosures, leave enough slack in the main cable to allow free motion of the inner tray fully outward. Remove cable entry knockouts as required.
- Installed copper and fiber cabling shall be properly strain relieved. Cable service coil, bend radius, and pathway fill ratio shall comply with applicable codes and standards.
- Use the plastic adhesive-backed clips provided to form the fiber strands into a large service coil on the surface of the inner tray. For FCR-series enclosures, be sure the inner tray has full mobility in and out, with no cable kinks or snags.
- Close inner tray and front cover, and lock the quick-release fasteners.
- Install SC fiber adapter panels by firmly using push fasteners to lock in place.
- Leave dust caps installed in the fiber adapter plates until connector termination is performed.
- Follow manufacturer’s termination instructions for pre-polished connectors as specified
- Uncoil the 900-micron buffered strands of cable from the service loop and set-up for termination.
- Un-package the connector, and leave dust cap installed. Firmly press downward on the connector wedge tab to fully seat clamp wedges.
- Slide the strain relief boot onto the fiber strand before stripping.
- Using a fiber strip tool, strip buffered fiber completely to approx. 1.0” of exposed glass fiber.
- Y CAUTION: Do not nick or scrape the glass fiber with the strip tool.
- Wipe the glass fiber firmly with an alcohol wipe. Always use 99.9% pure reagent grade alcohol for fiber cleaning.
- Mark the 900 micron buffer layer from the strip-off point per instructions.
- Insert the fiber into the cleave tool and cleave the fiber to the specified length from the end of the 900 micron buffer layer. Always keep the cleave tool clean.
- Y CAUTION: Always dispose of glass fiber waste in an approved container.
- Gently insert the cleaved fiber into the connector body. Rotate connector slightly during insertion to fully seat the fiber into the internal splice.
- Hold the seated fiber in place using slight force to form a bow in the fiber.
- Y CAUTION: Do not allow the installed fiber to slip backward.
- While holding the fiber seated, squeeze the wedge holder device to activate the clamp, and then slip the wedge holder off the connector body. Dispose the wedge holder.
- Remove the connector dust cap and inspect the ferrule tip. A 400X microscope is recommended. View of the polished fiber should be a smooth round circle with no scratches, pits, cracks or chips. Use a lint-free wipe to clean off any contamination.
- Y CAUTION: Do not view ends of live fibers, with or without a microscope.
- Plug the connector into the proper adapter panel and proceed with the next connector. Leave dust cap installed if the connector is not mated.

• Racks, Horizontal & Vertical Managers

1. Equipment Racks Requirements

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- Racks shall be a structural aluminum construction, having two 6-inch deep rails.
- Racks shall feature universal side mounting hole pattern for vertical cable managers.
- Racks shall feature a weight load capacity of 1,000 lbs when properly secured to the floor.
- Each basic rack delivered shall consist of: (2) vertical rails, (2) base angles, (1) assembly hardware kit, (2) top angles, and (20) #12-24 dog point machine screws for panel mounting.
- Racks shall be available in either for 19-inch standard rack configurations.
- Tapped holes in the front and rear vertical rails for mounting of panels shall be #12-24 thread size. Powder coat shall not interfere with thread fit.
- Standard rack heights of 8 ft (96 in)
- Racks with heights of 8 ft shall have a capacity of 51 rack mount units
- Rack base angles shall be pre-drilled for floor mounting, and for assembly to vertical rails.

2. Horizontal Managers Requirements

- Horizontal Managers shall be 19"W, 3.5"H
- Horizontal managers shall be 16ga. Cold rolled steel construction with (6) pass thru holes, and (7) Front mounted 3.5" steel rod D-Rings.
- Horizontal managers shall have hinged Aluminum front cover to conceal patch cords.

3. Vertical Managers Requirements

- Vertical cable managers shall be 14"D, 10"W
- Vertical cable managers shall feature a steel rod construction for increased air flow.
- Vertical cable managers shall feature a solid aluminum door that is designed to open left or right and swing out of way for cable management.
- Vertical cable managers shall feature power strip mounting brackets on rear of manager.
- Vertical cable manager shall accept and include (16) 3" black cable management spools.

4. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document
- Cooper B-Line.
The Cooper B-Line products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HPW84RR19D	84"H, 6"D Equipment Rack
HC219CE3N	2U Horizontal Manager w/ 3.5" Front rings and cover
XS1010	Vertical Cable Manager, 14"D, 10"W, with door & cable spools

B-Line CATALOG NUMBER	Description
SB55608419U6	84"H, 6"D Equipment Rack
SB87019S2FB	2U Horizontal Manager w/ 3.5" Front rings and cover
SB860810S084	Vertical Cable Manager, 14"D, 10"W, with door & cable spools

- Or approved equal of: Ortronics, Systemax, or Cooper B-Line as denoted on drawings

• Category 5e-110 Termination Blocks

1. 110 Termination Block Requirements

- Category 5e-110 wiring blocks shall be available in 50-pair, 100-pair and 300-pair capacities, with or without detachable standoff legs.
- Wiring blocks shall be available as kits that include wiring blocks, label strips, and the appropriate quantity of connecting blocks for termination to full capacity.

- Connecting blocks shall accommodate a 5-pair punch-down tool designed specifically for the purpose of Category 5e termination.
- Wiring blocks and connecting blocks shall be constructed of UL94-V0 rated high-impact flame-retardant polycarbonate blend thermoplastic.
- Wiring blocks shall accept 26-22 AWG solid or stranded conductors
- Wiring blocks shall accept conductor insulation diameters of .050 in to .070 in maximum.
- Wiring blocks and connecting blocks shall have a temperature rating of 14 °F to 140°F with up to 95% non-condensing humidity.
- Wiring blocks shall have through-openings to permit rear cable entry and direct routing to each point of termination.
- Connecting blocks shall connect to the wiring block with a locking force of 35 Lb minimum.
- Connecting blocks shall withstand a minimum of 200 re-terminations without degradation to electrical or mechanical performance.
- IDC contact termination towers on the connecting blocks shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist. IDC towers shall also have high-definition color-coding.

2. 110 Termination Block Performance Requirements

- A UL or ETL third party testing organization shall independently verify all Category 5e transmission performance parameters.
- Category 5e-110 termination blocks shall meet or exceed Category 5e transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2.
- The manufacturer shall provide Category 5e component compliance certificates from third party testing organization upon request.
- 5e-110 termination blocks shall be UL LISTED 1863.
- 5e-110 termination blocks shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
- 5e-110 termination blocks shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
- 5e-110 termination blocks shall meet or exceed the 4-connector channel performance requirements of Category 5e, per the ANSI/TIA/EIA-568-B.2.

3. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
110BLK50FTK5	110 Field Termination Kit, 5e-110/50-pair with 5-Pair Conn. Blocks
110BLK100FTK5	110 Field Termination Kit, 5e-110/100-pair with 5-Pair Conn. Blocks
110BLK300FTK5	110 Field Termination Kit, 5e-110/300-pair with 5-Pair Conn. Blocks

- Or approved equal of: Ortronics, Panduit, Systemax

4. 110 Installation Requirements

- Follow manufacturer’s instructions.
- Mount 5e-110 wiring blocks in the desired location.
- Route cables through the openings in the wiring block base.
- Terminate UTP cables to the 5e-110 block according to manufacturer’s instructions, using the connecting blocks and proper termination tool.
- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.
- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).
- Cables extending from the block terminations shall maintain a minimum bend radius of at least 4 times the cable diameter.
- Cable terminations shall have no tensile or bending strain on IDC contacts after termination. Note: Use the appropriate cable management hardware to relieve cable strain and control bend radius.

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PART 11 INFORMATION OUTLETS

Each school and District Office has a specific information outlets requirements, however, the standard specification is an information outlet providing (1) Data & (1) Voice Category 6 jack per location as a basic requirement wired to the 568B standard. See drawings for further specifications and configurations of the different types of information outlets.

A. Information Outlet Locations

1. The location of the information outlets is dependent on the environment in which the outlets will be installed. If the outlets are to be wall-mounted, the bottom of the outlet is to be located 15" above the finished floor unless otherwise shown or stated. If there is equipment or furniture that does not allow for this, such as a credenza or countertop, the outlet must be placed at a height appropriate to the situation.

Note: The outlet box conduit stub up should be at least 1" OD minimum.

2. Locate the outlet where it is closest to the equipment and people it will serve. Keep in mind that the cord from the outlet to the device can be a trip hazard or may span across doors.
3. Wall-mounted outlets should not be located on heating units, equipment or ductwork. They are always to be located in either a gypsum, sheetrock, or masonry wall.

B. Category 6 Jacks

The default cabling infrastructure shall be Category 6 for voice and data connectivity at the information outlet unless specified otherwise.

1. Category 6 Jack Requirements

- Jacks shall be standard 8-position, RJ-45 style, un-keyed, FCC compliant.
- Jacks shall be designed for 4-pair, 100 ohm balanced unshielded twisted pair (UTP) cable.
- Each jack shall be single unit construction, with snap – fit to industry standard keystone opening (.760" x .580").
- Jack housings shall fully encase and protect printed circuit boards and IDC fields.
- Modular jack contacts shall accept a minimum of 2000 mating cycles without degradation of electrical or mechanical performance.
- Jack contacts shall be constructed of Beryllium copper for maximum spring force and durability.
- Contact plating shall be a minimum of 50 micro-inches of hard gold in the contact area over 50 micro-inch of nickel.
- Jack termination method shall follow the industry standard 110 IDC punch-down
- Jacks shall be compatible with a 4-pair single punch impact tool designed specifically for the purpose.
- IDC contact termination towers shall have tapered pair-splitting features to aid wire insertion and minimize pair un-twist.
- Jacks shall terminate 26-22 AWG solid or stranded conductors.
- Jacks shall terminate insulated conductors with outside diameters up to .050".
- Jacks shall not require special cords, specialty tools or special installation requirements.
- Jacks shall include a translucent stuffer cap for wire retention and to permit visual inspection.
- Stuffer cap shall have retention snaps to assure conductor strain relief.
- Jacks shall accept FCC compliant 6 position plugs.
- Jacks shall accept optional hinged dust covers.
- Jacks shall be compatible with ANSI/TIA/EIA-606-A color code labeling.
- Jacks shall accept snap-on icons for specific identification.
- Jacks shall be available in various colors to meet specific customer applications.

STRUCTURED CABLING

27 10 00

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- Jacks shall have attached wiring instruction labels to permit either T568A or T568B wiring configurations.

2. Category 6 Jack Performance Requirements

- All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
- Category 6 jacks shall exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1, Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling.
- Category 6 jacks shall exceed 10 Gb/s transmission requirements for connecting hardware, under the constraints of ANSI/TIA-TSB-155 (current draft).
- The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
- Jacks shall be UL LISTED 1863 and CSA certified.
- Jacks shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
- Jacks shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3 standard.
- Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.
- Jacks shall exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-B.2-1 standard.
- Jacks shall exceed the 4-connector Category channel performance requirements for 10 Gb/s transmission over Category 6, according to TIA/TSB-155 (current draft).
- The 4-connector channel test configuration shall utilize Category 6 patch panels and Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.

3. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HXJ6xx	NEXTSPEED® Category 6 Jack

xx = Jack color. Replace xx with “W” for White, “BK” for Black, “B” for Blue, “GY” for Gray, “GN” for Green, “OW” for Office White, “OR” for Orange, “R” for Red, “Y” for Yellow. Refer to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systemax

4. Category 6 Jack Installation

- Horizontal cabling of the proper category shall be fully deployed from the TR or TE to each wall plate location according to applicable codes and standards.
- Cable slack, service coil, bend radii, and pathway fill ratio shall comply with applicable codes and standards.
- Metallic horizontal cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607-A.
- Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.
- Terminate jacks according to manufacturer’s instructions.
- To maximize transmission performance, maintain wiring pair twists as close as possible to the point of termination.
- The length of wiring pair un-twist in each termination shall be less than 0.5 inches (13 mm).
- Jacks shall be properly mounted in plates, frames, or housings with stuffer cap fully installed

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- over IDC contacts.
- Horizontal cables extending from mounted jacks shall maintain a minimum bend radius of at least 4 times the cable diameter.
- Cable terminations shall have no tensile or bending strain on IDC contacts after assembly of faceplate or housing to the wall outlet.
- Jacks shall be tested as part of the installed horizontal cabling system, with faceplates assembled complete and properly mounted.
- Each link or channel in the horizontal cabling system shall be identified and tested individually, using an industry standard level III tester with correct settings.
- Each jack shall be tested as part of the horizontal channel or link for the parameters listed below.

C. Face Plates

The typical information outlet consists of a 1-Gang, 2-Port face plate for flush mounting (2) Category 6 Jacks - (1) data and (1) voice See drawings for additional information outlet configurations.

1. Face Plate Requirements

- Faceplates shall be constructed of high impact, UL94 V-0 rated thermoplastic unless otherwise shown or stated.
- Faceplates shall be 2.75" W x 4.5" H (69.8 mm x 114.3 mm) for single gang and 4.5" X 4.5" (114.3 X 114.3 mm) for double gang.
- Port size in each faceplate shall be industry standard vertical keystone opening size (.760" x .580").
- Faceplates shall accept Hubbell XJ-series UTP jacks and Snap-Fit fiber optic, audio, and video modules for multimedia applications unless otherwise shown or stated.
- Faceplates shall provide for ANSI/TIA/EIA-606-A compliant workstation outlet labeling.
- Faceplates shall be provided with clear plastic and color-matched label field covers.
- Color-matched blank Snap-Fit modules shall be available separately to fill unused ports and openings as required.
- Two #6-32 pan head Phillips/slotted mounting screws shall be included with each single gang faceplate.
- Four #6-32 pan head Phillips/slotted mounting screws shall be included with each double gang faceplate.
- Jacks and Snap-Fit modules shall snap firmly into rear of faceplate and position flush to outer plate surface.
- Faceplates shall be compatible with standard NEMA openings and boxes.
- Faceplates shall be compatible with raceway fittings, surface mount boxes, service fittings, flush mount boxes and drywall rings.

2. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
IFP11xx	1-Gang, 1-Port IFP Face Plate
IFP12xx	1-Gang, 2-Port IFP Face Plate
IFP13xx	1-Gang, 3-Port IFP Face Plate
IFP14xx	1-Gang, 4-Port IFP Face Plate
IFP16xx	1-Gang, 6-Port IFP Face Plate
IFP26xx	2-Gang, 6-Port IFP Face Plate
IFP29xx	2-Gang, 9-Port IFP Face Plate
IFP212xx	2-Gang, 12-Port IFP Face Plate

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xx = Face Plate color. Replace xx with "W" for White, "BK" for Black, "GY" for Gray, "OW" for Office White, to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systimax

PART 12 CABLE ROUTING SYSTEMS

Each cable routing system has advantages and disadvantages. Particular systems are favored for a variety of reasons, including architectural considerations, appearances, cost, local ordinances, and material concerns.

Various means of distributing cable from Communications/Data rooms/closets to the user work areas are identified in the following:

A. Ceiling Distribution System

A distribution system within an accessible area above a false ceiling. This could either be a plenum area (where there is no enclosed system for cable routing) or an overhead conduit system (which has defined areas of access and routes).

B. "J" Hooks

Where not installed in conduits, cable trays, or other supporting devices, the horizontal wiring plan is to be installed onto "J" hooks or an acceptable equivalent from the information outlet to the termination point within the IDF or MDF/IDF room. The "J" hooks are to be installed a maximum of five feet apart and fastened to the ceiling or the top of the walls near the ceiling. The cables are to be tie-wrapped to the "J" hooks, without crimping the sheath. The cable contractor is to furnish and install the "J" hooks. Cooper B-Line BCM-21, 32, or 64 are acceptable.

C. Sleeves and Conduits

1. The use of conduits and sleeves within a building is common for the transport of communications cable. Conduits and sleeves are to be sized and routes are to be planned within and between buildings in order to route the cable plant from the MDF to IDF and IDF to Information Outlet, and to accommodate any additional cabling required. The sizing of the conduits and sleeves is to be based on the number of cables, the location and environment surrounding the sleeve or conduit, and acceptable conduit fill levels, which are typically 40%. All conduits are to be installed with the appropriate sweep to maintain the required bend radius for copper and fiber optic cable. All sleeves and conduits are to be installed with bushings and suspended according to building industry standards.
2. The following are guidelines to use in determining where sleeves and conduits are to be installed but does not limit nor identify all areas or situations where sleeves and conduits will be required.
 - All masonry walls that have cables passing through them are to have sleeves installed.
 - Gymnasiums and athletic areas are to have conduits installed to house cables passing through the and within the area.
 - Classrooms without suspended ceilings are to have conduits installed to house cables passing through and with the area.
 - Each MDF and IDF Room is to have sleeves installed to contain the large number of cables exiting the room. Conduits are to be installed in areas where cables extend from one building to another via covered or enclosed bridges and corridors.
3. Cable routing is to follow a "streets and avenues" path in corridors where possible. However, there are a number of reasons for exceptions. In some cases, the corridors do not allow cables to be run because of architectural constraints or inaccessible ceilings. Also, in order to maintain the 90-meter

standard for Category 6 cabling, some cables need to be run separately and diagonally to isolated information outlets. Throughout all runs, the contractor is to maintain EIA/TIA standards regarding the proximity of communications cabling to high voltage cabling, motors, transformers, fluorescent lighting, ballasts, etc.

PART 13 CABLING-GENERAL

- A. All cable shall meet the requirements of the NEC, except where other authorities or codes impose a more stringent requirement or practice. Codes, such as the NEC, do not normally include transmission performance requirements. This section specifies the essential media transmission characteristics. It is advisable to consult standards associated with the planned service or equipment to determine any specific media limitations.
- B. Contractor is to take all necessary precautions to assure that the maximum tensile load and minimum bend radius of all cables (fiber and copper) are not exceeded. When terminating Category 6 cable, care shall be taken to maintain pair twists up to the termination point and not more than 0.5" of the cable pairs shall be untwisted. It is preferred that the cable sheath is also not removed more than 0.5" from the termination point. Tie wraps are to be hand-tightened on cables and are not to crimp the sheath. Contractor is responsible for protecting all connectorized cables from damage by other contractors at the information outlet before and after installation of the outlet faceplates.
- C. All riser and station cable installed is to be plenum-rated cable. The fluoropolymer resin that insulates Category 6 plenum cables is engineered as a fire safety innovation. The NEC requires that all cable installed in plenum spaces and not encased in conduit must have certain fire resistance and low smoke producing characteristics. Not only are such cables highly resistant to fire but they also produce very little smoke.
- D. For all Voice cabling installed, "110" blocks shall be used for termination. The Copper Data cabling will be terminated onto Category 6 RJ45 Patch Panels. The fiber optic cabling will be terminated onto fiber distribution panels with SC connectors.
- E. Cables shall be terminated on the appropriate unassigned (vacant) portions of the wall-mounted Main and Intermediate Distribution Frames or Patch Panels and run as uninterrupted conductor sections to the Information Outlets. All cable terminations shall be made uniformly in sequence, commencing with termination of the first cable pair on the first connection points in the upper left-hand corner of each block.
- F. Minimum separation distances between pathways and power wiring of 480 V or less are shown in Table 1, below.

Table 1 Separation of Communications Pathways from <= 480V Power Lines

Condition	Minimum Separation Distances		
	< 2 kVA	2-5 kVA	> 5 kVA
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways.	127 mm (5 in)	305 mm (12 in)	610 mm (24 in)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	64 mm (2.5 in)	152 mm (6 in)	305 mm (12 in)
Power lines enclosed in a grounded metal conduit (or equivalent- shielding) in proximity to a grounded metal conduit pathway.	76 mm (3 in)	152 mm (6 in)	

All cabling shall be at least:

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- 12" from high voltage lighting and fluorescent fixtures
- 72" from transformers and motors

PART 14 HORIZONTAL CABLING - CATEGORY 6 UTP DATA

All riser and station cable installed is to be plenum-rated cable.

A. Category 6 100 OHM balanced UTP Cable Requirements

The default cabling infrastructure shall be Category 6 unless specified otherwise.

1. Cable construction shall be four twisted pairs of 23 AWG insulated solid conductors, with a ripcord, surrounded by a tight outer jacket.
2. Conductor diameters shall be 0.0224" \pm .0003" solid copper.
3. Conductor insulation diameter shall be 0.039" \pm .0005" fluoro copolymer.
4. Outer jacket diameter shall be 0.235" \pm .008" low smoke PVC, with a nominal wall thickness of 0.015".
5. Ripcord shall be directly underneath the outer jacket.
6. Cable shall be marked every 2 ft including
 - Cable Manufacturer
 - Cable Description
 - Month and Year of manufacture.
 - Job number.
7. UL, ETL, or CSA agency certification or verification markings shall be marked on the cable jacket according to the certifying agency's requirements.
8. Color coding of the pairs shall be as follows:
 - Pair 1: White/Blue; Blue
 - Pair 2: White/Orange; Orange
 - Pair 3: White/Green; Green
 - Pair 4: White/Brown; Brown
9. Cable shall be supplied in 1000 ft spools or 1000 ft Reelex boxes.

B. Category 6 100 OHM balanced UTP Cable Performance Requirements

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Cable shall exceed Category 6 transmission requirements specified in ANSI/TIA/EIA-568-B.2-1, and shall be tested through 550 MHz.
3. Worst-case cable performance shall be +8.0 dB headroom over current TIA/EIA and ISO standards limits for NEXT and PSNEXT loss, and ELFEXT and PSELFEXT loss.
4. Insertion loss shall be 3.0% lower than standard Hubbell Category 6 plenum and riser cables described in Section 27 15 13.
5. Worst case electrical performance characteristics shall be as follows:
 - Characteristic Impedance: 100 + 15 (1.0-100 MHz) 100 + 20 (101-250 MHz)
 - Maximum Conductor Resistance: 9.38 /100 Meters @ 20°C
 - Maximum Resistance Unbalance: 3%
 - Maximum Mutual Capacitance: 5.6 nF/100 Meters @ 1 kHz
 - Maximum Capacitance Unbalance: 330 pF/100 Meters
 - Maximum Delay Skew: 25 ns/100 Meters
6. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
7. Cable shall be UL and C(UL) listed.
8. Cable shall exceed IEEE 802.3af DTE Power specification to 4 times the rated current limits with no

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- degradation of performance or materials.
- 9. Cable shall be third party verified, error free Gigabit Ethernet performance to IEEE 802.3ab.
- 10. Cable shall exceed the requirements of TIA/TSB-155: 10 Gb/s Ethernet Operation over 55 Meters Channel Length.
- 11. Cable shall meet or exceed the 4-connector channel performance requirements of Category 6, per the ANSI/TIA/EIA-568-B.2-1 standard.
- 12. The 4-connector channel test configuration shall utilize Category 6 jacks and patch panels, with Category 6 patch cords, from the same manufacturer, with qualified Category 6 cable.

C. Acceptable Manufacturers:

- 1. Hubbell Premise Wiring and Mohawk Cable.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
C6SPxx	NEXTSPEED Category 6 550 MHz – Plenum Spool
C6RPxx	NEXTSPEED Category 6 550 MHz – Plenum REELEX

xx = Cable color. Replace xx with “W” for White, “GY” for Gray, “B” for Blue, “Y” for Yellow. Refer to project drawing for color applications.

MOHAWK CATALOG NUMBER	Description
M58801	Category 6 – Plenum, Blue, Spool
M58804	Category 6 550 MHz – Riser, Blue, Spool

Refer to project drawing for color applications.

- 2. Or approved equal of: Belden, Berk-Tek, Systemax

D. Category 6 100 OHM balanced UTP Cable Installation Requirements

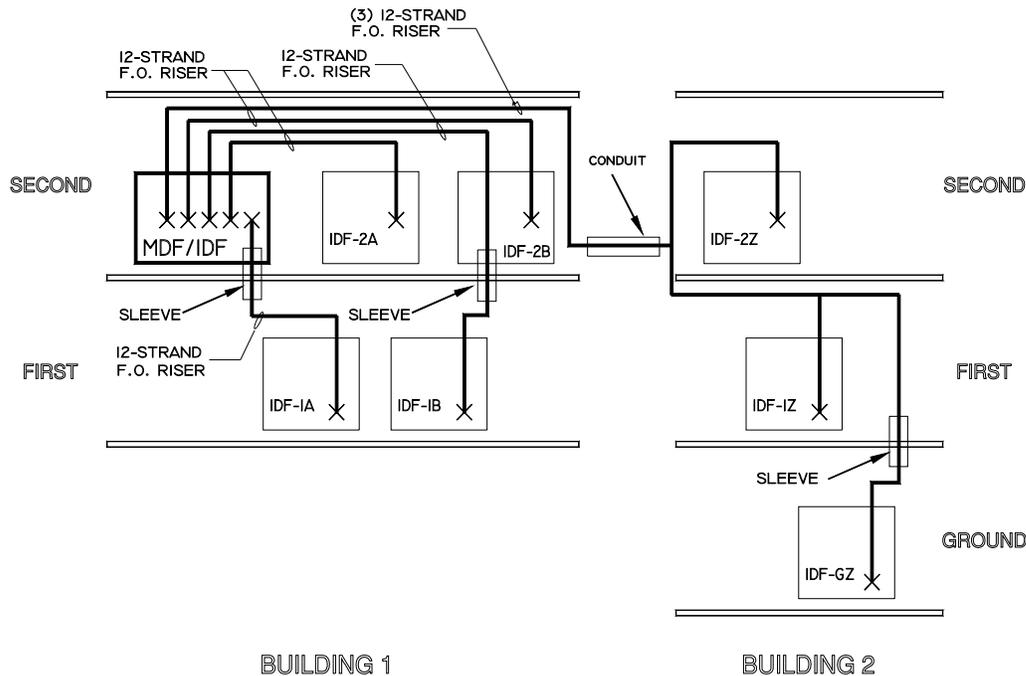
- 1. Pull cable into conduits, or place into raceway or cable tray as specified. Do not exceed 25 Lb pull force per cable. Use appropriate lubricants as required to reduce pulling friction.
- 2. All exposed wiring shall be installed in surface raceway.
- 3. All wiring above ceilings or below access floors shall be installed in cable tray or open-top cable hangers.
- 4. Cable slack and service loops shall be stored properly above the ceiling or under the access floor. A “figure-eight” service loop is recommended for Category 6 cabling to reduce EMI coupling.
- 5. Pathway fill ratio in conduit, tray, raceway, etc. shall not exceed 40% of pathway cross-sectional area.
- 6. Installed cable bend radius shall be greater than 4X cable diameter. Avoid kinking or twisting the cable during installation.
- 7. Do not over-tighten cable ties, and do not use staples or clamps to anchor cables. Velcro straps are recommended.
- 8. Recommended spacing of cable supports above the ceiling shall be 48”.
- 9. Maintain the following clearances from EMI sources:
 - Power cable: 6 in.
 - Florescent lights: 12 in.
 - Transformers and electrical service enclosures: 36 in.
- 10. Communications cabling that must cross power cables or conduit shall cross at a 90-degree angle, and shall not make physical contact.
- 11. Length of each horizontal cable run from the TR to the wall outlet shall not exceed 90 meters.
- 12. Leave sufficient slack for 90 degree sweeps at all vertical drops.
- 13. Do not install cable in wet areas, or in proximity to hot water pipes or boilers.
- 14. Cable ends for termination shall be clean and free from crush marks, cuts, or kinks left from pulling operations.

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B. Fiber Backbone Distribution cable: indoor, non-armored

1. Fiber Backbone Distribution cable Requirements

- Optical Fiber Indoor Distribution Cable shall be constructed with 12 optical fibers, each coated with a 900 micron color-coded PVC tight buffer, surrounded by an aramid yarn strength member, and a single outer jacket with the appropriate flame rating.
- Fiber cables shall be a non-metallic construction, OFNP (Plenum FT-6) flame rating.
- Cable markings shall repeat every meter, and shall have at minimum the following information:
 - a. Sequential length indicator marking (meters)
 - b. Manufacturer’s name and catalog number
 - c. Lot number, traceable back to the fiber draw lot
 - d. Date of Manufacture
 - e. Fiber type: (OM4 or Singlemode)
 - f. Cable rating (OFNR, OFNP, etc.)
 - g. Applicable Telcordia, TIA, IEC, and ICEA standard references and appropriate UL/CSA agency listings
- Cable jacket color shall be Aqua for Laser optimized 50 micron OM4 multimode.
- Buffer position color codes shall conform to standard ICEA and TIA-598 conventions as follows: 1-Blue, 2-Orange, 3-Green, 4-Brown, 5-Slate, 6-White, 7-Red, 9-Yellow, 10-Violet, 12-Aqua.
- Optical fiber in any cable construction shall be enhanced performance, bend-insensitive type.
- Multimode OM4 cables shall perform at minimum to the attenuation, bandwidth, and distance application parameters in the table below.



SAMPLE RISER-FIBER OPTIC CABLING
SCALE: NONE

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Multimode OM4 Fiber Gigabit and 10 Gigabit Ethernet Application Chart					
Fiber Type	Wavelength (nm)	Max Attenuation (dB/km)	Bandwidth (MHz•Km)	1 GbE Distance (m) @ 1300/850nm	10 GbE Distance (m) @ 1300/850nm
MM 50 μm (OM3)	850 / 1300	3.5 / 1.0	1500 / 500	1000* / 600	550 / 300

* 2000m for engineered links

- Optical fiber cables as supplied shall meet or exceed the applicable IEC 60793-1 qualification test requirements for optical, geometry, mechanical, and environmental parameters as specified, and tested in accordance with TIA/EIA-455.

2. PERFORMANCE REQUIREMENTS

- For installed fiber cables, all fiber strands shall pass insertion loss and return loss in accordance with test methods ANSI/TIA/EIA-526-14 for multimode OM4 cables.
- Installed fiber cables shall exceed all currently ratified bandwidth-distance- application performance parameters for IEEE 802.3ae (10 GbE) and for IEEE 802.3ba (40/100 GbE)
- Plenum cables shall be rated UL NFPA-262/UL910/CSA FT-6

3. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HFC1012P3	Fiber Optic Cable – 12-Strand MM 50 μm (OM3), Plenum, Aqua

MOHAWK CATALOG NUMBER	Description
M95048	Fiber Optic Cable – 12-Strand MM 50 μm (OM3), Plenum, Aqua

- Or approved equal of: Corning, Berk-Tek,

4. Fiber Backbone Distribution cable: indoor, non-armored Installation Requirements

- Prior to cable deployment, backbone pathways (conduit, tray, raceway, wire basket, etc.) for cable routing shall be permanently installed in compliance with contract documents, and applicable codes and standards.
- Racks, cabinets or enclosures into which cables are to be routed shall be permanently installed in compliance with contract documents, and applicable codes and standards.
- Optical fiber cables shall be deployed using the proper pulling grip or apparatus attached to the exposed cable strength member. Contact the cable manufacturer regarding permissible methods for cable pulling. Never pull directly on the fiber strands of an optical fiber cable.
- Cables shall not exceed minimum bend radius limits or maximum pulling loads during or after installation. Avoid crushing or abrasion of the cable jacket during installation.
- Installed cables shall be fully supported and strain relieved from pulling on terminated connections. Apply wire ties loosely and avoid crushing or clamping cables with excessive force.
- All non-armored fiber optic riser cables are to be installed in plenum inner-duct. Fibers in inner-duct or armored plenum riser fiber serving as riser cables are to be installed according to the attached riser drawing. Contractor to size the inner-duct for each cable run. Multiple fiber optic

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cables can occupy an individual inner-duct when non-armored fiber is not used.

PART 16 CAMPUS CABLING

A. Outside Plant Cabling

1. The contractor is to follow the drawings regarding the installation of outside plant (OSP) cabling to buildings remote from the main building, such as portable rooms, trailers, other small buildings, etc. Many remote buildings can be served by conduits underneath or within ceilings of protected overhangs and bridges.
2. The contractor is to furnish and install outside plant cables and associated protector blocks, splice cases, and grounding where applicable in an approved manner.
3. The contractor will be responsible for obtaining all required right-of-way easements and permits before any excavation on the property begins.
4. Outside plant optical fiber cable shall be 50/125 multimode OM4 laser-optimized or Singlemode strands loose-buffer tube water- blocking for outside plant application.
5. Outside plant copper cable will be solid insulated conductors 24 AWG with gel-filled core in 25-, 50-, or 100-pair increments.
6. RG-11 coaxial cable rated for OSP use will be used between buildings. Outside plant cables are to be routed aerially, underground, or buried by designed. Contractor may provide recommendations as to cable routing for approval.
7. Where noted, the contractor is to use aerial plant cabling between buildings. In cases where cables are attached to poles or buildings, aerial spans are not to exceed 100 ft from the last pole to the building, using slack span construction (no guying at either end). EIA/TIA guidelines and NEC code are to be strictly adhered to for separation and clearances from power lines and traffic.
8. Underground Cable is to be enclosed in conduit buried at least 24 inches below ground surface. In situations where fiber optic cables will be used, inner-ducts will be placed inside conduits to ensure physical protection for the cable. Proper fill ratios must be observed as well as proper bend radius. Metal sleeves through the foundation will be used to prevent conduit shearing. Sleeves must extend from inside the foundation wall to a minimum of 12". The end of the conduit within the building must be securely fastened to withstand the placing of cable. Sleeves are to be sealed with plugs or sealant. Conduit must be bounded and grounded in compliance with EIA/TIA and NEC requirements.
9. Minimum depth of trench should allow for 24 inches of cover from top of cable to final grade. Upon refilling the trench, the soil must be tamped to prevent sunken trench appearance. Conduit sleeves will be used for penetrations through foundation walls, using the same guidelines as for underground cable. OSHA regulations concerning shoring requirements must be followed during all phases of buried cable installation. Contractor must install buried cable so as to meet minimum separation distances from adjacent structures (power, gas, water, etc.) To minimize the chance of accidental dig-up, contractor will install detectable warning tape a minimum 18 inches above cable.
10. Multi-pair protector blocks shall be installed to provide protection from voltage surges and sneak current. The protector panel shall be equipped with 110 wiring block and solid state protector units type 4C, and others depending on the situation. Project Manager will coordinate with contractor.

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Protector panels shall be installed within 50 feet of each outside plant cable building entry point. Protector panels must be grounded and bounded to the building grounding system.

11. Splice cases shall be provided and installed at both ends of outside plant cables. Splice cases shall be used for cable transition from to inside plant cables.
 - Fiber optic splice cases shall be designed to seal, bind, anchor, and protect cable splices and transition points from outside plant to inside plant cables. The case shall be fully equipped with a suitable splice kit for the fiber quantities specified.
 - Copper splice case shall be designed for use with non-pressurized cable. The case shall be of a durable fire-retardant material, single piece with a hinged cover. The case shall be equipped with a cable entrance end plates assembly of adequate size to accommodate entering and exiting cables, ground straps, and all necessary termination, mounting hardware.
12. Pedestal/Cabinet shall have a heavy gauge galvanized steel housing or equivalent and be weather-resistant for the termination of copper and fiber optic cables. It shall be equipped with ground bar, protector blocks, and adequate space for splice cases to accommodate transition of cables into or out of the cabinet. Pedestal/Cabinet size dependent upon each situation.
13. All OSP cables will be grounded according to EIA/TIA and NEC standards and codes.
14. Contractor is to install a RG-11U Plenum Coaxial cable between the CATV Head-End Location and the MDF Room. These cables are not to be terminated, but must be neatly coiled and tie-wrapped with 40 feet of slack cable remaining at each end.

PART 17 PATCH CABLES

- A. Patch cables should meet the minimum performance requirements specified for each system. This requirement specifically prohibits the use of flat, non-twisted (also known as "silver satin") cords for Data or local area network applications. However, "silver satin" patch cables are acceptable for use in telephone systems.
- B. **Fiber Patch Cords (Fiber patch cords shall be Owner provided. This section is for reference only.)**
 1. **Fiber Patch Cord Requirements**
 - Provide factory-made, dual SC fiber cables in 1-Meter lengths for every fiber cable installed.
 - SC Optical fiber patch cords shall be constructed with aramid-reinforced PVC loose-jacket duplex cable, with optical fibers having a 900-micron PVC buffer coating diameter. Optical fiber used in 10 GbE patch cords shall be laser optimized 50 micron multimode OM4, per ANSI/TIA/EIA-492AAAC, with no substitutes.
 - Multimode OM4 50 micron core optical fiber within the patch cord cable shall be graded index type in accordance with ANSI/TIA/EIA-492AAAC, with the following specifications:
 - a. Core diameter: 50 +/-3.0 microns
 - b. Cladding diameter: 125 +/- 2.0 microns
 - c. Core/cladding concentricity: less than 3.0 microns
 - d. Core non-circularity: 6% maximum
 - e. Proof test: 100 kpsi
 - f. Effective modal bandwidth: 2000 MHz*km
 - g. Coating diameter: 245 +/-15 microns
 - h. Buffer diameter: 900 microns nominal
 - i.
 - Connector terminations on each end of the fiber patch cord shall be heat-cured epoxy type with a machine polish, inspected 100% for polish quality and mated-pair insertion loss.
 - Epoxy volume within each connector shall be sufficient to properly surround and strain relieve the fiber

- and buffer layer at the buffer/fiber transition inside the connector body.
- Optical fiber patch cords shall be supplied in a sealed plastic bag with dust caps installed on each end, with insertion loss test results included.
- Optical fiber patch cords shall be available in standard lengths of 1, 2, 3, and 5 meters.
- Optical fiber patch cords shall be manufactured with industry standard SC connector terminations on each end.
- Factory mounted connectors on each end of the patch cords shall comply with the applicable ANSI/TIA/EIA-604 Intermateability standard.
- Buffered fiber strands within the cable jacket shall be surrounded by aramid (Kevlar) material serving as a strength member.
- The aramid (Kevlar) strength member shall be mechanically secured at each connector to provide tensile strain relief of the optical fiber.
- Additional strain relief of the buffered fiber shall result from crimping the rear of the connector during termination.
- Duplex fiber patch cords shall be a zip-cord cable construction with jacket cross-section dimensions of 3.0 mm X 6.0 mm for SC style. \
- Duplex fiber patch cords shall have reverse-pair polarity according to ANSI/TIA/EIA-568-B.3 and TIA/EIA-TSB-125.
- Cable jacket shall be marked with the cable manufacturer, UL Optical Fiber Non-Metallic Riser rating (Type OFNR) designation, lot number, and fiber core/cladding diameter designation.
- Fiber A-B polarity shall be clearly marked on each end of duplex patch cords.
- Optical fiber patch cord jacket color shall be aqua blue, specifically for 50 micron laser optimized multimode OM4 fiber cables.
- Fiber patch cord connector materials shall be as follows:
 - a. SC Ferrules: zirconium ceramic
 - b. SC housings: injection molded thermoplastic
 - c. Dust Cap: nylon or PVC
 - d. Strain relief boot: UL94-V0 molded PVC
 - e. Strain relief boot on all connectors shall be beige.
 - f. SC connector outer housing shall be beige.

2. Fiber Patch Cord Performance Requirements

- Multimode OM4 50 micron laser optimized patch cords shall have a maximum mated-pair insertion loss of 0.60 dB per end, with a minimum return loss of -20 dB.
- Fiber patch cords shall exceed 10 Gigabit Ethernet performance requirements of IEEE 802.3 standard.
- Fiber patch cords shall exceed the mechanical reliability requirements for tensile, flex, twist and impact as specified in ANSI/TIA/EIA-568-B.3, Annex 'A'.
- Fiber patch cords shall exceed the environmental reliability requirements for high/low temperature and humidity as specified in ANSI/TIA/EIA-568-B.3, Annex 'A'.

3. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
DFPCSCSCEXMM	SC-SC Optical Fiber Patch cords, 50/125 MM, Aqua

x = Length. Replace x with standard lengths of 1, 2, 3, 5 meters

- Or approved equal of: Ortronics, Panduit, Systemax

C. Category 6 Patch Cords

The default cabling infrastructure shall be Category 6 unless specified otherwise.

1. Category 6 Patch Cord Requirements

- The contractor shall provide Category 6 Patch Cords only where called for on the drawings.

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- Category 6 patch cords shall be constructed with a clear polycarbonate plug and boot having vertically staggered, trifurcated contacts, each having 50 micro-inches of gold plating.
- Plug dimensions and function shall comply with FCC 47, Part 68.5.
- Patch cords shall have a snag-less feature, integral to the strain relief boot on each end.
- Patch cords shall be constructed with category 6 patch cable, with 24 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, and overall jacket with UL flame-retardant PVC.
- Patch cords shall be manufactured using a T568B wiring format, and shall function suitably for either T568A or T568B wiring schemes.
- Patch cords shall be available in the following colors: black, blue, gray, yellow, orange, red, green, white, and purple. Custom lengths and colors shall be available with a delivery lead-time quotation.
- Standard patch cord lengths shall range from 3 ft. to 20 ft.

2. Category 6 Patch Cords

- All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
- Category 6 patch cords shall be channel performance balanced with Hubbell category 6 jacks, patch panels, and punch-down blocks.
- Category 6 patch cords shall meet or exceed Category 6 component transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1 standard.
- The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
- Patch cords shall be cUL and UL LISTED 1863.
- Patch cords shall exceed IEEE 802.3 DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
- Patch cords shall be third party verified, error-free Gigabit Ethernet performance to IEEE 802.3 standard.
- Jacks shall exceed 4 Gb/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel.
- Category 6 patch cords shall meet or exceed the 4-connector channel transmission performance requirements of Category 6, per ANSI/TIA/EIA-568-B.2-1 standard.
- The 4-connector channel test configuration shall utilize Category 6 patch panels, blocks, and jacks,

3. Acceptable Manufacturers:

- Hubbell Premise Wiring.
The Hubbell products listed in the table below comply with all requirements specified in this document

HUBBELL CATALOG NUMBER	Description
HC6xx03	Category 6 Patch Cord, 3FT
HC6xx05	Category 6 Patch Cord, 5FT
HC6xx07	Category 6 Patch Cord, 7FT
HC6xx010	Category 6 Patch Cord, 10FT
HC6xx15	Category 6 Patch Cord, 15FT
HC6xx20	Category 6 Patch Cord, 20FT
HC6xx25	Category 6 Patch Cord, 25FT

xx = Cable Color. Replace xx with "W" for White, "BK" for Black, "B" for Blue, "GY" for Gray, "GN" for Green, "P" for Purple, "OR" for Orange, "R" for Red, "Y" for Yellow. Refer to project drawing for color applications.

- Or approved equal of: Ortronics, Panduit, Systimax

PART 18 FIRE STOP - PENETRATION SEALANT

- A. Provide fire-resistant silicone foam fill to restore fire ratings to all wall, floor, or ceiling penetrations. Foam must be UL classified and meet NEC and local code.
- B. All penetrations through fire-rated floors and walls shall be sealed to prevent the passage of smoke, fire, toxic gas, or water. The fire rating of the penetration seal shall be at least that of the floor or wall

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into which it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electric Code.

- C. No flammable material may be used to line the chase of the hole in which the fire stop material is to be installed.
- D. When damming materials are to be left in place after the seal is complete, then all such materials shall be non-flammable.
- E. The sealant shall be poured into the hole after each cable has been spread to allow a minimum of ½" of foam to flow between them. No cables may be touching each other, because contact between cables could allow voids to form in the fire stop.
- F. If plastic cartridges are used for smaller installations, the chemical components of the foam shall be pre-measured within the cartridges to ensure the proper ratios.
- G. The sealant shall remain resilient and pliable to allow for the removal and/or addition of cable without the necessity of drilling holes. It shall adhere to itself perfectly to allow any and all repairs to be made with the same material. It shall allow for vibration, expansion, and/or contraction of anything passing through the penetration without affecting the seal, or cracking, crumbling, and spalling.
- H. When sealant is injected into a penetration, the foam shall expand to surround all the items within the penetration at that time and be fire resistant, maintaining the pass-minute rating.. No heat shall be required to further expand the foam to block the passage of fire and smoke or water.
- I. The foam sealant material shall have been subjected to fire exposure testing in accordance with standard time-temperature curve in the Standard, UL, ASTM E
- J. 119, and NJPA 251. The foam fire-stop material shall also have been subjected to the hose stream test in accordance with UL 10B.

PART 19 TESTING

A. General Test Procedures

1. Before an application for final acceptance of the work will be considered, all tests stated within this section shall be satisfactorily completed. The communications work shall include miscellaneous tasks, (e.g., removal of panel trims, junction, and pull box covers) deemed necessary to demonstrate compliance with the requirements of the Communications specifications, as well as cable and equipment manufacturers' recommended installation procedures.
2. Upon completion of testing and problem resolution, all connections must be 100% error free: "Error free" is defined to mean the item meets all the manufacturers' specifications and recommendations as published in their latest manufacturing manuals for proper installation and testing. In addition, each item must conform with all other related industrial practices and standards, Building Trades, and Electrical and Communications Industry Standards and Practices.
3. Upon successful completion of each item of testing, the Contractor shall issue in writing a certificate of compliance, along with the test results, to the Project Manager. All failed CAT-6 cables and/or Fiber strands shall be clearly labeled and identified as defective, with the type of defect (i.e. open ring side, grounded tip, short, excessive loss, etc.) identified.
4. The Contractor shall remedy any defective copper cable pair or Fiber cable strand. The Fiber trouble location and identification must be completed with an OTDR.

B. Copper Cable Test Procedures

1. Contractor must complete cable system performance verifications on all copper and fiber cable as specified below and provide the test results to the owner or project manager. Category 6 cable must meet or exceed all manufacturer's and EIA/TIA standards for performance and installation. Fiber cable must also meet or exceed all manufacturer's and EIA/TIA standards for performance

and installation.

2. All copper and fiber optic testing documentation is to be submitted on a CD, as well as 8.5" x 11" hard copies.
3. At a minimum, in addition to any other required testing, the Contractor shall conduct and report on the following tests of copper cabling after the installation is complete:
 - MDF-to-IDF tests of all riser pairs installed under this contract, to determine continuity, shorts, crossed pairs, correct pinning, and grounds.
 - IDF (110 frame or patch panels)–to-information outlet tests of all cable pairs installed under this contract, to determine continuity, shorts, crossed pairs, correct pinning, and grounds.
 - The coaxial cable is to be tested from the MDF Room to the IDF Room and from the IDF Room to the coax outlet. Contractor is to test for continuity, shorts, and grounds.
 - The horizontal Category 6 cabling, installed from the IDF Room to the Information Outlet at the workstation, is to be manufacturer certified and warranted for Category 6 compliance. All manufacturers' performance certificates and extended warranties are to be provided to the owner or project manager upon completion of the testing and manufacturer certification. Contractor is to present copies of certificates identifying the contractor as a current certified VAR for the selected cabling system and therefore, qualified to install a certified cable plant.
 - All category 6 cabling is to be tested end-to-end and documented for Category 6 compliance at all frequencies up to and including 500MHz for Category 6. Such testing is to comply with the procedures and standards outlined by the cable manufacturer and EIA/TIA TSB - 67 concerning testing of Category 6 cable plant.
 - A certified Cat 6 testing system is to be used for such testing to insure that cable pairs are defect free. "Defect free" for the copper cable is defined as a copper pair not having any pair reversals, split pairs, shorts or opens. Test results shall be provided to the Owner or Project Manager within 2 days after testing or 5 days prior to the Owner connecting electronic equipment onto the cable network, whichever is sooner. The contractor must also provide testing summary reports of all category 6 cables including run numbers, and pass/fail results with respect to length, impedance, DC resistance, mutual capacitance, attenuation, NEXT loss, and active ACR. The contractor must also provide spreadsheet analysis of the linearly dependent parameters of length, DC resistance, mutual capacitance, and attenuation; the field measured values shall be compared to the specifications values on one spreadsheet.
 - In the event that a CAT-6 cable fails to perform to the manufacturer's specifications, the Contractor will, at the owner's request, remove the cable and replace it with a new cable, replacing the defective cable at no additional expense to the owner.
 - End-to-end testing is required for every RJ-45 connection. An owner's representative may accompany the Contractor's staff to witness the end-to-end testing. End-to-end testing is defined herein as testing all cabling links to the very last termination point. The Contractor is required to supply sufficient quantities of two-way radios and test equipment to ensure that the tests are completed accurately and expeditiously.
 - The Owner, DTI, or Project manager may conduct performance tests of transport electronics connected to the cabling system. Successful equipment performance tests do not relieve the Contractor from the specified testing, repair, and documentation requirements.
 - The Contractor shall provide to the Owner or Project Manager with copies of all copper-cable test results.

C. Fiber Optic Cable Test Procedures

1. All fiber optic cable and associated equipment lateral, and vertical riser cabling must be thoroughly tested. The fiber cable will be accepted only after each strand is tested in accordance with the specifications defined herein. All strands are to be tested and found to be 100% acceptable.
2. The Contractor shall test all cables, connectors, associated equipment, and hardware furnished by the Contractor upon receipt of same as defined herein.
3. As a minimum, the Contractor shall test, as described below, all optical fiber cable strands installed within the scope of this proposal:

STRUCTURED CABLING

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- Fully test complete links only. Piecemeal testing is not acceptable.
- Perform end-to-end, bi-directional attenuation (loss) test for each fiber strand at 850nm and 1300nm wavelengths. Conduct tests in accordance with EIA/TIA-526-14, Method B and with test instrument manufacturer's published instructions.
 - a. Demonstrate that measured link loss does not exceed the expected value based on the number of mated connector pairs, the connector's published loss per mated pair, and the cable's published loss based on distance.
 - b. Strands whose measured attenuation falls outside the acceptable range shall be subject to further inspection and testing to determine the nature of the fault. At a minimum, an OTDR shall be used to: determine the true loss for each connector pair and the exact length of the fiber, and to identify the presence of any core damage.
 - c. Riser end-to-end testing of individual optical fibers is considered to be from the MDF Room to the IDF Rooms distribution panels on each floor.
 - d. Horizontal end-to-end testing of individual optical fibers is considered to be from each floor's IDF Room's Fiber Distribution Panels to the Information Outlet.
- Faults related to connectors shall be corrected and the fiber re-tested as stated above until acceptable attenuation measurements are received.
- Where defects are found to be inherent in the fiber itself, notify the Project Manager in writing. Upon obtaining approval by the Project Manager, replace any cable having fewer than the manufacturer's guaranteed number of serviceable fibers.
- Remove all newly installed defective cables from pathways. Do not abandon cables in place.
- All test results and corrective procedures are to be documented and submitted as a spreadsheet to State/DTI within five (5) working days of test completion.
- Considering that the fiber cable plant is to be certified, each test report form shall provide at least the following information:
 - a. Project name
 - b. Contractor's name
 - c. Date(s) of preparation and of testing
 - d. Fiber type, strand count, connectors and patches
 - e. Designated cable number (regardless of whether only one cable of each type is present) and individual fiber numbers
 - f. Make, model, serial number, and date of last calibration of test equipment used
 - g. Name of test crew foreman
 - h. Test results: Calculated maximum link loss, length of run, OTDR, and also
 - i. Power Meter-measured link loss for each fiber, pass/fail result, and comments.
- In addition to the tests specified above, the Contractor shall be present while the Owner or Project Manager conducts performance tests of the transport electronics connected to the cabling system; the contractor shall conduct on- the-spot cable tests and effect cable plant repairs as necessary. Successful equipment performance tests do not relieve the Contractor from the specified testing, repair, and documentation requirements.
- Recommended test equipment:
 - a. Optical fiber power meter and Light Source: Siecor CPM-850/1300 meter and OS-100D Light Source, or equivalent.
 - b. TDR: Tektronix TFP2 FiberMaster, Laser Precision TD-2000 or equivalent with 850nm and 1300nm emitter modules and hard copy printout, or equivalent.
 - c. Optical fiber inspection scope: Cambridge Instruments 10x fiber scope, or equivalent.
- The Contractor shall provide copies of all fiber and copper cable test results to the Owner or Project Manager.
- All fiber optic cabling (workstation and riser) is to be installed in a manner that complies with and allows Owner to receive the manufacturer's extended warranty. The contractor is to be certified and authorized to provide the extended warranty. A manufacturer's extended warranty is to be provided, through the

STRUCTURED CABLING

27 10 00

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contractor, upon completion of the testing and manufacturer's certification. Contractor is to present copies of certificates identifying the contractor as a current certified VAR and therefore, qualified to certify and install the cable plant.

- The Owner and Project Manager reserves the right to observe any or all portions of the testing. Notification of testing is at least three days prior to start of testing.

D. Replacement

Any fiber strand, connector, block, or module installed by the Contractor that fails to meet the loss budget, or that tests below the manufacturer's standards, shall be replaced at no additional cost to the owners or State/DTI. The replacement cable, connector, or part shall be tested after repairs have been made to verify compliance. Only equipment that meets the installation requirements stated herein shall meet the system's acceptance requirements.

E. Source Manufacturing/Quality Control

Cables that are supplied by the Contractor, and test outside of the factory test data by a margin of 10 percent on loss, may be deemed non-usable and returned to the manufacturer for replacement.

F. Physical Inspection

Prior to conducting any transmission testing, the following visual inspections will be performed:

1. Verify that all cable has been installed in full compliance with the proposal specifications.
2. Check for physical damage to the Fiber Distribution Panels and termination hardware.
3. Check that all cabling is properly jacketed, installation properly labeled at both ends of the cable, inner-duct and termination hardware is completed in all IDFs and the MDF Room.
4. Verify that all cable bends are within the manufacturer's specified bend radius.
5. Verify that all cabinets and racks (which require grounding) are properly grounded and comply with the National and Local Electrical Codes and State Standards for grounding.
6. Verify that the cables are properly approved and structurally supported for termination.
7. Verify that all Delaware Fire Code requirements have been met and satisfied.

G. DOCUMENTATION

Proper labeling and documentation will allow a technician to quickly trace a particular cable link and will significantly reduce the time and costs of moves, additions, changes, and troubleshooting. Both labeling and documentation depend on the use of a system-wide coding scheme that will identify and locate each component of the wiring system and allow all components to be linked in a logical fashion.

1. There are three components of wiring system documentation:
 - Labeling Communications/Data room/closet termination areas aids in identifying the source and function of a circuit.
 - A labeling scheme simplifies the documentation process.
 - "As built" documents provide a permanent record of the communications infrastructure. These documents are a critical management resource. As a result, it is imperative that "as built" documentation be prepared as part of the communications infrastructure project. In addition, these documents must be kept current

throughout the system's life cycle.

2. Termination Blocks

Labels on the connecting hardware should be coded based on the function of the terminated wiring. Colored designation strips are typically provided with a termination block.

3. Cable and Information Outlet Identification

The Contractor shall furnish and install cable tags labeled with identifying cable numbers mutually agreed upon with contractor and the Owner or Project Manager.

- The Contractor shall clearly and consistently mark the appropriate designation strip labels on all termination hardware mutually agreed upon with the Owner or Project Manager. Contractor will submit a sample of all designation labels for approval before installation.
- The Contractor shall affix outlet identification labels, machine printed or typed, with identifying cable numbers as shown on the attached drawings.
- Subsequent to pulling and terminating cables, the Contractor shall place the appropriate cable tags within six (6) inches of each end of each copper cable and eighteen (18) inches of each optical fiber cable end.
- If the cable tape becomes illegible or is removed at any time during the job, the Contractor shall immediately replace it with a duplicate preprinted cable tag.
- The Contractor shall provide the Owner or Project Manager with a listing of all cable identification numbers, keyed to cable types.
- Contractor will label each information outlet with the following labeling scheme: If the 1st floor IDF closet "A" is the origination point of the cable feeding workstation "007" the following is the configuration of the label to be installed:
- Floor- IDF Closet - Information Outlet Number
- Example: 1A-B101-01, 1A-B101-02, etc.
- Contractor will submit for approval a sample of all information outlet designation labels.

H. "As-Built" Documentation

Maintaining records and documents is the most important portion of the administration of a communications infrastructure. Maintenance and moves, additions, and changes can become very difficult if a current set of records and documents is not maintained. In fact, isolation and resolution of problems are often delayed because configuration information is either unavailable or outdated.

Subsequent to the installation and prior to acceptance, the Contractor shall prepare and issue As-Built drawings, in an AutoCAD format, that shall reflect the lengths of cables installed and the actual manner and conditions of installation, including all deletions from, additions to, or departures from the contract documents. These documents are to include the information outlet station numbers and cable routing where they vary from the original plan. A copy of these documents will be stored in the MDF, with a master copy located at the Owner or Project Manager.

I. Cable Management System

Wiring and equipment relationships must be maintained in a database or spreadsheet (depending on their complexity). The best approach is to use a third-party vendor's application for tracking cable management. These records contain comprehensive information about the users' communications configuration. The information will be very valuable in the support of long-term user-community communications requirements.

PART 20 APPENDIX A – COMMUNICATIONS PLANNING CHECKLIST

A. Not Used**PART 21 APPENDIX B - CABLE INSTALLATION CHECKLIST****A. Check Local Building Codes**

The requirements stipulated by Section 800 of the National Electrical Code for Communications cable installations produce an orderly installation. However, it is important to consult your building inspector to determine whether there are special local requirements. Strapping requirements depend upon the building's design, State and Local Standards, and codes. Terminations can be made in standard junction boxes.

B. Coordinate with Other Contractors

Plan to install the cabling system in new buildings after the power wiring, air-handling ducts, and ceiling supports have been installed, but before the ceiling tiles are in place. This will prevent damage to the cable system during construction.

C. Plan the Job

On a blueprint, mark all terminations and desired routings, if known, to accommodate future building modifications.

D. Label the Cables

Label each cable reel and its free end according to the termination locations marked on your blueprint.

E. Pull Cable into Place

Deliver the cable from the bottom of each reel, making sure not to kink, crush, or pinch the cable. Pull groups of cables to a logical point and then fan out to the individual termination points. Arrange the cables neatly so they are easily identifiable for relocation. Separate the Communications cables from other cables by at least six inches and avoid sharp edges, tight bends, and locations that would subject the cable to abrasion, corrosion, or moisture. According to the National Electrical Code, low-voltage cables cannot share a tray with power cables. Running signal cables close to power cables may also cause hum pickup. If in doubt about cable locations, consult the standards or the Owner.

F. Remove Slack

Remove slack in lines by pulling the cables back to the wiring room and by adjusting their ceiling location as needed.

G. Label and Cut

Label each cable and then cut it off, making sure to leave enough cable to reach the termination panel.

H. Tie Cables Together

Use cable ties to bundle and secure parallel runs together. Place the ties at intervals sufficient to prevent sagging and to maintain neatness. Distances between ties may vary from six inches to four feet, depending on the size of the cables.

I. Strap the Cable

Use straps to fasten the tied cable bundles to hangers at 4-foot or other appropriate intervals. The distance between hangers will vary from 3 to 20 feet, depending upon the strapping surface, the type and number of cables in each bundle, State and Local Standards, and codes. Make sure to support the cables with hangers rather than pipes, conduit, or other structures in the building plenum. Do not use

straps that are too small for the cable diameter because they can cut or pinch the cable insulation.

J. Inspect the Job

Be sure that the cables are not resting on false ceilings or near electrical fixtures or sagging more than three inches from the point of the tie wrap.

PART 22 APPENDIX C - QUALITY ASSURANCE

- A. All materials used shall bear the Underwriters' Laboratory, Inc. label, provided a standard has been established for the material in question.
- B. All products and materials shall be new and unused, clean, and free of defects, damage, and corrosion.

PART 23 APPENDIX D - CODES, REGULATIONS AND STANDARDS

- A. All installations and equipment shall be in compliance with, equal to or exceed the minimum requirements of OSHA, NEC, NEMA, IEEE, SAME, ANSI, UL, EIA, TIA recommendations and the rules, regulations and requirements of the Federal Communications Commission.
- B. The installation shall comply fully with all applicable Local, County and State of Delaware laws and ordinances, regulations, and codes.
- C. Local electrical and building codes in Delaware may be more restrictive than national codes, recommendations or practice. Follow the most restrictive code or recommendations.
- D. Should any change in plans or Specifications be required to comply with governmental regulations, the Contractor shall notify the Owner or Architect/Engineer at the time of submitting the construction schedule.

PART 24 APPENDIX E - WARRANTY

Besides the manufacturer's extended warranty the Contractor shall submit a single Guarantee stating that all portions of the work are in accordance with Contract requirements and guaranteeing all work against faulty and improper material and workmanship, including work and materials of all subcontractors, manufacturers, suppliers, and sub trade specialists, for a period of one (1) year from date of final acceptance by the project manager, State/DTI, and Owner. Where guarantees or warranties for longer terms are provided, such longer terms shall apply. Within 24 hours after notification, the Contractor shall correct any deficiencies that occur during the guarantee period at no additional cost to Owner, all to the satisfaction of the Project Manager and or Owner.

When installed by a Certified Installer and used in a Structured Cable System, the manufacturer's extended warranty shall cover the installation for a period of 5 years against defects in material and workmanship. It shall also guarantee that it will support any current and future applications designed for Data transmission over the 100/500MHz link/channel, as defined in TIA/EIA 568A Communications Standard.

All move, add and change (MAC) activity shall be covered by the warranty provided it is performed by a Certified Installer.

PART 25 APPENDIX F - BID/QUOTE RESPONSE FORMAT

A. Not Used

PART 26 APPENDIX G —CERTIFIED CONTRACTOR LIST

http://contracts.delaware.gov/contracts_detail.asp?i=79

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SECTION 27 41 16
INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT FOR CLASSROOMS

PART 1 - GENERAL**1.1 SUMMARY****A. Section Includes:**

1. Stand-alone, networkable, scalable, one-room AV control and presentation system with user control panel. Available models support up to four audio inputs and four video inputs, and include user control panel, choice of amplifier/controller, ceiling or wall mounts, ceiling- or wall-mounted speakers, optional microphones for voice reinforcement, and AV interface cables required to integrate with a compatible video projector with screen. Local classroom software control from the teachers desktop, campus-wide scheduling, browser based remote room view/control interface, and management software are available.

B. Related Information:

1. Division 27 Section "Communications Horizontal Cabling" for communications cabling requirements for modular control system.

1.2 REFERENCES**A. National Fire Protection Association (NFPA):**

1. NFPA 70 - National Electrical Code.
2. ANSI/TIA/EIA-588-C.0 – General Cabling Standards
3. ANSI/TIA/EIA-568-C.1 -- Commercial Building Cabling Standard
4. ANSI/TIA/EIA-568-C.2 -- Balanced Twisted Pair Cabling Standard
5. ANSI/BICSI 001-2009, Information Transport Systems Design Standard for K-12 Educational Institutions
6. ANSI S12.60:2002 Acoustic Performance Criteria, Design Requirements, Guidelines for Schools
7. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
8. ANSI/TIA/EIA-569-B -- Commercial Building Standard for Telecommunications Pathways and Spaces
9. ISO/IEC 18010:2002 (2002) – Pathways and Spaces for Customer Premises Cabling
10. ANSI/TIA/EIA-606(A) -- The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
11. ISO/IEC 14763-1:1999 (1999) – Implementation and Operation of Customer Premises Cabling, Part 1 – Administration
12. J-STD-607-A -- Commercial Building Grounding and Bonding Requirements for Telecommunications
13. IEEE 1100 – IEEE Emerald Book

14. NFPA 780 Standard for the Installation of Lightning Protection
15. Cal/OSHA-Pocket Guide for the Construction Industry (recent edition)
16. BICSI -- Telecommunications Distribution Methods Manual (TDMM)
17. BICSI -- Information Transport Systems Installation Methods Manual
18. BICSI - AV Design Reference Manual
19. BICSI – Network Design Reference Manual
20. Federal Communications Commission
21. Federal, state, and local codes, rules, regulations, and ordinances governing the work

1.3 REFERENCES

A. ABBREVIATIONS

1. AV: Audio Visual.

1.4 SYSTEM DESCRIPTION

- A. For each classroom, the Contractor shall furnish and install a complete, networkable, scalable AV control and presentation System. Each System shall include but not be limited to:
 1. One control panel that meets or exceeds the specifications under section 2.B
 2. One amplifier/controller core that meets or exceeds the specifications under section 2.C
 3. Loudspeakers that meet or exceed the specifications under section 2.D
 4. AV connection wall plates that meet or exceed the specifications under section 2.E and 2.F
 5. One wireless receiver that meets or exceed the specifications under section 2.G, 2.K, and 2.L
 6. One neck-worn teacher transmitter/microphone, including charger cradle, that meets or exceeds the specifications under sections 2.H and 2.J
 7. One handheld student transmitter/microphone, including hands-free option and charger cradle, that meets or exceeds the specifications under sections 2.I and 2.J
- B. The System is to include all equipment, materials, labor, and training as required to install and test a complete and operating System as described herein.
- C. Contractor shall follow installation instructions provided by the manufacturer. Installation drawings shall show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- D. Contractor shall examine the installation drawings and verify the conditions governing the work on the job site. Contractor shall arrange accordingly, providing such fittings, horizontal cable raceways, conduits, junction boxes and accessories as may be required to meet such conditions.
- E. Deviations from the installation drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the Systems, shall not be made without the written approval of the Engineer.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product required, demonstrating compliance with requirements.

B. Shop Drawings: Indicate the following:

1. Schematic diagram of controlled circuits and motorized equipment actuators.
- C. Circuits and emergency circuits with capacity and phase, control zones, load type and voltage per circuit.

1.6 INFORMATIONAL SUBMITTALS

- A. Sample of manufacturer's warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operating and maintenance instructions.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualification: Manufacturer of controller with minimum five years record of satisfactory manufacturing and support of components comparable to basis of design system.
- B. Source Requirements: Provide control panel, amplifier/switch, loudspeaker, receiver, and microphone hardware and software through a single source from a single manufacturer.
- C. All miscellaneous equipment required for a complete, professional installation shall be included in the base bid. No allowances for any additional equipment, hardware, cabling, or miscellaneous will be considered unless specifically excluded from the base bid.
- D. All work materials shall be removed at the end of the work day and the work area left in the same condition as found.
- E. The work herein specified shall be performed by fully competent workmen, in a thorough manner. All materials furnished by the Contractor shall be new, and all work shall be completed to the satisfaction of the Architect/Engineer.
- F. All equipment shall be held firmly in place. This shall include speakers, receiver/amplifiers, cables, etc. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three. All switches, connectors, outlets, etc., shall be clearly, logically, and permanently marked during installation.
- G. The Contractor must take such precautions as are necessary to guard against electromagnetic and electrostatic hum and ground loops, to supply adequate ventilation, and to install the equipment so as to provide maximum safety to the person who operates it.
- H. Care shall be exercised in wiring so as to avoid damage to the cables (e.g., stapling, pinching, excessive bending) and to the equipment. All joints and connections shall be made with lead-free rosin-core solder or with mechanical connectors approved by the Engineer. All wiring shall be executed in strict adherence to standard broadcast practices.
- I. The Contractor shall be an established communications and electronics Contractor that has had and currently maintains a locally run and operated business for at least five years. The Contractor shall utilize a duly authorized reseller of the equipment supplied for this project location with full Manufacturer's warranty privileges.
- J. The Contractor shall test the installed System according to the Manufacturer's instructions and verify that the equipment has been installed properly and is functioning as designed.

- K. Manufacturer Qualifications: Approved manufacturer of controller listed in this Section with minimum five years record of satisfactory manufacturing and support of components comparable to basis of design system.
1. Refer to Section 01 16 00 for Substitution Requirements – Any substitution request shall be submitted at least 10 days prior to scheduled bid opening. Any substitution requests submitted after that shall be denied.
 2. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
 - a. Product data indicating compliance with requirements of this Section.
 - b. Samples of each component.
 - c. Sample submittals from similar project.
 - d. Project references: Minimum of 5 completed installations, with Owner and Architect contact information.
 - e. Sample warranty.
 3. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.
 4. Approved manufacturers must comply with separate requirements of Submittals Article.
- L. Regulatory Requirements: Provide components and systems that comply with requirements of the following:
1. Refer to Section 1.2 A.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of controls system that fail in materials or workmanship within the specified warranty period following substantial completion.
1. Warranty Period: Wireless transmitters, wireless receivers, infrared sensors, loudspeakers speakers, and charging stands: 5 years.
 2. Warranty Period: Rechargeable batteries, power cords, power supplies: 1 year.
 3. Warranty Period: Other components: 3 years.
- B. Manufacturer's Extended Support Service: Extended telephone support: Unlimited period.
- C. All warranties shall cover parts and labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products of FrontRow Calypso LLC, Petaluma, CA 94954, Phone +1 707 227 0735, www.gofrontrow.com.

2.2 ROOM AV SYSTEM AND CONTROLLER

- A. The System shall include:

1. One control panel that meets or exceeds the specifications under section 2.B
 2. One amplifier/controller core that meets or exceeds the specifications under section 2.C
 3. Loudspeakers that meet or exceed the specifications under section 2.D
 4. AV connection wall plates that meet or exceed the specifications under section 2.E and 2.F
 5. One wireless receiver that meets or exceed the specifications under section 2.G, 2.K, and 2.L
 6. One neck-worn teacher transmitter/microphone, including charger cradle, that meets or exceeds the specifications under sections 2.H and 2.J
 7. One handheld student transmitter/microphone, including hands-free option and charger cradle, that meets or exceeds the specifications under sections 2.I and 2.J
- B. Control panel:
1. Basis specification: FrontRow CB-2000
 2. Mounting: Single-gang, Leviton Decora® compatible
 3. Buttons: 8 back-lit
 4. Simultaneous control capacity: Unlimited network (IP addressable) devices, 2 bi-directional serial devices, plus 1 IR device or 1 GPI/relay
 5. On-board scheduler: Yes
 6. Security pass-code: Yes
 7. Battery back-up: Yes
 8. File-based cloning: Yes
 9. Configuration: Via web-browser
 10. I/O:
 - i. 1x RJ-45 for IR and serial control, power
 - ii. 1x RJ-45 for 10/100Mb network, power
 11. Weight: 102g/3.6 oz
 12. Power: 9V, 125 mA (via Cat 5)
 13. Size: 5 x 4.4 x 12.7 cm/2 x 1.75 x 5 in
- Or:
1. Basis specification: FrontRow CB-2050
 2. Mounting: Dual-gang, Leviton Decora® compatible
 3. Buttons: 8 back-lit
 4. Volume: Digital rotary
 5. Simultaneous control capacity: Unlimited network (IP addressable) devices, 2 bi-directional serial devices, plus 1 IR device or 1 GPI/relay

6. On-board scheduler: Yes
 7. Security pass-code: Yes
 8. Battery back-up: Yes
 9. File-based cloning: Yes
 10. Configuration: Via web-browser
 11. I/O:
 - i. 1x RJ-45 for IR and serial control, power
 - ii. 1x RJ-45 for 10/100Mb network
 12. Weight: 102g/3.6 oz
 13. Power: 12VDC, 125mA (via Cat 5)
 14. Size: 5 x 4.4 x 12.7 cm/2 x 1.75 x 5 in
- C. Amplifier/Controller Core:
1. Basis specification: FrontRow Conductor™-ready Plenum Core, Conductor™-ready Wall Core, with FrontRow CM3000 amplifier/switch
 2. Audio inputs:
 - i. 1x streaming audio (3.5mm TRS) or RJ45 network connection
 - ii. 4x analog stereo (3.5mm TRS, 1 RJ45)
 - iii. Intercom (RJ45)
 3. Audio outputs:
 - i. 2x audio line out (3.5mm TS)
 - ii. 1x streaming audio out (3.5mm TRS)
 - iii. Intercom (RJ45)
 4. Network support: 4 port 10/100Mb
 - i. 2x +12VDC powered ports for network plus power
 5. Digital Page-override: Yes (via Conductor)
 6. Analog Page-override: Yes (via TB13)
 7. Audio over IP: Yes
 8. Speaker Load Impedance: 4 ohms min - 16 ohm max
 9. Additional inputs: IR, GPI
 10. Additional outputs: IR, COM (RS232 serial)
 11. Amplifier Type: 92% efficient class D
 12. Continuous Power @ 1% THD:
 - i. 16 watts (rms) per channel @ 4 ohms

- ii. 8 watts (rms) per channel @ 8 ohms

13. Power input requirements: 12VDC, 3.5A

14. Mounting: Plenum-rated enclosure

D. Loudspeakers (Wall Mounted):

1. Basis specification: FrontRow 202-05-000-00 IR Speaker Kit
2. Form: A single speaker enclosure containing two offset woofers and a centrally mounted tweeter, plus a centrally mounted, integrated IR receiving module
3. Mounting type: wall mount
4. Speaker power rating: 20 Watts RMS/30 Watts Max.
5. Speaker impedance: 4 Ohms nominal
6. Speaker frequency response: 150Hz -20kHz
7. Inputs:
 - i. 2 quick connect/disconnect speaker cable terminals
 - ii. 1 RCA sensor cable connector
8. Indicator: LED power
9. Mounting brackets: two 16 gauge steel mounting brackets with set screws
10. Sensor module receiving frequencies: 2.3MHz & 2.8Mhz
11. Sensor power: powered by receiver
12. Maximum sensor operating range: 18.5m/60 ft.line-of-sight
13. Maximum sensor reception area: 232m²/2500 ft²
14. Cable form: Single cable combining sensor and speaker cables
15. Maximum cable length: 15.25m/50ft
16. Cable type:
 - i. Main jacket: UL listed, Plenum rated jacket
 - ii. Sensor cable: RG58/u coaxial cable CL3P shielded, UL listed, Plenum rated jacket
 - iii. Speaker cable: 18 AWG 2 conductor UL listed CL2P Plenum-rated
17. RoHS compliance: Combination sensor-speaker assembly, including cable, shall be manufactured using a lead-free process and be free of known hazardous metals and materials

E. Loudspeakers (Ceiling Mounted):

1. Basis specification: FrontRow 470-2856-125 Ceiling Speaker Kit and FrontRow 300-2176-120 Speaker Cable Kit
2. Mounting type: Ceiling mount
3. Speaker power rating: 30 Watts RMS/45 Watts Max.

4. Speaker impedance: 8 Ohms
 5. Speaker frequency response: 60Hz-20kHz
 6. Inputs: Quick connect/disconnect speaker terminals
 7. Mounting mechanism: UL Listed Plenum Rated tile bridges and UL Listed Plenum Rated speaker enclosures
 8. Cable type: 18 AWG 2 conductor UL listed CL2P or better plenum-rated
 9. RoHS compliance: UL Listed Plenum Rated tile bridges and UL Listed Plenum Rated speaker enclosures shall be manufactured using a lead-free process and be free of known hazardous metals and materials
- F. Analog Wall Plates:
1. Basis specification: FrontRow WP-PCAV
 - a. Inputs: DB15 VGA, 3.5mm mini-TRS audio, RCA composite video, stereo RCA audio
 - b. Profile: single-gang Decora® style wall plate with attached flying lead with locking 13-pin DIN connector
 - c. Video resolution: UXGA (1600x1200)
 - d. Cabling: Plenum-rated 50' AV cable
 - i. RoHS compliance: UL listed - shall be manufactured using a lead-free process and be free of known hazardous metals and materials
 - ii. Input: 13-pin DIN locking connector
 - iii. Output: DB15 VGA, 3.5mm mini-TRS audio, RCA composite video, stereo RCA audio
 - iv. Width: Fits through ¾" conduit
- G. Digital Wall Plates – HDMI:
1. HDMI extender
 - a. Profile: single-gang Decora™ style wall plate transmitter with HDMI type A female input connector, LED power indicator
 - b. I/O:
 - i. 2x RJ45 connectors on transmitter
 - ii. 2x RJ45 connectors on receiver
 - c. Input HDMI cable distance: ≤10FT
 - d. Output HDMI cable distance: ≤10FT
 - e. Total HDMI signal length 75' (HDMI cables + CAT5/6)
 - f. Power: +5VDC 300mA available line power (powered at receiver end)
 - g. PC resolution: up to UXGA (1600 x 1200)
 - h. Digital video resolution: 480i, 480p, 576i, 576p, 720p, 1080i, 1080p

- i. Compliance: HDMI 1.3b, HDCP
 2. HDMI audio de-embedder
 - a. Formats: Digital 2.0CH/5.1CH LPCM, Dolby Digital, or DTS audio
 - b. Input: HDMI type A female
 - c. Output: Stereo 3.5mm analog, HDMI type A female
 - d. Power: +5VDC, 200mA
 - e. Regulatory: FCC, CE, UL
 - f. Power consumption (max): 1W
 3. Cable type: 2x 50' plenum-rated Cat5e/6 UTP
 - a. RoHS: UL listed - shall be manufactured using a lead-free process and be free of known hazardous metals and materials
- H. Wireless Receiver:
 1. Basis specification: FrontRow 5201R Symbio
 2. Receiver frequency: 2.3MHz & 2.8MHz (2 simultaneous channels)
 3. Operating range: 18.5m/60ft line-of-sight (typical)
 4. Frequency Response: 50Hz to 10kHz
 5. THD: < 1% @ 1kHz
 6. Signal to Noise: > 65dB (system)
 7. Power Supply: +12VDC, 300mA
 8. Mic level out: 0V to 100mVrms at maximum volume & maximum deviation, typical
 9. Line level out: 0V to 1Vrms at maximum volume & maximum deviation, typical
 10. Size (wxhxd): 14 x 3.8 x 18 cm/5.5 x 1.5 x 7 in
 11. Weight: 766g/1.7lbs.
 12. Controls:
 - i. Power
 - ii. Two microphone volume controls (channel A and channel B)
 13. Signal-to-noise from microphone to speaker output (including audio circuitry): >65dB
 14. Reception area: 163m²/1225ft²
 15. Reception angle: 130° x 60°
 16. External sensor ports: 3, RCA
 17. The Wireless Microphone System shall be manufactured using a lead-free process and be free of hazardous metals and materials (RoHS compliant)
 18. The Wireless Microphone System receiver shall be UL listed

I. Teacher Transmitter/Microphone:

1. Basis specification: FrontRow 940TM Pendant Microphone
2. Transmission type: infrared
3. Number of switchable channels: 2
4. Transmitting frequencies: 2.3MHz & 2.8MHz
5. Number of built-in microphones: 2
6. Microphone type: uni-directional cardioid
7. Number of batteries required for operation: 1
8. Minimum battery life: 8 hours
9. Battery type: AA 2300mAh rechargeable NiMH or alkaline (1.5V)
10. Minimum operating range: 18.5m/60ft line of sight
11. Wearing style: Around the neck (pendant)
12. Maximum dimensions: 11 x 6 x 2.5 cm/4.5 x 2.5 x 0.9 in
13. Maximum weight: 85g/3oz (with battery)
14. Charge protection (prevents damage from accidentally recharging alkaline batteries):
Yes
15. Drop-in charger available: Yes
16. User controls:
 - i. Mute switch: Large, positioned on front
 - ii. On/off
 - iii. Channel selector
17. Inputs/outputs:
 - i. 2.5mm optional external mic input
 - ii. 3.5mm stereo summing auxiliary input
 - iii. 1.3mm DC charge jack
18. Indicator: LED for power on, low battery, charge, and mute
19. RoHS compliance: The transmitter shall be manufactured using a lead-free process and be free of hazardous metals and materials
20. UL listing: The transmitter/microphone shall be UL listed

J. Student Transmitter/Microphone:

1. Basis specification: FrontRow 950H Pass-Around Microphone
2. Transmission type: infrared
3. Number of switchable channels: 2

4. Transmitting frequencies: 2.3MHz & 2.8MHz
5. Number of batteries required for operation: 1
6. Minimum battery life: 5 hours
7. Battery type: AA 2300mAh rechargeable NiMH or alkaline (1.5V)
8. Minimum operating range: 12.2m/40ft line of sight
9. Wearing style: Handheld or around the neck (must include hands-free option)
10. Maximum weight: 73.7g/2.6oz (with battery)
11. Maximum dimensions: 14.6 x 2.8 x 3.5 cm/5.7 x 1.1 x 1.4 in
12. Charge protection (prevents damage from accidentally recharging alkaline batteries):
Yes
13. Drop-in charger included: Yes
14. User controls:
 - i. On/off
 - ii. Channel selector (inside battery compartment)
 - iii. 3-position mic gain (inside battery compartment)
15. Inputs/outputs
 - i. 3.5mm stereo summing auxiliary input
 - ii. 1.3mm DC charge jack
16. Indicator: LED for power on, low battery, charge
17. RoHS compliance: The transmitter shall be manufactured using a lead-free process and be free of hazardous metals and materials
18. UL listing: The transmitter/microphone shall be UL listed

K. Charging Cradle

1. Basis specification: FrontRow 950C Charger
2. Number of charging pockets: 2 (one for teacher transmitter/microphone and one for student transmitter/microphone)
3. Energy Star qualified: The charging cradle shall be Energy Star qualified and meet ENERGY STAR® Eligibility Criteria for Products with Battery Charging Systems (BCSs)
4. Indicators: One LED for each pocket indicating charging, battery fault, and charge complete
5. RoHS compliance: The charging cradle shall be manufactured using a lead-free process and be free of hazardous metals and materials
6. UL listing: The charging cradle shall be UL listed

L. External Ceiling Sensor

1. Basis specification: FrontRow 204-01-006-00 Ceiling Sensor Kit

2. Indicator: LED power
3. Mounting type: Drop ceiling acoustic tile or sheetrock ceiling
4. Sensor module receiving frequencies: 2.3MHz & 2.8Mhz
5. Sensor power: powered by receiver
6. Minimum sensor operating range: 18.5m/60 ft.line-of-sight
7. Minimum sensor reception area: 232m2/2500 ft2
8. Minimum cable length: 15.25m/50ft
9. Cable type: RG58/u coaxial cable CL3P shielded, UL listed, Plenum rated jacket
10. RoHS compliance: Must be manufactured using a lead-free process and be free of known hazardous metals and materials
11. UL listing: The ceiling sensor shall be UL listed

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation, examine work area to verify measurements, and that commencing installation complies with manufacturer's requirements.

3.2 INSTALLATION

- A. Comply with requirements of Division 27 Sections "Common Work Results for Communications."
- B. Do not install AV or control devices until space is enclosed, HVAC systems are running, and overhead and wet work in work space are complete.
- C. Install control devices in accordance with manufacturer's instructions.
- D. Install speakers in accordance with manufacturer's instructions.
- E. Install projector and mount in accordance with manufacturer's instructions.
- F. Grounding: Provide electrical grounding in accordance with NFPA 70.
- G. Perform setup for each audio-visual equipment component.

3.3 SYSTEM STARTUP

- A. Provide system startup and adjustment to occupied conditions in accordance with manufacturer's recommendations.
- B. Perform operational testing to verify compliance with Specifications. Adjust as required.

3.4 CLOSEOUT ACTIVITIES

- A. Demonstration: The Contractor shall demonstrate the System to operate in accordance with the requirements of these specifications as well as the Manufacturer's performance specifications. The test shall be performed in the presence of an authorized representative of the Owner.
- B. Should such a demonstration of performance show that the Contractor has not properly installed the System, the Contractor shall make all commercially reasonable changes or adjustments at no additional cost to the Owner.

- C. Training: Train Owner's personnel to operate, maintain, and program AV controls. Contractor shall provide manufacturer's representative and contractor representative for training. Contractor and Manufacture representatives shall provide training for a minimum of one day to Owner selected personnel.

END OF SECTION

Section 27 51 17
Public Address System

PART 1 - GENERAL**1.0 DESCRIPTION**

- A. The Contractor shall furnish and install all equipment including, but not limited to, outlet boxes, wiring, speakers, and all other necessary equipment to provide a complete operating system as indicated with the contract documents. Provide all necessary wall plates, specialty boxes, etc., not provided by others.
- B. Valcom Class Connection™ Talback Intercom System M/N VE72TR-5, shall be considered as the base bid. The specifying authority must approve alternate systems. Alternate bidders supplying another system shall make aware their intentions and provide all information, including catalog cuts, shop and working drawings, data sheets and a demonstration of the proposed system features. This information must be presented to the relative parties as to allow sufficient time to review all material. This should be accomplished at least 10 (ten) days prior to the bid date.
- C. The intent of this specification is to maximize communications between the classroom and administrative areas while enhancing school safety and reducing maintenance and operational cost.
- D. Under this specification, the system shall provide a complete Communication System for the Administrative, Classroom, Cafeteria, Library, and Recreational areas.
- E. The Communication System shall provide distribution of intercom, overhead paging, emergency paging, class change time tones, and emergency tones and program material and on board emergency messaging.
- F. The Communication System shall feature the capability to operate a system of cameras such that visual and audible communication may be synchronized.

1.1. RESPONSIBILITIES

- A. Contract documents are detailed only to the extent required to show design intent. It shall be understood and agreed upon by the Contractor that all work described herein shall be complete in every detail.
- B. Furnish additional items not mentioned herein to meet requirements as specified without claim for additional payments. Items, may include hardware, rack panels, 66Blocks etc., and other devices that are required for installation.
- C. Labor furnished shall be trained and experienced in telecommunication systems.
- D. All equipment unless otherwise specified, shall be new, free from defects, and the best craftsmanship in its class.

- E. All manufactured equipment shall be installed as recommended by the manufacturers, or as indicated in their published installation manual.
- F. Furnish and install necessary equipment, backboxes, supports and enclosures.
- G. Furnish and install all necessary wire.
- H. Furnish shop drawings.
- I. Perform initial programming of system and audio level adjustments.
- J. Perform final programming of system and audio level adjustments.
- K. Provide system documentation including equipment manuals and drawings.
- L. Guarantee all equipment and components for their specified period from date of acceptance.
- M. Provide information on system requirements to any Contractor responsible for supplying related materials for this system.
- N. System must be U.L. 813 and FCC Part 15 listed for safety reasons. Systems not listed as above shall not be acceptable.

1.2. SUBMITTALS

- A. See Section 01 13 00 – Administrative Requirements, for submittal procedures.
- B. Submit layout drawings of the communication system and all components.
- C. Submit drawings of control equipment showing all major components and positions in the rack.
- D. Provide block diagrams showing components and relative connections.
- E. Test Reports: Indicate satisfactory completion of each test recommended by the manufacturer.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- H. Submit a certificate showing a completion of installation, programming, and service training from the system manufacturer.

- I. Operation Data: Include instructions for adjusting, operating, and extending the system.
- J. Maintenance Data: Include repair procedures and spare parts documentation.
- K. Submit data sheets on equipment provided.

1.3. QUALIFICATIONS

- A. The Contractor shall be an established and local company providing solutions to the school market for a minimum of 3 (three) years with Telecom/Data/Sound Experience. The Contractor shall have service facilities within 30 miles of Project.
- B. The Contractor shall maintain an adequate parts inventory to perform necessary service and upgrades.
- C. Products: Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and stated.

1.4. WARRANTY

- A. The Contractor shall provide a 12 (twelve)-month warranty. The warranty shall cover parts and labor. Warrantee period shall begin on the date of acceptance by the Owner or Architect/engineer.

1.5. PLEDGE OF QUALITY

- A. The Contractor shall be an authorized dealer of the supplied equipment with full warranty privileges.
- B. The Contractor must have attended the Manufacturers' Training Program and be an authorized Class Connection Distributor.
- C. The Contractor shall inventory the necessary parts in order to maintain and service the equipment being supplied. This equipment inventory level shall be in direct proportion to total systems installed as recommended by the manufacture.
- D. The Contractor shall provide complete drawings detailing all interconnections, panel wiring diagrams, and specification sheets.

1.6. IN-SERVICE TRAINING

- A. The Contractor shall furnish in-service training with the system. The sessions shall facilitate the training of personnel in operating classroom equipment, administrative equipment, program distribution, and user programming functions. System specific customized user manuals shall be provided at the time of training. Provide a minimum of one day of training.

1.7. WIRING

- A. Wiring shall be in accordance with the Manufacturer's specifications. Wiring shall meet all local and state codes. All wiring shall be ground and short tested.

1.8. COMMUNICATION SYSTEM

The Communication System shall provide at least the following functions and features:

- A. Direct dialed, hands-free, two-way communication from all administrative telephones to any location equipped with a talkback speaker.
- B. Automatic gain control on intercom speech to assure constant talkback speech level.
- C. Microprocessor based system capable of handling up to 720 points (seven hundred twenty). A point is defined as a call-in switch or a speaker output.
- D. System shall be modular in design and capable of expanding in increments of 48 points allowing for budget flexibility and expandability.
- E. System shall interface with any telephone system, thus allowing the school(s) to upgrade or replace their telephone system without suffering a requirement to replace, or lose any feature of, their internal communications (intercom) system. Any system that limits system features based upon any selected telephone system, and/or is proprietary to one or only a few telephone systems shall not be acceptable.
- F. Automatically sound a tone or play a pre-page WAV file over any loudspeaker connected for two-way communication to alert the classroom teacher that this two-way call has been established. This is intended to prevent unauthorized monitoring. The privacy tone must repeat every 15 (fifteen) seconds.
- G. Distribution of emergency announcement(s) from any authorized telephone to all areas furnished with a loudspeaker. Emergency announcements shall have the highest system priority.
- H. Distribution of general announcements from any administrative telephone, staff telephone, or classroom telephone. The system shall be capable of providing all-call, group calls, multiple group call, or dial-on-the-fly page groups.
- I. Classroom speakers shall be software assignable to any or all of 72 (seventy-two) audio paging/distribution groups.
- J. Provide the ability to define and archive unlimited time tone schedules with up to 255 events per schedule. Each scheduled event shall be capable of controlling any one of 6 (six) internal tones; user selected custom audio/voice phrases, audio from any of 3 auxiliary sources or up to 40 relays for building control. Each scheduled audio event shall be distributable to up to 72 audio groups. The system shall feature the ability to automatically initiate up to 8 schedules per day, based upon the day of the week or calendar dates up to one year in advance. Up to 8 daily schedules shall operate simultaneously. Music distribution, control relay activation, paging & class change grouping and time schedule administration, modification and creation functions must be available through administration PC software. Systems that do not allow the school to manage their own audio groups and schedules with PC software

- or do not offer calendar based scheduling up to one year in advance or require separate page and time groups shall not be acceptable.
- K. Provide 1, 2, 3 or 4 digits numbering plan, thus allowing the classroom speaker and the classroom telephone to be the same architectural number.
 - L. Provide facilities for up to 7 (seven) call-in priority levels. Each classroom call button shall be assignable to any one or two of these priority levels. The call button priority levels shall have the capacity to change state on a time of day basis. The priority levels shall be as follows:
 - 1) Normal
 - 2) Security
 - 3) Normal/Emergency
 - 4) Urgent/Emergency
 - 5) Overhead Ring
 - 6) Emergency Only
 - 7) Ignore
 - M. Call button priority levels shall determine call queue placement. Emergency calls will be answered first; urgent calls second and normal calls last.
 - N. System shall be capable of placing intercoms call on hold in order to perform other administrative functions.
 - O. Any classroom/area loudspeaker must have the flexibility to be programmed as a testing room. A testing room shall be excluded from receiving general announcements, class change tones, group announcements and program material. The testing room must receive emergency tones and announcements. A dial code must be provided that will access these testing rooms at the same time, allowing for an announcement to the testing rooms for applications such as standardized testing. The testing rooms may be reactivated to normal operation at any time by the administration staff as needed. Testing rooms shall automatically be reset to normal operation before start of class the next day.
 - P. Programmable features shall be stored in non-volatile memory and shall not be lost due to power failures.
 - Q. Classroom initiated intercom calls must be able to be assigned to ring at specific administrative ports. These administrative ports shall have the flexibility to be forwarded to other administrative ports should a call go unanswered or should the assigned administrative port be busy.
 - R. Facilities to annunciate incoming intercom calls at multiple administrative phones simultaneously. Calls may be answered from any of the administrative telephones by simply lifting handset, dialing the room number or pressing a button on the telephone. Once answered, the call will automatically be cancelled for other administrative phones.
 - S. System functionality must include the capability to manually distribute up to 5 (five) alert emergency tones via pushbuttons, contact closure, or dial up tones from any

- administrative telephone. These tones shall be customizable with respect to cadence, type and duration. Dial up tones must only be accessible by authorized users.
- T. The system must provide a minimum of 4 (four) ports to be connected to the telephone system from the intercom system. These 4 (four) intercom lines shall provide built-in Enhanced Caller Line Identification which will visually announce the name of the teacher or location, the architectural classroom number, and the status of the call-in level; thus allowing interfacing to any telephone system. Systems that require integration to a specific telephone system or systems in order to offer any system feature shall not be acceptable.
- U. The system shall have the ability to control all system relays. Relays shall be controlled through the administrative software, DTMF controlled, automatically cycle at a programmed time of day, follow time schedule events, follow audio group events, follow security calls, and follow emergency and ADA calls. All relays must be software programmable with the flexibility to change as required. A minimum of eight (8) relays shall be provided.
- V. The system shall provide at least three simultaneously operating, non-restrictive program distribution channels. The audio program material shall be controlled and distributed with administration PC software allowing simple and easy changes. Systems that require manual operated switch-banks or cumbersome DTMF telephone codes for distribution shall not be acceptable.
- W. The Communication System shall feature voice call progress. When 2 or more system users attempt to announce into the same area, the unsuccessful user shall be notified via a voice message. When a user's announcement attempt is overridden by a higher priority announcement, the overridden user shall be notified via a voice message.
- X. The system shall have the ability to store up to 60 minutes of WAV files directly onto the CPU and shall not be lost due to power outage.
- 1)The WAV files shall be activated via the Administration Software, Telephone and/or Telephone system, and/or pushbuttons.
 - 2)The WAV files shall be programmable as to what level of priority they can be broadcast. They shall be programmable as to override any class change tones, normal all call, music, and intercom in the event of an emergency.
 - 3)The WAV files shall also have the ability to be broadcast into any one or all of the 72 audio groups as well to any zone within the system.
 - 4)The WAV files shall be have the ability to be broadcast via a schedule for any day of the week or time of the day. They shall also have the ability to be broadcast for any duration of time and repeat number of plays with the ability to select how long the duration is between each repeated broadcast.
 - 5)The WAV files shall be able to be broadcast via a pushbutton. When this pushbutton is activated it shall be programmable to select which WAV file is

broadcast, the priority level, where it is broadcast, and how many times it shall play.

6)The WAV files shall also have the ability to be a part of the class change tones within the system. These files shall be able to replace any tone within the class change schedules as to offer the flexibility of customizable tones and or phrases in this class change mode.

7)The WAV files shall be programmable as to replace the hands-free alert tone, repeated alert tone, or the all call alert tones.

PART 2 - PRODUCTS

2.0 INTERCOM CONTROL UNIT

- A. Shall be capable of expanding to 720 (seven hundred twenty) points. A point is defined as a call-in switch or speaker output.
- B. Provide pre-alert tone to classroom for intercom calls and general announcements.
- C. Ability to program and control the built-in master clock with unlimited events and unlimited time schedules with multiple audio groups.
- D. Ability to control wireless or wired clocks (various correction methods).
- E. Ability to produce user defined tone signals for time tones or emergency tones.
- F. Ability to select the tone on an all-call basis from any, or selected, administrative telephones.
- G. Provide an RS-232 and Ethernet port, which will give ability to monitor operations and functions of the systems.
- H. Provide off-site programming and diagnostics of the system. It shall also be capable of determining basic circuit faults.
- I. The system shall be capable of simultaneous conversations between administrative ports.
- J. The system shall have a Windows® based PC administration programming tool which allows the administrative personnel to easily manage Audio Sources, Class Change schedules, paging groups, time updates, holiday schedules and day/night mode operation from their desktop PC across a standard Ethernet LAN. It shall also have the ability to activate on board WAV files on a schedule and/or immediately in the event of an emergency at the highest priority override level. Systems that require propriety consoles, special LCD displays or solely utilize DTMF for changes to perform these functions shall not be acceptable.
- K. System shall provide calendar based scheduling up to one year in advance.

- L. The system shall be programmable via Ethernet or direct COM port cable connection.
- M. System shall be capable of utilizing 45 (forty-five) ohm or 25-volt speakers for classroom type speakers. Systems that require re-tapping existing classroom 25-volt speakers shall not be acceptable.
- N. System speakers shall be capable of utilizing standard CAT 3 (three), CAT 5 (five), or 6 (six) telephone/data wiring for installation. The speakers and call buttons shall be capable of utilizing spare pairs in the telephone wire connected to the classroom, allowing for lower installation cost. Systems that waste infrastructure by requiring separate heavy gauge infrastructure wire shall not be acceptable.
- O. Provide 8 (eight) unrestricted simultaneous audio paths for communication between administrative phones, program material, time tone distribution, and paging. Systems that do not allow simultaneous pages to different paging groups will not be accepted.
- P. Provide 6 (six) software programmable pushbutton inputs that can be used to activate tones, emergency tones, time tones, schedules, set system time, force a holiday schedule, door entry, etc.
- Q. Provide 8 (eight) software programmable output contact closures which can be activated manually to turn on cameras, unlock doors, emergency lockdown, etc., or automatically via Master Time Control Center.
- R. Provide voice-synthesized call-in, which allows the administrative telephones to hear the incoming intercom call's room number over the handset.
- S. Provide call confirmation tone at speaker when an intercom call is placed. This verifies that the call has been placed in queue. If the call is upgraded to an emergency, a second confirmation tone shall be activated.
- T. Automatically announce the architectural room number over any one, group, or all speakers if an emergency call-in from a classroom goes unanswered for a programmable period of time. Systems that do not announce emergency call-ins shall not be acceptable.
- U. Provide Emergency Override On Board Voice Messaging via the following methods:
 - Any authorized PC on the schools LAN/WAN
 - Any authorized telephone
 - Any pushbutton

2.1. SPEAKERS/CALL SWITCHES

2x2 Talkback Lay in Speaker – Valcom M/N VECTLA-2 or approved equal
Cone Diameter: 8"
Voice coil impedance: 45 Ohms
Power Handling: 12 Watts
Frequency response: 80Hz to 15Khz

Steel Housing with a white baked on acrylic enamel finish

Wall Talkback Speaker – Valcom V-WTGY or approved equal

Cone Diameter: 8”

Voice coil impedance: 45 Ohms

Power Handling: 12 Watts

Frequency response: 80Hz to 15Khz

Gray Metal enamel finish with Black cloth grill

2x2 Paging Speaker – Valcom – VE9022A-2 or approved equal

Cone Diameter: 8”

Input Impedance: 600 ohms

Power Requirements: 50mA @ 24 VDC

Frequency response: 80Hz to 15Khz

Steel Housing with a white baked on acrylic enamel finish

Wall Paging Speaker – Valcom – V-1052C or approved equal

Cone Diameter: 8”

Input Impedance: 600 ohms

Power Requirements: 50mA @ 24 VDC

Frequency response: 80Hz to 15Khz

Gray Metal enamel finish with Black cloth grill

Paging Loudspeaker (Weather Resistant) – Valcom V-1036CGY or approved equal

Cone Diameter: 8”

Input Impedance: 600 ohms

Power Requirements: 300mA @ 24 VDC

Frequency response: 275Hz to 15Khz

High impact grey ABS Plastic

2.2. WIRING

- A. All wiring shall be listed for the intended purpose. The intercom shall use CAT 3 (three) UTP U.L. listed cable. All two way speakers shall be homerun.
- B. All interior wiring shall be in accordance with new construction guidelines suggested by the Manufacturer; including the speaker.

2.3. INSTALLATION

- A. Complete system shall be installed in accordance with Manufacturer's recommendations.
- B. All wiring shall be installed in raceways or plenum rated cable where routed in plenum ceiling areas.

2.4. PROTECTION

- A. The contractor shall provide all necessary protection on the AC power feed and on all station lines leaving/entering the building.
- B. The contractor shall note in his system drawings, the type of protection devices and all relative information.

3.0 INSTALLATION

- A. Install in accordance with manufacturer's instructions
- B. Leave 18 inches excess cable at each termination at speaker and other system outlets
- C. Leave 3 feet excess cable at each termination at system cabinet
- D. Support cables above accessible ceilings to keep them from resting on ceiling tiles. Use J hooks to support cables from structure for ceiling suspension system.
- E. Ground and bond equipment and circuits in accordance with manufacturer's recommendations and instructions.

End of Section

SECTION 28 31 00**FIRE DETECTION AND ALARM****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Circuits from protected premises to supervising station, including conduit.
- D. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.
- E. Maintenance of fire alarm system under contract for specified warranty period.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Section 08 71 00 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
- C. Section 21 30 00 - Fire Pumps: Supervisory devices.
- D. Section 21 13 00 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- E. Section 14 20 10 - Passenger Elevators: Elevator systems monitored and controlled by fire alarm system.
- F. Section 23 33 00 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; (ADA Standards for Accessible Design).
- B. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 72 - National Fire Alarm Code and Signaling Code.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Drawings must be prepared using AutoCAD Release 11_.
 - 1. Red Clay Consolidated School District will provide floor plan drawings for Contractor's use; verify all dimensions on Red Clay Consolidated School District-provided drawings.
- C. Evidence of designer qualifications.

- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
1. Copy (if any) of list of data required by authority having jurisdiction.
 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 4. System zone boundaries and interfaces to fire safety systems.
 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 7. List of all devices on each signaling line circuit, with spare capacity indicated.
 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
 11. Certification by the manufacturer of the control unit that the system design complies with the contract documents.
 12. Certification by Contractor that the system design complies with the contract documents.
 13. Do not show existing components to be removed.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- I. Operating and Maintenance Data: See Section 01 78 00 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 4. List of recommended spare parts, tools, and instruments for testing.
 5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.
 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Red Clay Consolidated School District.
 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.

- J. Project Record Documents: See Section 01 78 00 for additional requirements; have one set available during closeout demonstration:
 - 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 - 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 - 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- K. Closeout Documents:
 - 1. Certification by manufacturer that the system has been installed in compliance with his installation requirements, is complete, and is in satisfactory operating condition.
 - 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
 - 3. Certificate of Occupancy.
 - 4. Maintenance contract.
- L. Maintenance Materials, Tools, and Software: Furnish the following for Red Clay Consolidated School District's use in maintenance of project.
 - 1. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
 - 2. In addition to the items in quantities indicated in PART 2, furnish the following:
 - a. All tools, software, and documentation necessary to modify the fire alarm system using Red Clay Consolidated School District's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
 - b. One copy, on CD-ROM, of all software not resident in read-only-memory.

1.05 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 - 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 - 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 - 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Alarm Control Units - Basis of Design: _GE EST 3 fire alarm systems - Tie into existing system.
- B. Fire Alarm Control Units - Other Acceptable Manufacturers: Provided their products meet or exceed the performance of the basis of design product, products of the following are acceptable:
 - 1. Provide all control units made by the same manufacturer.
- C. Initiating Devices, and Notification Appliances:
 - 1. Same manufacturer as control units.
 - 2. Provide all initiating devices and notification appliances made by the same manufacturer.
- D. Substitutions: See Section 01 60 00 - Product Requirements.
 - 1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with contract documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with contract documents.

2.02 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide modifications and extensions to the existing GE EST- 3 automatic fire detection and alarm system:
 - 1. Provide all components necessary, regardless of whether shown in the contract documents or not.
 - 2. Protected Premises: Entire building shown on drawings.
 - 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards for Accessible Design.
 - b. The requirements of the State Fire Marshal.
 - c. The requirements of the local authority having jurisdiction, which is Delaware state Fire Marshall's office..
 - d. Applicable local codes.
 - e. The contract documents (drawings and specifications).
 - f. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
 - 4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
 - 5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.

6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
 7. Program notification zones and voice messages as directed by Red Clay Consolidated School District.
 8. Hearing Impaired Occupants: Provide visible notification devices in all public areas and in dwelling units.
 9. Fire Command Center: Location indicated on drawings.
 10. Master Control Unit (Panel): New, located at fire command center.
- B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
 2. On-Premises Supervising Station: Existing proprietary station operated by Red Clay Consolidated School District, located at _____.
 3. Means of Transmission to On-Premises Supervising Station: Directly connected noncoded system.
- C. Circuits:
1. Initiating Device Circuits (IDC): Class A, Style D.
 2. Signaling Line Circuits (SLC) Within Single Building: Class A, Style 7.
 3. Notification Appliance Circuits (NAC): Class A, Style Z.
- D. Spare Capacity:
1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 3. Speaker Amplifiers: Minimum 25 percent spare capacity.
 4. Master Control Unit: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
 2. Secondary: Storage batteries.
 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 4. Each Computer System: Provide uninterruptible power supply (UPS).

2.03 EXISTING COMPONENTS

- A. On-Premises Supervising Station: Include as part of this work all modifications necessary to existing supervising station to accommodate new fire alarm work.
- B. Clearly label components that are "Not In Service."
- C. Remove unused existing components and materials from site and dispose of properly.

2.04 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 1. Sprinkler water control valves.
 2. Dry-pipe sprinkler system pressure.
 3. Dry-pipe sprinkler valve room low temperature.
 4. Fire pump(s).
 5. Elevator shut-down control circuits.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
 1. Sprinkler water flow.
 2. Kitchen hood suppression activation; also disconnect fuel source from cooking

- equipment.
- 3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
- 4. Duct smoke detectors.
- C. Elevators:
 - 1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
 - 2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
 - 3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
- D. HVAC:
 - 1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

2.05 COMPONENTS

- A. General:
 - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units, Initiating Devices, and Notification Appliances: Analog, addressable type; listed by Underwriters Laboratories as suitable for the purpose intended.
- C. Master Control Unit: As specified for Basis of Design above, or equivalent.
- D. Remote Annunciators: _____.
- E. Initiating Devices:
 - 1. Manual Pull Stations: _____.
 - 2. Key Operated Pull Stations: _____.
 - 3. Smoke Detectors: _____.
 - 4. Duct Smoke Detectors: _____.
 - 5. Heat Detectors: _____.
 - 6. Addressable Interface Devices: _____.
- F. Notification Appliances:
 - 1. Bells: _____.
 - 2. Speakers: _____.
 - 3. Strobes: _____.
- G. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.
- H. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
- I. Locks and Keys: Deliver keys to Red Clay Consolidated School District.
- J. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
 - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 - 2. Provide one for each control unit where operations are to be performed.
 - 3. Obtain approval of Red Clay Consolidated School District prior to mounting; mount in location acceptable to Red Clay Consolidated School District.
 - 4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and the contract documents.
- B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- C. Obtain Red Clay Consolidated School District's approval of locations of devices, before installation.
- D. Install instruction cards and labels.

3.02 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Red Clay Consolidated School District 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.03 Red Clay Consolidated School District PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Red Clay Consolidated School District personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Red Clay Consolidated School District furnished classroom, on-site or at other local facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
 - 1. Initial Training: 1 session pre-closeout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
- D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.04 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Red Clay Consolidated School District.
 - 1. Be prepared to conduct any of the required tests.

2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Substantial Completion.
- C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
1. Approved operating and maintenance data has been delivered.
 2. Spare parts, extra materials, and tools have been delivered.
 3. All aspects of operation have been demonstrated to Red Clay Consolidated School District.
 4. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 5. Occupancy permit has been granted.
 6. Specified pre-closeout instruction is complete.

3.05 MAINTENANCE

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide to Red Clay Consolidated School District, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.
- C. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- D. Provide trouble call-back service upon notification by Red Clay Consolidated School District:
1. Provide on-site response within 2 hours of notification.
 2. Include allowance for call-back service during normal working hours at no extra cost to Red Clay Consolidated School District.
 3. Red Clay Consolidated School District will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- F. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Red Clay Consolidated School District's representative upon completion of site visit.
- G. Comply with Red Clay Consolidated School District's requirements for access to facility and

security.

END OF SECTION

SECTION 23 81 29**VARIABLE REFRIGERANT VOLUME (VRV, VRF) HVAC SYSTEM****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Variable refrigerant volume HVAC system includes:
 - 1. Outdoor/Condensing unit(s).
 - 2. Indoor/Evaporator units.
 - 3. Branch selector units.
 - 4. Refrigerant piping.
 - 5. Control panels.
 - 6. Control wiring.

1.02 RELATED REQUIREMENTS

- A. Section 01 23 00 - Alternates: List of alternates relevant to this section.
- B. Section 01 79 00 - Demonstration and Training.
- C. Section 01 91 13 - General Commissioning Requirements.
- D. Section 01 91 14 - Commissioning Authority Responsibilities.
- E. Section 22 10 05 - Plumbing Piping: Condensate drain piping.
- F. Section 22 30 00 - Plumbing Equipment: Cooling condensate removal pumps.
- G. Section 23 08 00 - Commissioning of HVAC.
- H. Section 23 23 00 - Refrigerant Piping and Specialties: Additional requirements for refrigerant piping system.
- I. Section 26 27 17 - Equipment Wiring: Power connections to equipment.
 - 1. Provide separate power connections for each unit of equipment.
- J. Section 23 09 23 and 23 09 93: Building automation system providing centralized control of this system.

1.03 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.
- C. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc (ANSI/ASHRAE/IESNA Std 90.1).
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.
- E. UL 1995 - Heating and Cooling Equipment.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, and alternate systems/products, as defined above, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2.
- C. Design Data:
 - 1. Provide design calculations showing that system will achieve performance specified.
 - 2. Provide design data required by ASHRAE 90.1.
- D. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:
 - 1. Outdoor/Central Units:
 - a. Refrigerant Type and Size of Charge.
 - b. Cooling Capacity: Btu/h.
 - c. Heating Capacity: Btu/h.
 - d. Cooling Input Power: Btu/h.
 - e. Heating Input Power: Btu/h.
 - f. Operating Temperature Range, Cooling and Heating.
 - g. Air Flow: Cubic feet per minute.
 - h. Fan Curves.
 - i. External Static Pressure (ESP): Inches WG.
 - j. Sound Pressure Level: dB(A).
 - k. Electrical Data:
 - 1) Maximum Circuit Amps (MCA).
 - 2) Maximum Fuse Amps (MFA).
 - 3) Maximum Starting Current (MSC).
 - 4) Full Load Amps (FLA).
 - 5) Total Over Current Amps (TOCA).
 - 6) Fan Motor: HP.
 - l. Weight and Dimensions.
 - m. Maximum number of indoor units that can be served.
 - n. Maximum refrigerant piping run from outdoor/condenser unit to indoor/evaporator unit.
 - o. Maximum height difference between outdoor/condenser unit to indoor/evaporator unit, both above and below.
 - p. Control Options.
 - 2. Indoor/Evaporator Units:
 - a. Cooling Capacity: Btu/h.
 - b. Heating Capacity: Btu/h.
 - c. Cooling Input Power: Btu/h.
 - d. Heating Input Power: Btu/h.
 - e. Air Flow: Cubic feet per minute.
 - f. Fan Curves.
 - g. External Static Pressure (ESP): Inches WG.
 - h. Sound Pressure level: dB(A).
 - i. Electrical Data:
 - 1) Maximum Circuit Amps (MCA).
 - 2) Maximum Fuse Amps (MFA).
 - 3) Maximum Starting Current (MSC).
 - 4) Full Load Amps (FLA).

- 5) Total Over Current Amps (TOCA).
 - 6) Fan Motor: HP.
 - j. Maximum Lift of Built-in Condensate Pump.
 - k. Weight and Dimensions.
 - l. Control Options.
3. Control Panels: Complete description of options, control points, zones/groups.
- E. Specimen Warranty: Copy of manufacturer's warranties.
- F. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
1. Detailed piping diagrams, with branch balancing devices.
 2. Condensate piping routing, size, and pump connections.
 3. Detailed power wiring diagrams.
 4. Detailed control wiring diagrams.
 5. Locations of required access through fixed construction.
 6. Drawings required by manufacturer.
- G. Operating and Maintenance Data:
1. Manufacturer's complete standard instructions for each unit of equipment and control panel.
 2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
 3. Identification of replaceable parts and local source of supply.
- H. Project Record Documents: Record the following:
1. As-installed routing of refrigerant piping and condensate piping.
 2. Locations of access panels.
 3. Locations of control panels.
- I. Warranty: Executed warranty, made out in Owner's name.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.
 2. Company that provides system design software to installers.
- B. Installer Qualifications: Trained and approved by manufacturer of equipment.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Compressors: Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced by the manufacturer. All warranty service work shall be preformed by a Daikin factory trained service professional.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: The system design shown in the contract documents is based on equipment and system designed by Mitsubishi Electric: www.mitsubishipro.com.
- B. Additional acceptable manufacturers:
 - 1. Daikin AC: www.daikinac.com
 - 2. LG Industries: www.lg-vrf.com
 - 3. Samsung: www.samsungaccentre.com
 - 4. Trane Corporation: www.trane.com
- C. For systems proposed by other manufacturers, all required modifications to the design and installation shall be the responsibility of the contractor and supplier for both costs and coordination with all other contractors and designers. These changes include, but are not limited to:
 - 1. Changes in refrigerant piping sizes, legnhts, and locations.
 - 2. Changes in branch selector quantities, locations, and accessibility.
 - 3. Changes in electrical requirements, including all power wiring, terminations, breakers, disconnects, and control wiring.
 - 4. Changes in heat-pump unit locations and quantities.
 - 5. Changes in structural supports, vibration isolation, and hangers.
 - 6. Changes to the drawings to reflect the new system parameters.

2.02 HVAC SYSTEM DESIGN

- A. System Operation: Heating and cooling, simultaneously.
 - 1. Zoning: Provide capability for temperature control for each individual indoor/evaporator unit independently of all other units.
 - 2. Zoning: Provide heating/cooling selection for each individual indoor/evaporator unit independently of all other units.
 - 3. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
 - 4. Conditioned spaces are shown on the drawings.
 - 5. Branch selector unit locations are shown on the drawings for reference only. Final design locations shall be corrdinated in the field to ensure optimized line lengths and maintainence access.
 - 6. Required equipment unit capacities are shown on the drawings.
 - 7. Refrigerant piping sizes shown on the drawings are for general reference only. Final line sizing shall be the responsibility of the successful contractor and manufacturer.
 - 8. Connect equipment to condensate piping; condensate piping is shown on the drawings.
- B. Cooling Mode Interior Design Performance:
 - 1. Daytime Setpoint: 74 degrees F, plus or minus 2 degrees F.
 - 2. Setpoint Range: 57 degrees F to 80 degrees F.
 - 3. Night Setback: 78 degrees F.
 - 4. Interior Relative Humidity: 50 percent, maximum.
- C. Heating Mode Interior Design Performance:
 - 1. Daytime Setpoint: 70 degrees F, plus or minus 2 degrees F.
 - 2. Setpoint Range: 59 degrees F to 76 degrees F.
 - 3. Night Setback: 60 degrees F.
 - 4. Interior Relative Humidity: 20 percent, minimum.

- D. Outside Air Design Conditions:
 1. Summer Outside Air Design Temperature: 0.4 percent cooling design condition listed in ASHRAE Fundamentals Handbook.
- E. Operating Temperature Ranges:
 1. Simultaneous Heating and Cooling Operating Range: minus 4 degrees F to 60 degrees F dry bulb.
 2. Cooling Mode Operating Range: minus 4 degrees F to 110 degrees F dry bulb.
 3. Heating Mode Operating Range: 0 degrees F to 77 degrees F dry bulb; minus 4 degrees F to 60 degrees F wet bulb; without low ambient controls or auxiliary heat source.
- F. Refrigerant Piping Lengths: Provide equipment capable of serving system with following piping lengths without any oil traps:
 1. Minimum Piping Length from Outdoor/Central Unit(s) to Furthest Terminal Unit: 540 feet, actual; 620 feet, equivalent.
 2. Total Combined Liquid Line Length: 3280 feet, minimum.
 3. Minimum Piping Length Between Indoor Units: 49 feet.
- G. Controls: Provide the following control interfaces:
 1. For Each Indoor/Evaporator Unit: One wall-mounted wired "local" controller, with temperature sensor; locate where directed, in each space.
 2. One central remote control panel for entire system; locate where indicated.
 3. BACNet gateways sufficient to connect all units to building automation system by others; include wiring to gateways. Unit shall be BTL certified.
 4. Building automation system by HVAC system manufacturer; provide one user stations located where indicated.
- H. Local Controllers: Wall-mounted, wired, containing temperature sensor, setpoint adjustment (with central control override, maximum temperature adjustment +1/-1 degree, adjustable), and temperature display.

2.03 EQUIPMENT

- A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
 1. Refrigerant: R-410A.
 2. Performance Certification: AHRI Certified; www.ahrinet.org.
 3. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL and bearing the certification label.
 4. Provide outdoor/condensing units capable of serving indoor unit capacity up to 200 percent of the capacity of the outdoor/condensing unit.
 5. Provide units capable of serving the zones indicated.
 6. Thermal Performance: Provide heating and cooling capacity as indicated, based on the following nominal operating conditions:
 7. Energy Efficiency: Report EER and COP based on tests conducted at "full load" in accordance with AHRI 210/240 or alternate test method approved by U.S. Department of Energy.
- B. Electrical Characteristics:
 1. See drawings.
- C. System Controls:
 1. Include self diagnostic, auto-check functions to detect malfunctions and display the type and location.

- D. Unit Controls: As required to perform input functions necessary to operate system; provided by manufacturer of units.
1. Provide interfaces to remote control and building automation systems in BACNET native format.
- E. Wiring:
1. Control Wiring: 18 AWG, 2-conductor, non-shielded, non-polarized, stranded cable.
 2. Control Wiring Configuration: Daisy chain.
 3. **All control wiring for the VRF system in it's entirety is the responsibility of the installing contractor, including, but not limited to: Wiring between the condensing unit(s) and system controller, wiring between the branch selector boxes and system controller, wiring from the terminal units to the system controllers, wiring from the thermostats to the terminal units.** The BAS contractor shall only be required to provide communications wiring to the BACnet interface from the nearest BAS controller.
- F. Refrigerant Piping:
1. Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance.
 2. Insulate each refrigerant line individually between the condensing and indoor units.

2.04 OUTDOOR/CONDENSING UNITS

- A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls; modular design for ganging multiple units.
1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
 2. Refrigerant: Factory charged.
 3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.
 4. Capable of being installed with wiring and piping to the left, right, rear or bottom.
 5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle (cooling mode) oil return or defrost is not permitted, due to potential reduction in space temperature.
 6. Sound Pressure Level: As specified, measured at 3 feet from front of unit; provide night setback sound control as a standard feature; three selectable sound level steps of 55 dB, 50 dB, and 45 dB, maximum.
 7. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
 8. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
 9. Provide refrigerant sub-cooling to ensure the liquid refrigerant does not flash when supplying to us indoor units.
 10. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.
 11. Controls: Provide contacts for electrical demand shedding.

- B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
 - 1. Designed to allow side-by-side installation with minimum spacing.
- C. Fans: One or more direct-drive propeller type, vertical discharge, with multiple speed operation via DC (digitally commutating) inverter.
 - 1. Provide minimum of 2 fans for each condensing unit.
 - 2. External Static Pressure: Factory set at 0.12 in WG, minimum.
 - 3. Indoor Mounted Air-Cooled Units: External static pressure field set at 0.32 in WG, minimum; provide for mounting of field-installed ducts.
 - 4. Fan Airflow: As indicated for specific equipment.
 - 5. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.
- D. Condenser Coils: Copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.
- E. Compressors: Scroll type, hermetically sealed, variable speed inverter-driven and fixed speed in combination to suit total capacity; minimum of one variable speed, inverter driven compressor per condenser unit; minimum of two compressors per condenser unit; capable of controlling capacity within range of 6 percent to 100 percent of total capacity.
 - 1. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours. Provide twinning kits where required.
 - 2. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced capacity; provide microprocessor and associated controls specifically designed to address this condition.
 - 3. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.
 - 4. Provide oil separators and intelligent oil management system.
 - 5. Provide spring mounted vibration isolators.

2.05 BRANCH SELECTOR UNITS

- A. Branch Selector Units: Concealed boxes designed specifically for this type of system to control heating/cooling mode selection of downstream units; consisting of electronic expansion valves, subcooling heat exchanger, refrigerant control piping and electronics to facilitate communications between unit and main processor and between branch unit and indoor/evaporator units.
 - 1. Provide one electronic expansion valve for each downstream unit served, except multiple indoor/evaporator units may be connected, provided balancing joints are used in downstream piping and total capacity is within capacity range of the branch selector.
 - 2. When branch unit is simultaneously heating and cooling, energize subcooling heat exchanger.
 - 3. Casing: Galvanized steel sheet; with flame and heat resistant foamed polyethylene sound and thermal insulation.
 - 4. Refrigerant Connections: Braze type.
 - 5. Condensate Drainage: Provide condensate drain tap where required.

2.06 INDOOR/EVAPORATOR UNITS

- A. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
 2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
 3. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
 - a. Provide thermistor on liquid and gas lines.
 4. Fans: Direct-drive, with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.
 5. Return Air Filter: Washable long-life net filter with mildew proof resin, unless otherwise indicated.
 6. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.
 7. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.
- B. Recessed Ceiling Units: Four-way airflow cassette with central return air grille, for installation in a fixed ceiling.
1. Cabinet Height: Maximum of 10 inches above face of ceiling.
 2. Exposed Housing: White, impact resistant, with washable decoration panel.
 3. Supply Airflow Adjustment:
 - a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
 - b. Field-modifiable to 3-way and 2-way airflow.
 - c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
 4. Return Air Filter: High efficiency, MERV 8.
 5. Minimum Capacity: As indicated on the drawings.
 6. Sound Pressure Range: Between 28 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.
 7. Fan: Direct-drive turbo type, with motor output range of 0.06 to 0.12 HP.
 8. Condensate Pump: Built-in, with lift of 21 inches, minimum.
 9. Provide side-mounted fresh air intake duct connection.
- C. Concealed-In-Ceiling Units: Ducted horizontal discharge and return; galvanized steel cabinet.
1. Return Air Filter: MERV 11.
 2. Sound Pressure: Measured at low speed at 5 feet below unit.
 3. Provide external static pressure switch adjustable for high efficiency filter operation
 4. Condensate Pump: Built-in, with lift of 9 inches, minimum.
 5. Switch box accessible from side or bottom.
- D. Wall Surface-Mounted Units: Finished white casing, with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
1. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaulting to same angle as previous operation.
 2. Sound Pressure Range: Measured at low speed at 3.3 feet below and away from unit.

3. Condensate Drain Connection: Side (end), not concealed in wall.
4. Fan: Direct-drive cross-flow type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.
- B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.
- C. Notify Architect if conditions for installation are unsatisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install refrigerant piping in accordance with equipment manufacturer's instructions.
- C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).
- D. Coordinate with installers of systems and equipment connecting to this system.

3.03 FIELD QUALITY CONTROL

- A. Provide manufacturer's field representative to inspect installation prior to startup.

3.04 SYSTEM STARTUP

- A. Provide manufacturer's field representative to perform system startup.
- B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- C. Adjust equipment for proper operation within manufacturer's published tolerances.

3.05 CLEANING

- A. Clean exposed components of dirt, finger marks, and other disfigurements.

3.06 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Red Clay Consolidated School District's designated representative.
- B. Demonstration: Demonstrate operation of system to Red Clay Consolidated School District's personnel.
 1. Use operation and maintenance data as reference during demonstration.
 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Red Clay Consolidated School District's personnel on operation and maintenance of system.
 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 2. Provide minimum of two hours of training.
 3. Instructor: Manufacturer's training personnel.
 4. Location: At project site.

3.07 PROTECTION

- A. Protect installed components from subsequent construction operations.
- B. Replace exposed components broken or otherwise damaged beyond repair.

3.08 MAINTENANCE

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.

END OF SECTION

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Protecting existing trees, shrubs, plants and grass to remain.
2. Removing existing trees and other vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, and abandoning site utilities in place and removing site utilities.
7. Temporary erosion and sedimentation control measures.

- B. Related Sections include the following:

1. Division 01 Section "Temporary Construction Utilities, Facilities & Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities.
2. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.
3. Division 32 Section "Turf and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing. The contractor is responsible for all costs associated with a utility locator service.
- C. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.
- D. Contact DNREC, Division of Sediment and Stormwater to arrange a preconstruction meeting prior to any site clearing or site disturbance activities.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to approved Sediment and Erosion Control Drawings.

- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within fenced area.
 - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
 - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.
 - 1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
 - 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

3.4 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Construction Manager will arrange to shut off indicated on-site utilities when requested by Contractor.
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Construction Manger and Owner not less than five days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
- C. Excavate for and remove underground utilities indicated to be removed. Refer to sections covering site utilities.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
 - 4. Use only hand methods for grubbing within tree protection zone.
 - 5. Chip removed tree branches and dispose of off-site.

- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Do not stockpile topsoil within tree protection zones.
 - 2. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.8 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 311000

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. The General Conditions, any Supplementary General Conditions and Division 1, General Requirements, are hereby made a part of this Section as fully as if repeated herein.

1.2 SECTION INCLUDES

- A. Earthwork includes areas below building foundations, below concrete slabs on grade, below paved areas and grading of all unpaved areas on the site.
 - 1. Layout and staking for earthwork.
 - 2. Excavation and rough grading.
 - 3. Erosion and sediment control.
 - 4. Foundation excavation for footings.
 - 5. Establishing subgrades, leveling and proof rolling.
 - 6. Filling, backfilling and compaction.
 - 7. Keeping streets clean of materials tracked off site.
 - 8. Includes trenching, excavation and backfill for utilities.
 - 9. Maintenance and/or repair of damage to the rough grading.
 - 10. Removal and disposal of stones, rock, debris, excess and unsuitable materials.
 - 11. Soil treatment for termite control.
 - 12. Field quality control, testing, and inspection.

1.3 DEFINITIONS

- A. Rock Excavation: Natural geological formations or other material which cannot be removed by adequate equipment (in good condition) as defined below, shall be considered a change in the scope of work and paid for by the Owner if encountered.
 - 1. Open Excavation and Grading: Rock in excess of the capabilities of a Caterpillar D-8 tractor (or equivalent) with 2 cu. yd. bucket and hydraulically operated single tooth power ripper.
 - 2. Trenches, Pits and Footings: Rock in excess of the capabilities of a Caterpillar 235 Hydraulic Backhoe (or equivalent) using a 2 ft. Bucket width (3/4 cu. yd.)
 - 3. Minimum Effort: If rock is not removed during the process of normal digging and ripping, then extend the excavation to expose the rock surface within the limit of original excavation. Contact the A/E and he may direct the sides of rock to be exposed to a depth of 3 feet. This will be to determine the extent of additional work.
- B. Earth Excavation: Anything not classified as rock including as example: soils, gravels, stones, boulders, vegetation, debris, and unsuitable materials.
- C. Unsuitable Materials: All excavated materials; debris, man made or fabricated materials, concrete spoil, organic, soft, expansive, or unstable matter; all shall be disposed of as herein specified. Excessive moisture content shall not classify a material as unsuitable.
- D. Removal and disposal of unsuitable material above the subgrade elevation and placement of approved specific fill material (from on or off the site) above the subgrade elevation as directed by the Soils Engineer shall be considered a part of the work.
- E. Removal and disposal of unsuitable material approved below the subgrade elevation and placement of approved specific fill material (from on or off the site) below the subgrade elevation as directed by the Soils Engineer shall be considered a change in the scope of work.

- F. Soils Engineer or Inspection Agency: An Agency and its designated representatives who monitor and approve all earthwork operations described herein.
- G. Subgrade: The finished elevation of the earth immediately below all slabs, granular and porous fill, paving, footings, walls, etc., except the subgrade elevation shall not be higher than 12" below the existing earth elevation at the start of the project.
- H. Subgrade for utility construction: Underside of barrel of pipe, or underside of any cradle or bedding if noted on drawings, or referenced in applicable local government specifications. For pipe drains and miscellaneous structures encased in concrete or on concrete, stone and/or gravel cradle, subgrade is lowest outside surface of encasement or cradle.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.
- K. Drainage Course: Course supporting the slab on grade that also minimizes upward capillary flow of pore water.
- L. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- M. Utilities: On site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- N. Filter Material: Course placed around drainage pipes.

1.4 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO).
 - 2. American Society for Testing and Materials (ASTM).
 - 3. Delaware Department of Transportation, State Highway Administration "Standard Specifications for Materials and Construction", as amended to date (DelDOT as hereinafter referred). Delete references to Measurement and Payment.
- B. Geotechnical Testing Agency Qualifications: An independent testing agency (with a Geotechnical engineer licensed in the state where the project is being constructed on staff) qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.
- C. Tolerances: As indicated herein.
- D. Testing: Requirements as specified herein.

1.5 SUBMITTALS

- A. Notification:
 - 1. Notify and provide data to regulatory authorities and A/E prior to commencement of work.
 - 2. Provide notice of: encounter with unknown utilities; subgrades before filling; areas requiring
 - 3. testing or inspection.

- B. Product Data: For the following:
 - 1. Geotextile.
 - 2. Detection Warning Tape.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D2487 of each on site and borrow soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D1557 for each on site and borrow soil material proposed for fill and backfill.
 - 3. Field reports; in-place soil density tests.
 - 4. One optimum moisture – maximum density curve for each type of soil encountered.
 - 5. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.
 - 6. Test reports must be submitted daily to the Architect and Owner.

1.6 PROJECT CONDITIONS

- A. Subsurface Conditions: Subsurface soils investigations have been made at the site. The report and logs of the test borings and test pits are included in the Appendix of these specifications. Such investigations have been made for the purposes of design only and neither the Engineers, the Owner, nor the Geotechnical Engineer guarantee adequacy or accuracy of the data, or that data are representative of all conditions to be encountered. Such information is made available for general information only and shall not relieve the Contractor of the responsibility for making his own investigations, tests, and analyses. Any additional test borings and other exploratory operations may be made by Contractor shall be at no cost to Owner.
 - 1. See Geotechnical Engineering Report prepared by Hillis Carnes Engineering Associates, Inc., in Division 1 for test boring data and other requirements.
- B. Erosion and sediment control, in addition to erosion control specified in Section 31100 and Division 1:
 - 1. Standards: Comply with the requirements of the "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas" by the U.S.D.A. Soil Conservation Service.
 - 2. General Erosion: Prevent erosion of earthwork; repair and correct any ditches, gullies or erosion immediately and upon occurrence.
 - 3. Excavations: Prevent water from flowing into open excavations and toward building walls.
 - 4. Slopes: Cover (with continuous plastic membrane) and stake all slopes steeper than 1.5 horizontal to 1 vertical.
- C. Environmental Conditions:
 - 1. Do not apply soil treatment when temperature is at or below freezing or when ground is frozen or frost is expected.
 - 2. Do not apply soil treatment when surface water is present.
- D. Existing Conditions: Accept the site in the condition which it exists at the time of the award of the contract and perform all work to the grades indicated.
 - 1. Protect plant material, lawns and other features not designated for removal.
 - 2. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

- E. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
 - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility Owner immediately for directions. Cooperate with 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 others, except when permitted in writing by A/E and then only after acceptable temporary utility services have been provided. Provide a minimum of 48 hour notices to utility Owners and receive written notice to proceed before interrupting any utility.
- F. Rock Excavation: Rock excavation may be performed with hoe rams, jack hammers, or any method the Contractor wishes to employ except for explosives.

1.7 PROTECTION

- A. Safety: Provide protective measures necessary for the safety of workmen, to the public and adjacent property. Prevent cave-ins, collapse of walls, structures and slopes, both on and adjacent to the site.
- B. Standards: Comply with regulations of local authorities having jurisdiction, including all applicable O.S.H.A. requirements.
- C. Repair: Includes the removal and replacement with new materials all materials so affected by settlement.

PART 2 - PRODUCTS

2.1 FILL AND BACKFILL

- A. Satisfactory Soils:
 - 1. Compacted granular fill and backfill (less than 35% passing the #200 sieve) shall be free of deleterious matter such as frozen materials, organics, wood, debris, or rock larger than 4 inches in diameter and be classified SP, SW, SP-SM, or SC, per ASTM D-2487. All material shall have a liquid limit and plasticity index not exceeding 40 and 20 respectively when tested in accordance with ASTM D-4318.
 - 2. The minimum dry unit weight shall not be less than 105 PCF maximum dry density as determined by ASTM D-698, standard proctor.
 - 3. All fill and backfill materials shall be obtained from on site or from off site sources and shall be approved by the Geotechnical Engineer prior to placement.
 - 4. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with a least 90 percent passing a 1 ½ inch sieve and not more than 12 percent passing a No. 200 sieve.
 - 1. Locations: All on site fill areas
- C. Structural Fill: On-site soils free of organic material, topsoil, miscellaneous fill, debris and rock fragments in excess of 3 inches in their largest dimension may be suitable as structural fill. The granular on-site soils may be suitable for re-use as structural fill. Some of these soils have an in-situ moisture content that exceeds the typical range that would allow the recommended compaction to be achieved. Therefore, moisture conditioning of these soils may be required to achieve the recommended

compaction. All on-site soils to be used as structural fill must be approved by the Geo-Technical Engineer.

If sufficient quantities of suitable on-site soils are not available for structural fill, imported borrow consisting of predominately granular soils conforming to the requirements of the Delaware Department of Transportation Standard Specifications Select Borrow, Type G should be utilized or AASHTO SP-57 stone. All off-site borrow materials must be approved by the Geo-Technical Engineer.

D. Drainage fill:

1. Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel, (ASTM D 448 Coarse - aggregate grading size 57), with 100% passing of 1-1/2" sieve and not more than 5% passing a No. 8 sieve. Aggregate shall meet DELDOT specification for No. 106A aggregate. Provide by Contractor from off site source.

a. Locations: All concrete slab on grade areas

2. For foundation drainage, use aggregate meeting DELDOT specification for No. 113 aggregate.

a. Locations: Drainage fill behind basement walls and retaining walls.

E. Stone Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, reclaimed concrete, and natural or crushed sand (ASTM D2490) with at least 95% passing a 1 1/2" sieve and not more than 8% passing a No. 200 sieve. Provide by contractor from off site sources.

F. Subbase Material: Designation CR-6 in accordance with DELDOT Specifications.

1. Locations: All vehicular traffic areas

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100 percent passing a 1 inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve. For utility installations, bedding shall conform to AASHTO #57 stone.

H. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; AASHTO M-43, size No. 17.

I. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

J. Processed Rubble Fill: Existing brick and concrete rubble, free of wood and steel may be processed by use of tracked equipment such that no particle size greater than 6 inches in the longest dimension remains.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 FILL AND BACKFILL FOR UTILITIES

A. Backfill: Earth removed from the trench provided that in the opinion of Soils Engineer such excavated material is satisfactory for backfilling.

B. Should the excavated material be considered unsatisfactory for backfilling, the Contractor shall remove and dispose of such unsatisfactory material and substitute, in lieu thereof, suitable material obtained from elsewhere on or off the site.

C. Materials shall meet the requirements specified in paragraph 2.1.A above.

2.3 TOPSOIL

- A. Refer to Section 329200 Turf and Grasses.

2.4 SOIL TREATMENT - TERMITE CONTROL

- A. Emulsion soil chemicals of only water-based type. Do not use any fuel oil as a diluent.
- B. Solutions and chemicals listed and approved by EPA, USDA, and Delaware State Department of Agriculture.
- C. Chemicals used in retreatment shall also be certified and state type of chemical and rate of concentration.

2.5 ACCESSORIES

- A. Detectable Warning Tape: Acid and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:
 - 1. Red: Electric
 - 2. Yellow: Gas, oil, steam, and dangerous materials.
 - 3. Orange: Telephone and other communications.
 - 4. Blue: Water systems
 - 5. Green: Sewer systems.

2.6 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
 - 4. Tear Strength: 56 lbf; ASTM D 4533.
 - 5. Puncture Strength: 56 lbf; ASTM D 4833.
 - 6. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
 - 7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 - 8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2; AASHTO M 288.
 - 2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 - 3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 - 4. Tear Strength: 90 lbf; ASTM D 4533.
 - 5. Puncture Strength: 90 lbf; ASTM D 4833.
 - 6. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.

7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.7 FLOWABLE FILL

- A. Stabilized flowable fly ash mixture with a maximum slump of 8" and a minimum unconfined compressive strength of 100 psi used to fill construction excavations.
- B. Manufacturer: American Stone Mix or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify existing ground surfaces have been stripped of topsoil, root mat and existing pavement, unsatisfactory soils, concrete spoil, obstructions and deleterious material.
- B. Following rough grading and prior to foundation excavation, placement of fill, or construction of the floor slabs, the exposed subgrade shall be proofrolled. The proofroll should be performed using a minimum 20-ton, fully loaded dump truck (or equal) in the presence of the qualified soils technician working under the supervision of a geotechnical engineer. Yielding or otherwise unsuitable subgrade conditions encountered within the proposed building areas should be undercut to firm subgrade conditions and backfilled with compacted structural fill.
- C. Locate underground utilities in areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations. Contact "Miss Utility".
- D. Use of explosives will not be permitted, unless approved by Owner in writing and Regulatory Agencies having jurisdiction.
- E. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.
- F. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- G. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- H. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 EXCAVATION

- A. Excavation consists of removal and disposal of material encountered when establishing required finish grade elevations.
- B. Unauthorized Excavations:
 1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of A/E. Unauthorized excavation, as well as remedial work directed by A/E, shall be at Contractor's expense.
 2. Under footings, foundations, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing to excavation bottom, without altering required top

elevation. Lean concrete, flo-ash fill, or compacted structural fill may be used to bring elevations to proper position, when acceptable by A/E.

- C. Additional Excavation: When excavation has reached required subgrade elevations, notify Soils Engineer who will make an inspection of conditions.
1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated materials as directed by A/E
 2. Removal of unsuitable material below the subgrade elevation and its replacement as directed will be paid by the Owner on basis of contract conditions relative to change in work.
- D. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of materials excavated.
1. Maintain sides and slopes of excavations in safe conditions until completion of backfilling.
- E. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition.
1. Establish requirements for trench shoring and bracing to comply with local, State & Federal codes and authorities having jurisdiction.
 2. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
- F. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Excavations shall be kept free of water for a minimum of two (2) inches below subgrade of excavation. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 2. Convey water removed from excavations and rain water into approved sediment control devices. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
 3. Excessive groundwater conditions: Refer to Article 4.3.6 of the General Conditions.
- G. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
1. Prevent saturation of soil above the optimum moisture content.
 2. Locate and retain soil materials away from edge of excavations.
 3. Dispose of excess soil material and waste materials as herein specified.
- H. Excavation for Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. If in excavating for building foundations the soil directly below the building foundations is disturbed, the disturbed soil shall be removed and shall be re-compacted to 95% of the standard proctor maximum dry density or replaced with concrete backfill.

- I. Excavation for Stone and Concrete Pavements: Cut surface under pavements to comply with cross sections, elevations and grades as shown:
 - 1. Where rock or concrete spoil is encountered, carry excavation 18" below subgrade and backfill with suitable material approved by the A/E.
- J. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed with ample working room.
 - 1. Excavate trenches to depth, lines, gradients, and elevations indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze ups.
 - 2. Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.
 - 3. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
 - a. For pipes and conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - b. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
 - 4. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing. Concrete is specified in Division 3.
 - 5. Do not backfill trenches until tests and inspections have been made and backfilling authorized by A/E. Use care in backfilling to avoid damage or displacement of pipe systems.
- K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F. (1 degree C.).
- L. Ground Surface Preparation (Structural and Pavement areas):
 - 1. The existing ground surface in the structural and pavement areas shall be stripped of topsoil, root mat, existing pavements, unsatisfactory soils, concrete spoil, obstructions and deleterious material. Base course material from the existing pavements may remain if approved by the A/E. The entire area shall be proof rolled, a minimum of four (4) passes, with a loaded dump truck with a minimum axle load of 20 tons in the presence of the soils engineer. Soft spots identified by the Soils Engineer during proof rolling will be undercut and backfilled in accordance with Section 3.4. Proof rolling and compaction equipment shall meet the requirements of Section 3.3.D.
 - 2. In cut areas, prior to the construction of paving or concrete slab on grade, the entire subgrade shall be proof rolled in the presence of the Soils Engineer. Soft areas encountered during proof rolling shall be undercut and backfilled in accordance with section 3.4. Proof rolling and compaction equipment shall be in compliance with Section 3.3 D.
- M. Earthwork Quantities:
 - 1. Contractor shall be responsible for determining earthwork quantities for the completion of the work.

3.3 COMPACTION

- A. General: Control soil compaction during construction providing percentage of dry density specified for each area classification.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of the maximum dry density which is determined in accordance with ASTM D-698, standard proctor.
 - 1. Structural, pavement and walkway areas, steps and utility trenches - 95% of the maximum dry density.
 - 2. Lawn areas outside the designated structural fill limits – minimum compaction 90% of the maximum dry density.
- C. Moisture Control: Obtaining a uniformly high degree of compaction requires control over the moisture content of the material being placed in the fills and backfill. The soils used in fill and backfill shall be brought to within 2% of optimum moisture at no additional cost to the Owner.
 - 1. Where the soil layer is too dry, the Contractor shall apply water uniformly using approved equipment to increase the moisture content to within 2% of the optimum, taking precautions to prevent free water from appearing on the surface during or subsequent to compaction operations.
 - 2. Where the soil layer is too wet, the Contractor shall dry the soils by plowing or discing to aerate the soil and reduce the moisture content to within 2% of the optimum.
- D. Compaction equipment shall be as required to complete the scope of work outlined in the geotechnical report, contract documents and specifications for this project.

3.4 BACKFILL AND FILL

- A. General: Place acceptable soil material in layers not more than eight (8) inches in thickness to required subgrade elevations, for each area classification listed below. Each layer shall be compacted to the requirements of Section 3.3B.
 - 1. Fill and backfill within building and pavement limits and in utility trenches shall be structural fill soils meeting the requirements of Section 2.1.A.
 - 2. Under lawn areas outside the designated structural fill limits, backfill and fill soils shall be soils meeting the requirements of Section 2.1.A, or other on site materials approved by the Geotechnical Engineer.
 - 3. Fill and backfill located below walkways and steps shall be constructed of structural fill soils meeting the requirements of Section 2.1.A.
 - 4. Drainage fill material shall be proof rolled to a uniform stable condition prior to placement of vapor retarder.
 - 5. Stone base course shall be compacted to 95% maximum dry density per ASTM D-1557.
- B. Backfill excavations as promptly as work permits, but not until completion of the following:
 - 1. Acceptance of construction below finish grade including, where applicable, subdrainage damp proofing, waterproofing, and perimeter insulation.
 - 2. Concrete and masonry have cured 28 days and is adequately braced.
 - 3. Inspection, testing, approval, and recording locations of underground utilities.
 - 4. Removal of concrete formwork.
 - 5. Removal of trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- C. Ground surface preparation: Shall be in accordance with Section 3.2K.
 - 1. When existing ground surface has density less than that specified under Section 3.3B for particular area classification, follow the recommendations of the on-site Geo-Technical Engineer. In general

break up ground surface, pulverize, moisture condition to optimum moisture content, and compact to required depth and percentage of maximum dry density.

- D. Placement and Compaction: Place backfill and fill materials in layers not more than 8" in loose depth, for material compacted by heavy compaction equipment and not more than 4" in loose depth for material compacted by hand operated tampers.
1. Before compaction, moisten or aerate each layer as may be necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density for each classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Place backfill and fill materials evenly adjacent to structures, to required elevations. Take care to prevent wedging action of backfill against structures by carrying material uniformly around structure to approximately same elevation in each lift.
 3. Structural fill shall extend a minimum of five (5) feet beyond building and road pavement limits and shall include the support slopes to their full width.
 4. Backfilling against pipe structures, whose joints involve the use of cement mortar or other concrete, or where buttresses are constructed, shall not be done until mortar has set at least 12 hours.
 5. Compaction over one foot above the pipe shall be done with approved mechanical tampers. Compaction density shall be as specified in Section 3.3.
- E. Utility trench backfill
1. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
 2. Coordinate backfilling with utilities testing.
 3. Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
 4. Fill voids with approved backfill materials while shoring, bracing, and sheeting is removed.
 5. Place and compact final backfill of satisfactory soil material to final subgrade.
 6. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.5 ROUGH GRADING

- A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surfaces with specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades. In fill areas, sloped surfaces steeper than 5 horizontal to 1 vertical shall be benched so that fill materials will be placed on a level surface. All fill subgrades shall be observed by the Geotechnical Engineer.
- B. Grading Outside Building Lines: 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:
1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 2" above or below required subgrade elevations.
 2. Walks: Shape surface or areas under walks to line, grade and cross section, with finish surface not more than .04' above or below required subgrade elevation.
 3. Pavements: Shape surface areas under pavement to line, grade and cross section, with finish surface not more than .04' for bituminous surfaces and 08' for stone surfaces, above or below required subgrade elevation.

- C. Grading Surface or Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of .02' when tested with a 10' straightedge.

3.6 BUILDING SLAB BASE COURSE

- A. General: Slab base course consists of placement of drainage fill or stone base course material, in layers of indicated thickness, over subgrade surface to support concrete building slabs.
- B. Placing: Place slab base course on prepared subgrade in layers of uniform thickness, conforming to indicate cross section and thickness. Maintain optimum moisture content for compacting material during placement operations.
 - 1. When a compacted drainage course is shown to be 6" thick or less, place material in a single layer. Where shown to be more than 6" thick, place material in equal layers, except no single layers more than 6" or less than 3" in thickness when compacted.
- C. Any ruts or soft yielding spots which may occur or any areas having inadequate compaction or deviations from the requirements set forth herein shall be corrected by removing and adding uniformly graded crushed stone or by loosening crushed gravel, reshaping and recompacting. The subgrade shall have a uniform density throughout its entire depth and width and shall be approved by the A/E prior to pouring any concrete.
- D. Following this preparation, the subgrade shall be protected from damage as described below:
 - 1. The subgrade shall be protected from damage by heavy loads or equipment moving on tracks or cleats.
 - 2. The contractor shall at all times keep the subgrade drained.
 - 3. No concrete shall be deposited upon a frozen subgrade nor, until the subgrade has been approved by the Geo-Technical Engineer and the A/E.
 - 4. Immediately in advance of placing concrete, the subgrade shall be sprinklered with as much water as it can readily absorb.

3.7 FINISH GRADING & PLACING TOPSOIL

- A. Refer to Specification Section 329200 – "Turf and Grasses"

3.8 MAINTENANCE

- A. Protection of graded areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and re establish grades in settled, eroded and rutted areas to specified tolerances.
- B. Reconditioning compacted areas: 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.
- C. Restore areas previously occupied by stockpiled materials to match finished condition of the remainder of the work.

3.9 APPLICATION OF SOIL TREATMENT

- A. Refer to Section 313116 Termite control

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Removal from Owner's Property: Remove waste materials including trash, debris, and unsuitable and excess excavated material, and dispose of off Owner's property.

3.11 FIELD QUALITY CONTROL – SOILS

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed.
 - 1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2922 and D-3017 (shallow depth nuclear method), as applicable.
 - 2. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2,000 sq. ft. of paved area or building slab area, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 2 tests. Field density tests shall be made at all walkway entrances and ramps into the proposed building.
 - 3. Foundation Wall Backfill: Take enough field density tests to ensure backfill is being properly compacted.
 - 4. Utility Trench Backfill: Perform field density tests on a spot-check basis to assist the Contractor in determining if compaction is in accordance with the specifications.
 - 5. If in opinion of A/E, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense.
 - 6. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent evaluation and approval of each footing subgrade should be performed by Geotechnical Testing Agency.
 - 7. Costs of testing and inspection shall be borne by the Owner.

3.12 FIELD QUALITY CONTROL - SOIL TREATMENTS

- A. Pay costs for required testing of termite control materials. Samples shall be taken and analyzed by an independent testing laboratory.
- B. Sampling: Test one sample of working solution for each 10,000 square feet of area applied. Take samples from discharge end of spraying equipment for each batch mixed and applied if less than 10,000 square feet.
- C. Retreating: Retreat all areas if the test results average less than 90 percent of listed minimum concentration.

3.13 TESTING AND INSPECTION

- A. INSPECTION AGENCY: Owner shall engage a qualified Independent Testing agency for purposes of inspecting and testing construction of embankments, fills, backfills, trenches, and subgrades and report to the A/E conformance in all particulars to specification requirements.
- B. Scheduling:
 - 1. Assign qualified personnel to be on site at all times when operations are scheduled.
 - 2. The Contractor should note that no earthwork operation shall be permitted in their absence.

C. Responsibilities:

1. Evaluation of subgrade preparation and suitability.
2. Moisture content and field density tests on all layers of fill and backfill material placed.
3. Evaluation of degree of compaction attained for all fill and backfill material placed.
4. Testing and evaluation of borrow material.
5. Sources of borrow and of select fill.
6. Footing subgrade suitability.
7. Inspection of installation of Subdrainage system.

D. Results of Tests:

1. Make results available to the Soils Engineer and A/E immediately upon completion of areas of layers.

E. Final Report: The Inspection Agency shall prepare a written report that summarizes the work inspected during the course of the project. A discussion of all deviations from the contract documents and specifications, with their related impact on the final construction, shall be described in detail. The engineer of record shall review this final report, and recommend corrective measures (as deemed necessary) that must be made prior to final acceptance of the work. Prior to final payment, a written report certifying that the work meets the requirements of the contract documents, specifications, and all governing agencies shall be prepared, submitted, and approved by the A/E.

END OF SECTION 312000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes construction dewatering.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Construction Utilities, Facilities and Controls" for temporary utilities and support facilities.
 - 2. Division 31 Section "Earth Moving" for excavating, backfilling, site grading and for site utilities.
 - 3. Division 31 Section "Excavation Support and Protection."

1.3 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.
 - 1. 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.
 - 2. Prevent surface water from entering excavations by grading, dikes, well pointing or other means.
 - 3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
 - 4. Remove dewatering system if no longer needed.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Construction Manager and then only after arranging to provide temporary utility services according to requirements indicated.
- 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 elsewhere in the Project Manual.

- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain property permits from DNREC prior to dewatering activity.
- B. 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.
- C. 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.

3.2 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.
- 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 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 in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- 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.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 OBSERVATION WELLS

- A. Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated and additional observation wells as may be required by authorities having jurisdiction.
- B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
- C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 - 1. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

END OF SECTION 312319

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes temporary excavation support and protection systems.
- B. Related Sections include the following:
 - 1. Division 01 Section "Temporary Construction Utilities, Facilities and Controls" for temporary utilities and support facilities.
 - 2. Division 31 Section "Earth Moving" for excavating and backfilling and for existing utilities.
 - 3. Division 31 Section "Dewatering" for dewatering excavations.

1.3 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. Contractor is solely responsible for maintenance of excavations and worker safety. Architect, Owner and Construction Manager bear no liability for excavation support and protection systems.
 - 2. Provide professional engineering services needed to assume engineering responsibility where required, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer.
 - 3. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 4. Install excavation support and protection systems without damaging existing buildings, pavements, and other improvements adjacent to excavation.

1.4 SUBMITTALS

- A. Shop Drawings for Information: Prepared by or under the supervision of a qualified professional engineer for excavation support and protection systems.
 - 1. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Qualification Data: For Installer and professional engineer.
- C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining 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.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated.
- 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 excavation support and protection.
 2. The geotechnical report is included elsewhere in the Project Manual.
- C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor; 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 (Not Used)

PART 3 - EXECUTION

3.1 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 is 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.

3.2 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. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION 315000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving overlay.
4. Asphalt surface treatments.
5. Pavement-marking paint.
6. Cold milling of existing hot-mix asphalt pavement.

- B. Related Sections include the following:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 DEFINITIONS

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

- B. DOT: Delaware Department of Transportation.

1.4 SYSTEM DESCRIPTION

- A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of Specifications for Road and Bridge Construction of the Delaware Department of Transportation.

1. Standard Specification: Division 400
2. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

- C. Job-Mix Designs: For each job mix proposed for the Work.

- D. Qualification Data: For manufacturer.

- E. Material Test Reports: For each paving material.

- F. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
 - 1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.
- C. Regulatory Requirements: Comply with Delaware Department of Transportation Specifications for Road and Bridge Construction for asphalt paving work. All work within DelDOT Right of Way shall conform to the Delaware Department of Transportation Specifications for Road and Bridge Construction.
- D. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
 - 1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
 - 2. Review condition of subgrade and preparatory work.
 - 3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 - 4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp. Adhere to all specifications in Delaware Department of Transportation Specifications for Road and Bridge Construction.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at minimum ambient or surface temperatures specified in the Delaware Department of Transportation Specifications for Road and Bridge Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials: All materials used under this section shall conform to the requirements of Delaware Department of Transportation Specifications for Road and Bridge Construction, including, but not limited to: graded aggregate, asphalt cement, and tack coat.
- B. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency. Provide granular, liquid or wettable powder form. Obtain written approval from the Delaware Department of Natural Resources and Environmental Control prior to application of the herbicide.
 - 1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Ciba-Geigy Corp.
 - b. Dow Chemical, USA
 - c. E.I. Du Pont de Nemours & Co., Inc.
 - d. FMC Corp
 - e. Thompson-Hayward Chemical Co.
 - f. U.S. Borax and Chemical Corp.
 - g. Allied Chemical Corp.
 - h. Ag-Chem Products, Inc.
- C. Lane Marking Paint: Paint shall comply with Division 700 of the Delaware Department of Transportation Specifications for Road and Bridge Construction.
 - 1. Color: White
 - 2. Color: Yellow
 - 3. Color: Blue
- D. Joint Sealants: Joint Sealants shall comply with Delaware Department of Transportation Specifications for Road and Bridge Construction, Divisions 700 & 800.

2.2 MIXES

- A. Hot-Mix Asphalt: Provide Plant Mixed, hot-laid, asphalt-aggregate mixture complying with Delaware Department of Transportation Specifications for Road and Bridge Construction, Division 400 and referred Divisions.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with if formulated by manufacturer for that purpose.
2. Remove spillages and clean affected surfaces.

- D. Proceed with paving only after unsatisfactory conditions have been corrected.
- E. Tack Coat: Apply to contact surfaces of previously constructed asphalt or Portland cement concrete and surfaces abutting or projecting into hot-mixed asphalt pavement. Distribute at a rate of 0.05 to 0.15 gal. Per sq. yd. of surface in accordance Section 401 of the Delaware Department of Transportation Specifications for Road and Bridge Construction.
- F. Allow to dry until at proper condition to receive paving.
- G. Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
1. Mill to a depth of as specified on plans.
 2. Mill to a uniform finished surface free of gouges, grooves, and ridges.
 3. Control rate of milling to prevent tearing of existing asphalt course.
 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 6. Transport milled hot-mix asphalt to asphalt recycling facility.
 7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..
1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

- E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. All cracks greater than 1/8th inch but less than 1/2 inch shall be cleaned to a depth of 1 inch and sealed with hot bitumastic sealer.
 - 3. All cracks greater than 1/2 inch shall be sealed using a slurry seal containing fine sand aggregate. Fill flush with surface of existing pavement and remove excess.
 - 4. Longitudinal cracks shall be sealed using a pavement repair membrane such as paveprep or equal as noted on the construction plans.

3.5 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at minimum temperature of 225 deg F.
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Immediately correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course. Joints shall comply with Delaware Department of Transportation Specifications for Road and Bridge Construction, Section 401.12.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 98 percent of reference laboratory density according to AASHTO T 209, but not less than 96 percent nor greater than 100 percent.
 2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 1. Base Course: Plus or minus 1/2 inch.
 2. Surface Course: Plus 1/4 inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
 1. Base Course: 1/4 inch.
 2. Surface Course: 1/8 inch.
 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.9 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Contractor shall provide striping on parking and roadway surfaces as indicated on the plans. The following is a list of all required striping:
 - 1. Parking stalls.
 - 2. Cross-hatch/gore areas.
 - 3. Handicap Parking symbols.
 - 4. Stop bars.
 - 5. Directional arrows.
 - 6. Lane lines.
 - 7. Words/numbers.
- C. Allow paving to age for 30 days before starting pavement marking.
- D. Sweep and clean surface to eliminate loose material and dust.
- E. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal. for all markings with the exception of parking stall lines.

3.10 WHEEL STOPS

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.12 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
 - 1. Driveways and roadways.
 - 2. Parking lots.
 - 3. Curbs and gutters.
 - 4. Walkways.
- B. Related Sections include the following:
 - 1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.
 - 3. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Samples: 10-lbsample of exposed aggregate.
- D. Qualification Data: For manufacturer. Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- E. Material Test Reports: Construction Manager will engage a qualified testing agency for indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- F. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.

3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

- G. Field quality-control test reports.
- H. For plazas and wide walkways, submit control joint spacing plan for review.
- I. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. **Testing Agency Qualifications:** An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
- C. **ACI Publications:** Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. **Concrete Testing Service:** Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. **Mockups:** Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. **Preinstallation Conference:** Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete producer.

- d. Concrete pavement subcontractor.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
 - 1. Use flexible or curved forms for curves with a radius 100 feet or less.
- B. 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.

2.3 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
- C. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
- H. Plain Steel Wire: ASTM A 82, as drawn.

- I. Deformed-Steel Wire: ASTM A 496.
- J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain.
- K. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- L. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
- M. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- O. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- P. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

- A. Materials: All materials including but not limited to reinforcing materials, concrete materials, concrete mix, admixtures, curing materials, traffic paint and other related materials used under this section shall conform to the requirements of the Delaware Department of Transportation Specifications for Road and Bridge Construction. References to a required class of concrete shall correspond to the classes as shown in the State of Delaware Department of Transportation Specifications for Road and Bridge Construction Division 500 and Division 800.
- B. Fly ash shall meet the approval of the ASTM C-618 pozzolan Class F and may be used as a partial substitute for cement when approved by the Architect.
- C. The concrete mix used in performing this work shall be DelDOT Class "A" or DelDOT Class "B" depending on the compressive strength shown on the details and shall meet the approval of the Architect.
- D. The concrete temperature shall not exceed 90°F when delivered to the job-site or at any time prior to placement in the forms.
- E. Type I - Portland Cement: Shall be used from October 1 through May 1 and when the air temperature in the shade and away from artificial heat is above 70°F or less, or as directed by the Architect.
- A. Type II - Portland Cement: Shall be used from May 1 through October 1 and when the air temperature in the shade and away from artificial heat is above 70°F, or as directed by the Architect.
- F. When approved by the Architect, Hi-Early strength concrete may be used. Approval will be on a case by case basis.
- G. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:

1. Aggregate Sizes: 1/2 to 3/4 inch nominal.
2. Aggregate Source, Shape, and Color: Submit color samples for review by Architect and owner

H. Water: ASTM C 94/C 94M.

I. Air-Entraining Admixture: ASTM C 260.

J. Chemical Admixtures: Admixtures may only be use with prior approval by the Architect. Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber: fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

1. Available Products:

a. Fibrillated Fibers:

- 1) Axim Concrete Technologies; Fibrasol F.
- 2) FORTA Corporation; Forta.
- 3) Euclid Chemical Company (The); Fiberstrand F.
- 4) Grace, W. R. & Co.--Conn.; Grace Fibers.
- 5) SI Concrete Systems; Fibermesh.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

1. Available Products:

- a. Axim Concrete Technologies; Cimfilm.
- b. Burke by Edeco; BurkeFilm.
- c. ChemMasters; Spray-Film.
- d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
- e. Dayton Superior Corporation; Sure Film.
- f. Euclid Chemical Company (The); Eucobar.
- g. Kaufman Products, Inc.; Vapor Aid.
- h. Lambert Corporation; Lambco Skin.
- i. L&M Construction Chemicals, Inc.; E-Con.

- j. MBT Protection and Repair, ChemRex Inc.; Confilm.
- k. Meadows, W. R., Inc.; Sealtight Evapre.
- l. Metalcrete Industries; Waterhold.
- m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
- n. Sika Corporation, Inc.; SikaFilm.
- o. Symons Corporation; Finishing Aid.
- p. Vexcon Chemicals, Inc.; Certi-Vex EnvioAssist.

E. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

1. Available Products:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
- b. Burke by Edoco; Resin Emulsion White.
- c. ChemMasters; Safe-Cure 2000.
- d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
- f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
- g. Kaufman Products, Inc.; Thinfilm 450.
- h. Lambert Corporation; Aqua Kure-White.
- i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
- j. Meadows, W. R., Inc.; 1200-White.
- k. Symons Corporation; Resi-Chem White.
- l. Tamms Industries, Inc.; Horncure 200-W.
- m. Unitex; Hydro White.
- n. Vexcon Chemicals, Inc.; Certi-Vex Enviocure White 100.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Chemical Surface Retarder: (For exposed aggregate concrete) Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
 - 1. Products:
 - a. Burke by Edeco; True Etch Surface Retarder.
 - b. ChemMasters; Exposee.
 - c. Conspec Marketing & Manufacturing Co., Inc.; Delay S.
 - d. Euclid Chemical Company (The); Surface Retarder S.
 - e. Kaufman Products, Inc.; Expose.
 - f. Metalcrete Industries; Surfard.
 - g. Nox-Crete Products Group, Kinsman Corporation; Crete-Nox TA.
 - h. Scofield, L. M. Company; Lithotex.
 - i. Sika Corporation, Inc.; Rugasol-S.

- j. Vexcon Chemicals, Inc.; Certi-Vex Envioset.

2.8 WHEEL STOPS

- A. Wheel Stops: Solid, 3000 PSI concrete, precast.
 - 1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.9 ADA TRUNCATED DOMES

- A. General: In-line replacable designed to be installed in a “wet set” condition. Units must include anchors which allow replacement by removing colored covers and bolts while leaving anchors in place.
- B. Materials: Homogenous glass and carbon reinforced composite
 - 1. UV stable and colorfast.
 - 2. Resistant to salt and chemical staining per ASTM B 117 & 1308.
 - 3. Minimum Compressive and Tensile Strength of 28,900 psi and 11,600 psi respectively.
 - 4. Must be able to handle load bearing capacity of 16,000 lbs per AASHO –H20 with no visible damage.
 - 5. Color must be uniform throughout with no paint or coating to provide color.
 - 6. Dome geometry must comply with ADA regulations for detectable warnings at curb ramps in diameter, height and spacing.
- C. Where installation on radius is shown, provide precut and scored units for installation without gaps and piecemeal infills. Field cut rectangular units will not be acceptable.
- D. Units shall be by ADA Solutions, Inc. or approved equal.

2.10 CONCRETE MIXTURES

- A. The concrete mix used in performing this work shall be DelDOT Class “A” or DelDOT Class “B” depending on the compressive strength shown on the details and shall meet the approval of the Architect.
- B. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- C. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 4000 psi or 3000 psi. depending on location
 - 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 - 3. Slump Limit: 2-5, plus or minus 1 inch.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
- E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, plasticizing and retarding 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.
- G. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals. Limits shall be as follows per DelDOT requirements:
1. Fly Ash or Pozzolan: 25 percent.
 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- H. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116 where synthetic fibers are noted on the plans. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
 - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
 - 2. Provide tie bars at sides of pavement strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. 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.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 20 feet, unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. All Isolation Joints shall be treated with joint filler.
 - 4. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For larger walkways, width greater than 12' and plazas, submit shop drawing of joint pattern. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - 2. Doweled Contraction 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.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 3/8-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed pavement surfaces with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- K. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- L. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.
- M. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
1. Construct test sections of each type of concrete paving, including at least one expansion joint and control joints, for review by CM, Owner and Architect for agreement of finish prior to starting concrete installation. Review will include texture of broom finish, joint striking, picture framing and geometric conformity.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 3. Incorporate "picture framing" of concrete in finish within lump sum prices bid.

3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. 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. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 2. 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.

3.9 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
 - 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 - 5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
 - 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
 - 8. Joint Spacing: 3 inches.
 - 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 - 10. Joint Width: Plus 1/8 inch, no minus.

3.10 WHEEL STOPS

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Firmly bond each dowel to wheel stop and to pavement. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner shall engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix 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 C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

- C. Strength of each concrete mix will be satisfactory if average of any 3 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.
- D. Test results shall be reported in writing to Architect, 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.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 323116 - WELDED WIRE FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Steel welded-wire fences.
- 2. Steel welded wire gate.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete for base material.
- 2. Section 281300 "Access Control" for access control devices installed at gates and provided as part of a security system.
- 3. Section 312000 "Earth Moving" for site excavation, fill, and backfill where welded-wire fences and gates are located.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's descriptive data for each type of product.
- B. Shop Drawings: For fence and gates. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include diagrams for power, signal, and control wiring.
- C. Samples: For each fence material and for each color specified.
 - 1. Provide Samples 12 inches (300 mm) square for wire mesh.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For gate operators to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 2 years documented experience in work of tis section.

- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Include 10-foot (3-m) length of fence complying with requirements.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 WARRANTIES

- A. Furnish manufacturer's 10 year warranty providing coverage against corrosion of galvanized steel coatings and blistering or loosening of powder coatings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 METALLIC-COATED-STEEL, WELDED-WIRE FENCES

- A. Metallic-Coated-Steel, Welded-Wire Fences:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Designmaster fence panels as manufactured by Deacero or comparable product by one of the following only:
 - a. Ametco Manufacturing Corporation.
 - b. BarnettBates Corporation.
 - c. BetaFence USA LLC.
 - d. Deacero S.A. DE C.V.
 - e. Hill & Smith Inc.
 - f. Jerith Manufacturing Company, Inc.
 - g. Master Halco.
 - h. Metalco Fence & Railing Systems; Atlantis Products, Inc.
 - i. Omega II Fence Systems; a division of Metaltech - Omega Inc.
- B. Fence Fabric: Metallic-coated-steel wire.
 - 1. Spacing of Vertical Wires: 2 inches (51 mm).
 - 2. Spacing of Horizontal Wires: 6 inches (153 mm).
 - 3. Horizontal & Vertical Wire Size: 6 Gauge [0.2031 inch (5.16 mm)].
 - 4. Resistance welded steel wire mesh, ASTM A185/A815M, 6 Gauge, Class 1 galvanized steel wire per ASTM A641/A641M.
- C. Posts:
 - 1. Posts: Square tubes 2 by 2 inches (50 by 50 mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
 - 2. Length: To suit panel height and post mounting.
 - 3. Bases: Steel plate welded to bottom of posts, with four plated steel anchor bolts per base.
- D. Post Caps: UV-resistant plastic sized to post dimensions, friction fit.

- E. Fasteners: Manufacturer's standard tamperproof, corrosion-resistant, color-coated fasteners matching fence components with resilient polymer washers or clips.
- F. Finish: Polyester powder coated to approximately 4 mils thickness.
 - 1. Color: Black
 - 2. Salt Spray Resistance: no rusting or blistering tested to ASTM B117 for 1000 hours.
 - 3. Adhesion: tested to ASTM D3359, Method B

2.3 SWING GATES

- A. Gate Configuration: As indicated on drawings.
- B. Gate Frame Height: As indicated on drawings.
- C. Gate Opening Width: As indicated on drawings
- D. Galvanized-Steel Frames and Bracing: Fabricate members from square tubes 2 by 2 inches (50 by 50 mm) formed from 0.108-inch (2.74-mm) nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch (2.66-mm) nominal-thickness steel sheet and hot-dip galvanized after fabrication.
- E. Frame Corner Construction: Welded.
- F. Additional Rails: Provide as indicated, complying with requirements for fence rails.
- G. Infill: Welded-wire fence fabric matching adjacent fence.
- H. Hinges: BHMA A156.1, Grade 1, suitable for exterior use.
 - 1. Function: 39 - Full surface, triple weight, antifriction bearing.
 - 2. Material: Wrought steel, forged steel, cast steel, or malleable iron; galvanized.
- I. Exit Hardware: BHMA A156.3, Grade 1, Type 1 (rim exit device), with push pad actuating bar, suitable for exterior use.
 - 1. Function: 08 - Entrance by lever. Key locks or unlocks lever.
 - 2. Mounting Channel: Bent-plate channel formed from 1/8-inch- (3.2-mm-) thick, steel plate; hot-dip galvanized after fabrication. Channel spans gate frame. Exit device is mounted on channel web, recessed between flanges, with flanges extending 1/8 inch (3.2 mm) beyond push pad surface.
- J. Cane Bolts: Provide for inactive leaf of pairs of gates. Fabricated from 3/4-inch- (19-mm-) diameter, round steel bars, hot-dip galvanized after fabrication. Finish to match gates. Provide galvanized-steel pipe strikes to receive cane bolts in closed position.
- K. Metallic-Coated-Steel Finish: High-performance coating.

2.4 FENCE AND GATE MATERIALS

- A. Metallic-Coated-Steel Wire: Welded-wire fence fabric, hot-dip galvanized after fabrication. Weight of zinc coating shall be not less than 1.0 oz./sq. ft. (305 g/sq. m).
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

- C. Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- D. Uncoated Steel Sheet: Hot-rolled steel sheet, ASTM A 1011/A 1011M, Structural Steel, Grade 45 (Grade 310) or cold-rolled steel sheet, ASTM A 1008/A 1008M, Structural Steel, Grade 50 (Grade 340).
 - 1. Interior surface of tubes formed from uncoated steel sheet shall be hot-dip zinc coated same as exterior.
- E. Metallic-Coated Steel Sheet: Galvanized-steel sheet or aluminum-zinc, alloy-coated steel sheet.
- F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 50 (Grade 340), with **G90 (Z275)** coating.
- G. Galvanizing: For components indicated to be galvanized and for which galvanized coating is unspecified, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.

2.5 MISCELLANEOUS MATERIALS

- A. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi (20 MPa), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum aggregate size.
- B. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.6 GROUNDING MATERIALS

- A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper.
 - 2. Material on or below Finished Grade: Copper.
 - 3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Grounding Connectors and Grounding Rods: Comply with UL 467.
 - 1. Connectors for Below-Grade Use: Exothermic-welded type.
 - 2. Grounding Rods: Copper-clad steel.
 - a. Size: 5/8 by 96 inches (16 by 2440 mm).

2.7 METALLIC-COATED-STEEL FINISHES

- A. Galvanized Finish: Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a zinc-phosphate conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

- C. High-Performance Coating: Apply epoxy primer, polyurethane intermediate coat, and polyurethane topcoat to prepared surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.
 - 1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
 - 1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening rails and infill panels to posts.
- C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches (600 mm) plus 3 inches (75 mm) for each foot (300 mm) or fraction of a foot (300 mm) that fence height exceeds 4 feet (1.2 m).
- D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Concealed Concrete: Top 2 inches (50 mm) below grade to allow covering with surface material. Slope top surface of concrete to drain water away from post.
 - 3. Posts Set in Concrete: Extend post to within 6 inches (150 mm) of specified excavation depth, but not closer than 3 inches (75 mm) to bottom of concrete.
 - 4. Space posts uniformly at 8 feet (2.44 m) o.c.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) except as follows:
 - 1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
- B. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- C. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- D. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- E. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.
- F. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- G. Lubricate hardware and other moving parts.

END OF SECTION 323116

SECTION 329200 - TURF AND GRASSESPART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Execute the work of this Specification in accordance with applicable portions of;
1. Division 1 – General Requirements

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Sodding.
4. Plugging.
5. Sprigging.
6. Meadow grasses and wildflowers.
7. Turf renovation.
8. Erosion-control material(s).
9. Grass paving.

B. Related Sections:

1. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
2. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Division 32 Section "Planting Irrigation " for turf irrigation.
4. Division 32 Section "Plants" for border edgings.
5. Division 33 Section "Subdrainage" for subsurface drainage.

1.3 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- H. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

1.5 INFORMATIONAL SUBMITTALS

- A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for turfgrass. Include identification of source and name and telephone number of supplier.
- B. Qualification Data: For qualified landscape Installer.
- C. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- D. Material Test Reports: For existing in-place surface soil and imported topsoil.
- E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
 - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 - 2. Experience: Three years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

- a. Certified Landscape Technician - Exterior, with specialty area(s), designated CLT-Exterior.
 - b. Certified Turfgrass Professional, designated CTP.
 - c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.
5. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
 6. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
 2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
 3. Report suitability of tested soil for turf growth.
 - a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- D. Pre-installation Conference: To Be Announced

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Sod: (NOT USED).
- C. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.8 PROJECT CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance.

1. Spring Planting: March 15 – June 15
2. Fall Planting: September 15 – November 15

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.9 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1. Seeded Turf: 90 days from date of installation.
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
2. Sodded Turf: (NOT USED)
3. Plugged Turf: (NOT USED).
4. Sprigged Turf: (NOT USED)

B. Initial Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than 90 days from date of installation.

C. Continuing Maintenance Proposal: From Installer to Owner, 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

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: State-certified seed of grass species as follows: (As noted on Plans L-103 for Parking Area Bio-retention and L-104 for Wetland Construction)

C. Seed Species: (For Fine Lawn Areas) Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Full Sun: Bermudagrass (*Cynodon dactylon*).
2. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
3. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
 - b. 30 percent chewing red fescue (*Festuca rubra* variety).
 - c. 10 percent perennial ryegrass (*Lolium perenne*).
 - d. 10 percent redtop (*Agrostis alba*).

4. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety).
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).

D. Grass Seed Mix: Proprietary seed mix as follows:

1. Products: Subject to compliance with requirements, As Specified by Ernst Conservation Seeds.

2.2 TURFGRASS SOD

- A. Turfgrass Sod: (NOT USED)
- B. Turfgrass Species: (NOT USED).
- C. Turfgrass Species: (NOT USED)

2.3 PLUGS (NOT USED)

2.4 SPRIGS (NOT USED)

2.5 MEADOW GRASSES AND WILDFLOWERS (NOT USED)

2.6 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 85 percent calcium carbonate, ground so that not less 90% passes a 10 mesh sieve and not less than 30% passes a 100 mesh sieve. Apply at the rate adequate to bring pH range up to 6.0 to 6.5.
- B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.7 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through ½ inch sieve; soluble salt content of 4 to 8 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: (NOT USED).
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: (Not Used).
- E. Manure: (Not Used).

2.8 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
 - 3. For lawns, provide fertilizer with not less than 4% phosphoric acid and not less than 2% potassium and the percentage of nitrogen required to provide not less than 1 lb. of actual nitrogen per 1000 sq. ft. of lawn area. Provide nitrogen in a form that will be available to the lawn during the initial period of growth.

2.9 PLANTING SOILS

A. TOPSOIL

Topsoil shall be from off-site sources. It shall be without admixture of subsoil or slag and shall be free of stones, lumps, plants or their roots, sticks and extraneous matter, and shall not be moved, placed or used while in a frozen or muddy condition.

Topsoil from off-site sources shall have an acidity range of pH 5.0 to 7.0 and shall contain not less than 5% organic matter as determined by the "Walkley-Black Method" (Colorimetric version). Sufficient limestone shall be added to topsoil used to bring it to a range of pH 6.0 to pH 6.5.

Soil sample tests will be ordered by the Landscape Architect and shall be made by a state or commercial laboratory using methods approved by the Associates of Official Agricultural chemists or the State Agricultural Experiment Station.

Such analysis will be paid for by the Contractor. Moving and placing of topsoil may be made after approval of the analysis by the Landscape Architect.

If approved, natural topsoil not having the hydrogen-ion value specified above may be amended by the contractor, at his own expense, to bring it within the specified limits. Topsoil shall meet the following mechanical analysis:

	<u>Passing %</u>	<u>Retained %</u>
1" Screen	100%	0%
1/2" Screen	97-100%	0-3%
No. 100 Mesh Sieve	60-40%	40-60%

There shall be a minimum of 4" of topsoil (after settlement) in all plant beds, pit plantings, ground cover areas, and lawns or as called for on the drawings whichever is greater.

B. LIGHT WEIGHT ON-STRUCTURE PLANTING SOIL (NOT USED)

2.10 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.
- C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content 2-5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
 - 1. Organic Matter Content 50-60 percent of dry weight.
 - 2. Feedstock: (NOT USED).
- E. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- F. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

- G. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.11 PESTICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.12 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples,
- C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface,. Include manufacturer's recommended anchorage system for slope conditions.

2.13 GRASS-PAVING MATERIALS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Thoroughly blend planting soil off-site before spreading.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.
 - 2. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
 - a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
 - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
 - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
 - 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
 - 3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
 - 4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

- F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 PREPARATION FOR GRASS-PAVING MATERIALS (NOT USED)

3.6 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of as noted on plans.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying peat mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.7 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with [fiber-mulch manufacturer's recommended tackifier.
 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than [1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
 3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.8 SODDING (Not Used)

3.9 PLUGGING (Not Used)

3.10 SPRIGGING (Not Used)

3.11 TURF RENOVATION

- A. Renovate existing turf.
- B. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
 2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches
- I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
- J. Apply seed and protect with straw mulch as required for new turf.

- K. Water newly planted areas and keep moist until new turf is established.

3.12 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. All mowing shall be the contractor's responsibility until final acceptance. Heavy mowing, resulting in grass piles, shall be "double-mowed" or the contractor shall remove the piles. Repeat mowing to maintain 2-1/2 to 3" height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- D. Turf Post fertilization: Apply fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.13 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over and bare spots not exceeding 5 by 5 inches .
 - 2. Satisfactory Sodded Turf: (NOT USED).
 - 3. Satisfactory Plugged Turf: (NOT USED).
 - 4. Satisfactory Sprigged Turf: (NOT USED).
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.14 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.15 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Grout.
2. Flowable fill.
3. Piped utility demolition.

1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 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.

PART 2 - PRODUCTS

2.1 GROUT

- A. Description: ASTM C 1107, 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: 5000-psi , 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.2 FLOWABLE FILL

- A. Description: Low-strength-concrete, flowable-slurry mix.
 1. Cement: ASTM C 150, Type I, portland.
 2. Density: 115- to 145-lb/cu. ft..
 3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
 4. Water: Comply with ASTM C 94/C 94M.
 5. Strength: 100 to 200 psig at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 GROUTING

- A. Mix and install grout for 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.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 330500

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes gravity-flow, nonpressure storm drainage outside the building, with the following components:
 - 1. Precast concrete manholes.
 - 2. Catch Basins
 - 3. Storm drain pipe and appurtenances

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: 10-foot head of water. Pipe joints shall be at least watertight, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Storm drain pipe.
- B. Shop Drawings: For the following:
 - 1. Manholes: Include plans, elevations, sections, details, and frames and covers.
 - 2. Catch Basins and Stormwater Inlets. Include plans, elevations, sections, details, and frames, covers, and grates.
 - 3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.
- C. Field quality-control test reports.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Handle manholes according to manufacturer's written rigging instructions.
- C. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.
- D. Handle downspout boots according to manufacturer's written instructions.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager Owner no fewer than five days in advance of proposed interruption of service.
 2. Do not proceed with interruption of service without Construction Manager's written permission.
- B. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that Storm Drainage System piping may be installed in compliance with original design and referenced standards.
1. Locate existing Storm Drainage System piping and structures that are to be abandoned, closed or removed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.

2.3 PE PIPE AND FITTINGS

- A. Corrugated PE Drainage Pipe and Fittings NPS 48 and Smaller: AASHTO M 252M, Type S, with smooth waterway for coupling joints.
1. Watertight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
 2. Corrugated PE Pipe and Fittings NPS 12 to NPS 48: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
 3. Watertight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
- B. Corrugated PE Pipe and Fittings NPS 56 and NPS 60: AASHTO MP7, Type S, with smooth waterway for coupling joints.
1. Watertight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

2.4 REINFORCED CONCRETE PIPE:

1. Materials shall be in accordance with ASSHTO M-170.
2. Pipe class shall be Class III unless otherwise indicated on the drawings.
3. Joints to be tongue and groove.
4. Joining material may be either:
 - a. Portland cement mortar consisting of 1 part Portland cement, 2 parts sand and enough water to provide a workable mix, or
 - b. Bitumastic joint filler equal to Ram-Neck.

5. Joints shall be watertight under full flow conditions.

2.5 NONPRESSURE-TYPE PIPE COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
 1. For Concrete Pipes: ASTM C 443, rubber.
 2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

2.6 MANHOLES

- A. Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, of depth indicated with provision for rubber gasket joints.
 1. Base Section: 8-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
 2. Riser Sections: 5-inch minimum thickness; 48-inch diameter, and lengths to provide depth indicated.
 3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone to match grade rings.
 4. Grade Rings: Provide 2 or 3 reinforced concrete rings, with 12 maximum inches total thickness and match 24-inch diameter frame and cover.
 5. Gaskets: ASTM C 443, rubber.
 6. Steps: Cast into base, riser, and top sections sidewall at 12-to 16-inch intervals.
 7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 8. Channel and Bench: Concrete or Brick.
 9. Coat Exterior Surface with two (2) coats of coal-tar epoxy, 15 mil. Minimum thickness.
- B. Manhole Steps: Wide enough for a man to place both feet on one step and designed to prevent lateral slippage off the step.
 1. Material: Steel-reinforced plastic.
 2. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, heavy-duty, ductile iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover, indented top design, with lettering "STORMDRAIN" cast into cover.

2.7 CATCH BASINS & INLETS

- A. Standard Precast Concrete Catch Basins & inlets: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 1. Catch basins & inlets shall be according to the local utility standard as noted on the structure schedule.
 1. All materials for catch basins, steps, frames and grates, curb inlets and other appurtenances and incidentals shall conform to Section 708 of DelDOT Specifications and Standard Details for structures noted as DelDOT structures on the plans.
- B. Standard PVC Surface Drainage Inlets and In-Line Drains as indicated on the drawings.

1. Ductile Iron Grates shall be considered an integral part of the surface drainage structure and shall be furnished by the same manufacturer.
2. Structures shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc. or approved equal.

2.8 STORMWATER DETENTION STRUCTURES

- A. Cast-in-Place or Pre-Cast Concrete, Stormwater Detention Structures: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete, as required to prevent flotation.
 2. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 36 inches.
 3. Trash Rack: Include installation of peaked roof trash rack as shown on the Precast Outlet Structure detail.
- B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service Include indented top design with lettering "STORM SEWER" cast into cover.

2.9 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, and the following:
1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
 2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
 - a. Invert Slope: 1 percent through manhole.
 2. Benches: Concrete, sloped to drain into channel.
 - a. Slope: 4 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.10 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe.
 - e. Watts Water Technologies, Inc.
 - f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.
2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Pipe couplings and special pipe fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping, unless otherwise indicated.
 - a. Flexible or rigid couplings for same or minor difference OD pipes.
 - b. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 - c. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.
- B. Gravity-Flow, Nonpressure Sewer Piping: Use the following pipe materials for each size range and material as indicated on drawings:
 1. NPS 4 and NPS 36 Corrugated PE drainage pipe and fittings, watertight couplings, and coupled joints.
 2. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, with groove and tongue ends.

3.3 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing stormdrain system is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.
- F. Install gravity-flow, nonpressure drainage piping according to the following:
 1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
 2. Install piping below frost line.
 3. Install corrugated steel piping according to ASTM A 798/A 798M.
 4. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
 5. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
 6. Install PE corrugated sewer piping according to CPPA's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

3.4 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

- B. Join gravity-flow, nonpressure drainage piping according to the following:
 - 1. Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 - 2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
 - 3. Join dissimilar pipe materials with nonpressure-type flexible or rigid couplings.
 - 4. Join corrugated PE piping according to CPPA 100 and the following:
 - a. Use watertight couplings for Type 1, watertight joints.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections according to ASTM C 891.

3.6 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.7 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Install outlets that spill onto grade, anchored with concrete, where indicated.
- C. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- D. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318/318R.

3.9 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
 - 1. Close open ends of piping with at least 8-inch- thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.11 IDENTIFICATION

A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.12 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.

3.13 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100