

HEAT PUMP REPLACEMENT
& DRY STORAGE HVAC
FOR
NEW CASTLE COUNTY
DETENTION CENTER
WILMINGTON, DELAWARE

959 CENTRE ROAD
WILMINGTON, DELAWARE

OWNER

DEPARTMENT OF SERVICES FOR CHILDREN, YOUTH
AND THEIR FAMILIES
1825 FAULKLAND ROAD
WILMINGTON, DELAWARE

This copy is for
information only.
You must purchase
the proposal to
submit a bid.

MC3701000022

ARCHITECTS

DELAWARE ARCHITECTS, LLC
550 SOUTH DUPONT BOULEVARD, SUITE E
MILFORD, DELAWARE
302-491-6047

DALLC PROJECT NO. 011-040/043

September, 2012

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**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

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**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

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ADVERTISEMENT FOR BIDS

Sealed bids for **OMB/DFM Contract No. MC3701000022 – New Castle County Detention Center – Heat Pump Replacement** will be received by the State of Delaware, Office of Management and Budget, Division of Facilities Management, in Room 011 of the Main Building Annex of the Herman Holloway Campus, 1901 N. DuPont Highway, New Castle, DE 19720 until 1:30 p.m. local time on Tuesday, October 9, 2012, 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.

Project involves removal and replacement of existing heat pumps and installation of split system HVAC unit in the New Castle County Detention Center located on the Ferris Campus in Wilmington, Delaware.

Attention is called to construction schedule as detailed in the Bid Documents.

A **MANDATORY** Pre-Bid Meeting will be held on Thursday, September 20, 2012, at 10:00 a.m. at the YRS Maintenance Shop at the Ferris Campus, 1825 Faulkland Road, Wilmington, Delaware, for the purpose of establishing the list of subcontractors and to answer questions. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to the Division of Facilities Management, Herman Holloway Campus, Main Building Annex, Room 011, 1901 N. DuPont Highway, New Castle, DE 19720, Attn: Danny Episcopo. The outer envelope should clearly indicate: **"OMB/DFM CONTRACT NO. MC3701000022 – NEW CASTLE COUNTY DETENTION CENTER – HEAT PUMP REPLACEMENT – SEALED BID - DO NOT OPEN."**

Contract documents may be obtained at the office of Delaware Architects, LLC, 550 S. DuPont Boulevard, Suite E, Milford, DE 19963, phone (302) 491-6047, upon receipt of \$50.00 per set/non-refundable. Checks are to be made payable to "Delaware Architects, LLC".

Construction documents will be available for review at the following locations: Delaware Architects, LLC; Delaware Contractors Association; Associated Builders and Contractors.

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

END OF ADVERTISEMENT FOR BIDS

INSTRUCTIONS TO BIDDERS

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ARTICLE 1: GENERAL

1.1 DEFINITIONS

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

1.2 STATE: The State of Delaware.

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

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

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

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

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

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

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

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

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

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

- 1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.
- 1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).
- 1.15 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 Prior to receiving an award, the successful Bidder shall furnish to the Agency proof of State of Delaware Business Licensure. If the Bidder does not currently have a Business License, they may obtain an application by writing to: Division of Revenue, Carvel State Office Building, 820 French Street, Wilmington, DE 19899. A copy of the letter written to the Division of Revenue, sent with your Bid will be adequate proof for your firm to be considered for award until such time as you receive your license.
- 5.4.8 The Bid Security shall be returned to the successful Bidder upon the execution of the formal contract. The Bid Securities of unsuccessful bidders shall be returned within thirty (30) calendar days after the opening of the Bids.

ARTICLE 6: POST-BID INFORMATION

6.1 CONTRACTOR'S QUALIFICATION STATEMENT

6.1.1 Bidders to whom award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.

6.2 BUSINESS DESIGNATION FORM

6.2.1 Successful bidder shall be required to accurately complete an Office of Management and Budget Business Designation Form for Subcontractors.

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

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

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

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

END OF INSTRUCTIONS TO BIDDERS

BID FORM

For Bids Due: _____

To: Mr. Daniel Episcopo
State of Delaware
Facilities Management
Construction Projects Coordinator
1901 N. DuPont Hwy.
Main Bldg., Rm. 002
New Castle, DE 19720

Name of Bidder: _____

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

(Other License Nos.): _____

Phone No.: () _____ - _____

Fax No.: () _____ - _____

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

1. Heat Pump Replacement:

\$ _____
(\$ _____)

2. New HVAC Equipment for Dry Storage:

\$ _____
(\$ _____)

ALTERNATES

None required

BID FORM

UNIT PRICES

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

UNIT PRICE No. 1: None required

_____ \$ _____

BID FORM

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

This bid shall remain valid and cannot be withdrawn for 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 (if 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 achieve substantial completion of all the work within _____ calendar days of the Notice to Proceed.

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

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

**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

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

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

(State of Corporation)

Business Address: _____

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

(Title)
Date: _____

ATTACHMENTS

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

BID FORM

SUBCONTRACTOR LIST

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

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City & State)</u>
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____

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 Office of Management and Budget, Division of Facilities Management)*.

All the terms and conditions of *(Project or Contract Number)* have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE
(TYPED): _____

AUTHORIZED REPRESENTATIVE
(SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

PHONE NUMBER: _____

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

My Commission expires _____. NOTARY PUBLIC _____.

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

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____
_____ of _____ in the County of _____
_____ and State of _____ as **Principal**, and _____
_____ of _____ in the County of _____ and State
of _____ as **Surety**, legally authorized to do business in the State of Delaware
("State"), are held and firmly unto the **State** in the sum of _____
_____ Dollars (\$_____), or _____ percent not to exceed _____
_____ Dollars (\$_____
_____) of amount of bid on 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

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

PERFORMANCE BOND

Bond Number: _____

KNOW ALL PERSONS BY THESE PRESENTS, that we, _____, as principal (“**Principal**”), and _____, a _____ corporation, legally authorized to do business in the State of Delaware, as surety (“**Surety**”), are held and firmly bound unto the _____ (“**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.

**HEAT PUMP REPLACEMENT AT
NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040
STATE NO. MC370100022**

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)

Name:

Title:

SURETY

Name: _____

Witness or Attest: Address: _____

Name:

(Corporate Seal)

By: _____ (SEAL)

Name:

Title:

STATE OF DELAWARE
OFFICE OF MANAGEMENT AND BUDGET

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:

DRAFT AIA® Document A101™ - 2007

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

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

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

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

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

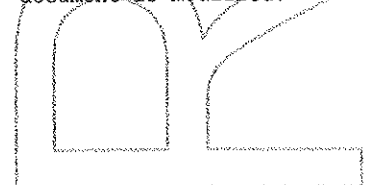
The Architect:
(Name, legal status, address and other information)

The Owner and Contractor agree as follows.

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

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

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



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TABLE OF ARTICLES

1 THE CONTRACT DOCUMENTS

2 THE WORK OF THIS CONTRACT

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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 a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner. (Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

« »

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

« »

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

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

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

« »

Portion of Work

Substantial Completion Date

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

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

« »

ARTICLE 4 CONTRACT SUM

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

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

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

« »

§ 4.3 Unit prices, if any:

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

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

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

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

Item	Price
------	-------

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

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

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

« »

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

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported

by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

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

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

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

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

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

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

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

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

§ 5.2 FINAL PAYMENT

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

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

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

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201-2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »
« »
« »
« »

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201-2007, the method of binding dispute resolution shall be as follows:

(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

Arbitration pursuant to Section 15.4 of AIA Document A201-2007

Litigation in a court of competent jurisdiction

Other *(Specify)*

« »

ARTICLE 7 TERMINATION OR SUSPENSION

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

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

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

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

« » % « »

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

« »
« »
« »
« »
« »
« »
« »

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

« »
« »
« »
« »
« »
« »
« »

§ 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 A101-2007, Standard Form of Agreement Between Owner and Contractor.

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

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

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

« »

Section	Title	Date	Pages

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

« »

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

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

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

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



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



ARTICLE 10 INSURANCE AND BONDS

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

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

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

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

OWNER (Signature)

« »« »

(Printed name and title)

CONTRACTOR (Signature)

« »« »

(Printed name and title)

AIA® Document G702™ - 1992

Application and Certificate for Payment

TO OWNER: PROJECT: DVMC - Bear APPLICATION NO: 001 Distribution to: OWNER: ARCHITECT: CONTRACTOR: FIELD:

PERIOD TO: General Construction CONTRACT FOR: CONTRACT DATE: PROJECT NOS: /

FROM CONTRACTOR: VIA ARCHITECT:

CONTRACTOR'S APPLICATION FOR PAYMENT

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

- 1. ORIGINAL CONTRACT SUM..... \$0.00
- 2. NET CHANGE BY CHANGE ORDERS..... \$0.00
- 3. CONTRACT SUM TO DATE (Line 1 ± 2)..... \$0.00
- 4. TOTAL COMPLETED & STORED TO DATE (Column G on G703)..... \$0.00

- 5. RETAINAGE:
 - a. 0 % of Completed Work (Column D + E on G703) = \$0.00
 - b. 0 % of Stored Material (Column F on G703) = \$0.00

- 6. TOTAL EARNED LESS RETAINAGE..... \$0.00
(Line 4 Less Line 5 Total)
- 7. LESS PREVIOUS CERTIFICATES FOR PAYMENT..... \$0.00
(Line 6 from prior Certificate)
- 8. CURRENT PAYMENT DUE..... \$0.00
- 9. BALANCE TO FINISH, INCLUDING RETAINAGE (Line 3 less Line 6) \$0.00

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

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

CONTRACTOR:

By:

Date:

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

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

AMOUNT CERTIFIED..... \$0.00
(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By:

Date:

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

AIA Document G702™ - 1992. Copyright © 1993, 1963, 1965, 1978 and 1992 by The American Institute of Architects. All rights reserved. WARNING: This AIA® Document is protected by U.S. Copyright Law and International Treaties. Unauthorized reproduction or distribution of this AIA® Document, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under the law. This draft was produced by AIA software at 10:28:39 on 02/26/2010 under Order No. 03711896314_1 which expires on 05/19/2010, and is not for resale. User Notes: (1383483201)

STANDARD
GENERAL CONDITIONS
OF THE
CONSTRUCTION CONTRACT

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (1997 Edition) entitled General Conditions of the Contract for Construction and is part of this project manual as if herein written in full.

Copies of the Document are available through the Owner.

CANNOT BE USED FOR BIDDING

SUPPLEMENTARY GENERAL CONDITIONS A201-1997

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-1997. 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
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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.”

Add the following Paragraph:

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

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Paragraphs:

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

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

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

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

Delete Paragraph 1.6.1 in its entirety and replace with the following:

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

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

ARTICLE 2: OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

To Subparagraph 2.2.3 – Add the following sentence:

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

Delete Subparagraph 2.2.5 in its entirety and substitute the following:

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

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

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

Delete the third sentence in Paragraph 3.2.3.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Paragraphs:

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

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

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

3.4 LABOR AND MATERIALS

Add the Following Paragraphs:

3.4.4 Before starting the Work, each Contractor shall carefully examine all preparatory Work that has been executed to receive their Work. Check carefully, by whatever means are required, to insure that its Work and adjacent, related Work, will finish to proper contours, planes and levels. Promptly notify the General Contractor/Construction Manager of any defects or imperfections in preparatory Work which will in any way

affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized.

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

3.5 WARRANTY

Add the following Paragraphs:

- 3.5.1 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for one year after Acceptance by the Owner, and will maintain all items in perfect condition during the period of guarantee.
- 3.5.2 Defects appearing during the period of guarantee will be made good by the Contractor at his expense upon demand of the Owner, it being required that all work will be in perfect condition when the period of guarantee will have elapsed.
- 3.5.3 In addition to the General Guarantee there are other guarantees required for certain items for different periods of time than the one year as above, and are particularly so stated in that part of the specifications referring to same. The said guarantees will commence at the same time as the General Guarantee.
- 3.5.4 If the Contractor fails to remedy any failure, defect or damage within a reasonable time after receipt of notice, the Owner will have the right to replace, repair, or otherwise remedy the failure, defect or damage at the Contractor's expense.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Paragraphs:

- 3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators, including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.
- 3.11.2 At the completion of the project, the Contractor shall obtain a set of reproducible drawings from the Architect, and neatly transfer all information outlined in 3.11.1 to provide a complete record of the as-built conditions.
- 3.11.3 The Contractor shall provide two (2) prints of the as-built conditions, along with the reproducible drawings themselves, to the Owner and one (1) set to the Architect. In addition, attach one complete set to each of the Operating and Maintenance Instructions/Manuals.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ARCHITECT'S ADMINISTRATION OF THE CONTRACT

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

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

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

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

Add the following Paragraph:

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

4.3 CLAIMS AND DISPUTES

Delete Paragraph 4.3.10 in its entirety.

4.4 RESOLUTION OF CLAIMS AND DISPUTES

Delete Paragraph 4.4.5 in its entirety and replace with the following:

4.4.5 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 4.4.6 in its entirety.

4.5 MEDIATION

4.5.2 At the end of the second sentence, delete "and with the American Arbitration Association."

4.6 ARBITRATION

Delete Paragraph 4.6 and its sub-sections in its entirety.

ARTICLE 5: SUBCONTRACTORS

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

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

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

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

Delete Paragraph 6.1.4 in its entirety.

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK OF 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

Add the following Paragraph:

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

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

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

Add the following Paragraph:

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

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Paragraphs:

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

9.2.3 The Schedule of Values is to include a line item for Project Closeout Document Submittal. The value of this item is to be no less than 10% of the initial contract amount.

9.3 APPLICATIONS FOR PAYMENT

Add the following Paragraph:

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

Add the following Paragraphs:

9.3.4 Until Closeout Documents have been received and outstanding items completed the Owner will pay 95% (ninety-five percent) of the amount due the Contractor on account of progress payments.

9.3.5 The Contractor shall provide a current and updated Progress Schedule to the Architect with each Application for Payment. Failure to provide Schedule will be just cause for rejection of Application for Payment.

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following to 9.5.1:

.8 failure to provide a current Progress Schedule;

.9 a lien or attachment is filed;

.10 failure to comply with mandatory requirements for maintaining Record Documents.

9.6 PROGRESS PAYMENTS

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

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

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Paragraphs:

10.1.2 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.

10.1.3 Each Contractor shall appoint a Safety Representative. Safety Representatives shall be someone who is on site on a full time basis. If deemed necessary by the Owner or

Architect, Contractor Safety meetings will be scheduled. The attendance of all Safety Representatives will be required. Minutes will be recorded of said meetings by the Contractor and will be distributed to all parties as well as posted in all job offices/trailers etc.

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Paragraph:

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

10.3 HAZARDOUS MATERIALS

Delete Paragraph 10.3.3 in its entirety.

10.5 Delete Paragraphs 10.5 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.2 OWNER'S LIABILITY INSURANCE

Delete Paragraph 11.2 in its entirety.

11.3 PROJECT MANAGEMENT PROTECTIVE LIABILITY INSURANCE

Delete Paragraph 11.3 in its entirety.

11.4 PROPERTY INSURANCE

Delete Paragraph 11.4 in its entirety and replace with the following:

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

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.

ARTICLE 13: MISCELLANEOUS PROVISIONS

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.

END OF SUPPLEMENTARY GENERAL CONDITIONS

GENERAL REQUIREMENTS

TABLE OF ARTICLES

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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 shall not begin until the Contractor is in receipt of a bonafide State of Delaware Purchase Order.

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
(NOT ADDENDED)**

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 State Tax Department within ten (10) days after award of the Contract, a statement of the total values of each contract and Subcontract, together with the names and addresses of the contracting parties "

3.12 PREFERENCE FOR DELAWARE LABOR

3.12.1 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 conditioned upon the faithful compliance and performance by the successful bidder of each and every term and condition of the contract and the proposal, plans, specifications, and bid documents thereof. Each term and condition shall be met at the time and in the manner prescribed by the Contract, Bid documents and the specifications, including the payment in full to every person furnishing material or performing labor in the performance of the Contract, of all sums of money due the person for such labor and material. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the State and the agency from all costs, damages and expenses growing out of or by reason of the Contract in accordance with the Contract.)
- 4.1.4 Invoking a Performance Bond – The agency may, when it considers that the interest of the State so require, cause judgement to be confessed upon the bond.
- 4.1.5 Within twenty (20) days after the date of notice of award of contract, the Bidder to whom the award is made shall furnish a Performance Bond and Labor and Material Payment Bond, each equal to the full amount of the Contract price to guarantee the faithful performance of all terms, covenants and conditions of the same. The bonds are to be issued by an acceptable Bonding Company licensed to do business in the State of Delaware and shall be issued in duplicate.
- 4.1.6 Performance and Payment Bonds shall be maintained in full force (warranty bond) for a period of twelve months 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 three (3) years from the date of final payment under the Prime Contract and by the Subcontractor for a period of 3 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 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 point five 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 additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

- 8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.
- 8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.
- 8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a

waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility.

8.4 SUSPENSION AND DEBARMENT

8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: 1) failure to supply the adequate labor supply ratio for the project; 2) inadequate financial resources; or, 3) 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: 1) failure to supply the adequate labor supply ratio for the project; 2) inadequate financial resources; or, 3) 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., 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 hold permanently, 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 will 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 “Article 6516, Chapter 65, Title 29 of the Delaware Code stipulates annualized interest 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.

9.4 FINAL PAYMENT

9.4.1 Final payment, including the five percent (5%) retainage, 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: provide two original, bound, full size sets of As-built drawings with changes marked clearly in red at time of project close-out.

9.4.1.5 Operations and Maintenance Manuals,

- 9.4.1.6 Instruction Manuals,
- 9.4.1.7 Consent of Surety to final payment.
- 9.4.1.8 The Owner reserves the right to retain payments, or parts thereof, for its protection until the foregoing conditions have been complied with, defective work corrected and all unsatisfactory conditions remedied.

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

- 10.1 The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take all reasonable precautions to prevent damage, injury or loss to: workers, persons nearby who may be affected, the Work, materials and equipment to be incorporated, and existing property at the site or adjacent thereto. The Contractor shall give notices and comply with applicable laws ordinances, rules regulations, and lawful orders of public authorities bearing on the safety of persons and property and their protection from injury, damage, or loss. The Contractor shall promptly remedy damage and loss to property at the site caused in whole or in part by the Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable.
- 10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.
- 10.3 As required in the Hazardous Chemical Information Act of June 1984, all vendors supplying any materials that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a warning caution on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees may be exposed under normal conditions or in any foreseeable emergency situation. Material Safety Data Sheets must be provided directly to the Owner along with the shipping slips that include those products.
- 10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

- 11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.
- 11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.

11.3 Bodily Injury Liability and Property Damage Liability Insurance shall, in addition to the coverage included herein, include coverage for injury to or destruction of any property arising out of the collapse of or structural injury to any building or structure due to demolition work and evidence of these coverages shall be filed with and approved by the Owner.

11.4 The Contractor's Property Damage Liability Insurance shall, in addition to the coverage noted herein, include coverage on all real and personal property in their care, custody and control damaged in any way by the Contractor or their Subcontractors during the entire construction period on this project.

11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, shall not be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

11.6 Certificates of the insurance company or companies stating the amount and type of coverage, terms of policies, etc., shall be furnished to the Owner, within 20 days of contract award.

11.7 The Contractor shall, at their own expense, (in addition to the above) carry the following forms of insurance:

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

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

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

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

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

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

- 11.7.4 Prime Contractor's and Subcontractors' policies shall include contingent and contractual liability coverage in the same minimum amounts as 11.7.1 above.
- 11.7.5 Workmen's Compensation (including Employer's Liability):
- 11.7.5.1 Minimum Limit on employer's liability to be as required by law.
- 11.7.5.2 Minimum Limit for all employees working at one site.
- 11.7.6 Certificates of Insurance must be filed with the Owner guaranteeing fifteen (15) days prior notice of cancellation, non-renewal, or any change in coverages and limits of liability shown as included on certificates.
- 11.7.7 Social Security Liability
- 11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.
- 11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.
- 11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

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

ARTICLE 13: MISCELLANEOUS PROVISIONS

- 13.1 CUTTING AND PATCHING
- 13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

13.2.1 All dimensions shown shall be verified by the Contractor by actual measurements at the project site. Any discrepancies between the drawings and specifications and the existing conditions shall be referred to the Owner for adjustment before any work affected thereby has been performed.

13.3 LABORATORY TESTS

13.3.1 Any specified laboratory tests of material and finished articles to be incorporated in the work shall be made by bureaus, laboratories or agencies approved by the Owner and reports of such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.

13.3.2 The Contractor shall furnish all sample materials required for these tests and shall deliver same without charge to the testing laboratory or other designated agency when and where directed by the Owner.

13.4 ARCHAEOLOGICAL EVIDENCE

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

13.5 WARRANTY

13.5.1 For a period of one year 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 one year, 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 GENERAL REQUIREMENTS

CANNOT BE USED FOR BIDDING

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

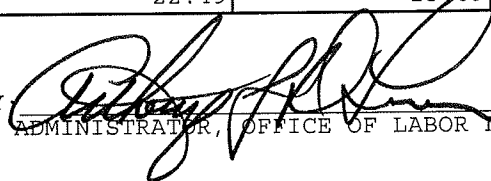
Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

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

PREVAILING WAGES FOR BUILDING CONSTRUCTION EFFECTIVE MARCH 15, 2012

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	23.22	29.83	39.20
BOILERMAKERS	65.47	33.22	48.83
BRICKLAYERS	45.63	45.63	45.63
CARPENTERS	49.06	49.06	39.22
CEMENT FINISHERS	40.38	29.11	21.20
ELECTRICAL LINE WORKERS	43.49	37.29	28.44
ELECTRICIANS	59.10	59.10	59.10
ELEVATOR CONSTRUCTORS	73.14	40.93	30.55
GLAZIERS	62.60	62.60	54.20
INSULATORS	50.38	50.38	50.38
IRON WORKERS	58.70	58.70	58.70
LABORERS	37.20	37.20	37.20
MILLWRIGHTS	60.85	60.85	47.42
PAINTERS	40.62	40.62	40.62
PILEDRIVERS	66.42	37.64	30.45
PLASTERERS	21.61	21.61	17.50
PLUMBERS/PIPEFITTERS/STEAMFITTERS	57.95	43.24	46.28
POWER EQUIPMENT OPERATORS	55.81	55.81	24.13
ROOFERS-COMPOSITION	21.01	20.71	17.02
ROOFERS-SHINGLE/SLATE/TILE	17.59	17.50	16.45
SHEET METAL WORKERS	64.39	62.18	62.18
SOFT FLOOR LAYERS	44.92	44.92	44.92
SPRINKLER FITTERS	50.65	50.65	50.65
TERRAZZO/MARBLE/TILE FNRS	50.50	50.50	45.45
TERRAZZO/MARBLE/TILE STRS	57.98	57.98	52.63
TRUCK DRIVERS	22.49	23.89	20.03

CERTIFIED: 5/29/12

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: MC3701000022 Heat Pump Replacement and Dry Storage HVAC for NCC Detention Center, New Castle County

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Work covered by the Contract Documents.
 2. Work phases.
 3. Work under other contracts.
 4. Use of premises.
 5. Owner's occupancy requirements.
 6. Specification formats and conventions.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Heat Pump Replacement AND Dry Storage HVAC, State No MC3701000022
1. Project Location: New Castle County Detention Center
- B. Owner: State of Delaware, Department of Services for Children, Youth and Their Families, 1825 Faulkland Road, Wilmington, Delaware 19805
- C. Owner's Representative: Daniel Episcopo, State of DE, Facilities Management, Construction Projects Coordinator, 1901 N. DuPont Hwy., Main Building, Room 002, New Castle, DE 19720
- D. Architect: Delaware Architects, LLC, 550 S. DuPont Blvd., Suite E, Milford, Delaware 19963.
- E. The Work consists of the following:
1. The Work includes the disconnection, removal and disposal of existing ceiling mounted heat pumps. The installation of new heat pumps including all wiring, piping, and connections to the existing system. The installation of a new split system HVAC unit to main temperature in the existing Dry Storage area of the Kitchen, including all piping, wiring and tying into existing systems.
- F. Project will be constructed under a single prime contract.

1.3 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as directed by the Owner.
- B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Limits: Confine constructions operations to those areas as indicated on the drawings.
 - 2. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
 - 3. Maintain access to existing walkways, drives, parking areas, and other adjacent site amenities as well as occupied or used buildings and facilities. Do not close or obstruct walkways, or other occupied buildings or used facilities without written permission from Owner.
 - 4. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.4 OPERATIONS AND STORAGE AREAS

- A. Coordination of Work with the Owner's Representative to cause the least possible interference with building activities,
- B. The Contractor shall confine all operations (including storage of materials) on to areas authorized or approved by the Owner's Representative. The Contractor shall hold and save the Department of Services for Children, Youth and Their Families and the State of Delaware, its officers and agents, free and harmless from liability of any nature resulting from the Contractor's performance and/or negligence. It is understood that the Department of Services for Children, Youth and Their Families and the State of Delaware shall not be held responsible for any damage to the Contractor's equipment, materials, supplies or the like which may result from vandalism, theft etc. while on site.
- C. The Contractor shall, under regulations prescribed by the Owner's Representative, use only established roadways.
- D. When materials are transported in performance of work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.
- E. The Owner's Representative shall designate working space and space available for storing materials. Unless otherwise indicated on drawings as the Contractor's "Staging Area", all working and storage space must be approved by the Owner's Representative prior to its use.

- F. Contract personnel are subject to the State of Delaware rules of conduct
- G. Contractor shall execute work in such a manner as to interfere as little as possible with work being done by others. Keep roads clear of construction materials, debris, standing construction equipment and vehicles at all times. Materials and Equipment shall not be stored in other than assigned areas.

1.5 WORK RESTRICTIONS

- A. Federal Holidays: No construction related work will be allowed on Federal Holidays.

1.6 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 33-division format and CSI/CSC's "MasterFormat" numbering system.
 - 1. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. 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. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. See Division 01 Section "Unit Prices" for administrative requirements for using unit prices.

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."

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect 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 Architect 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 Architect.

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 01 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 for Proposal Requests.

1.4 ALLOWANCES

A. Allowances are not considered as part of this contract.

1.5 CHANGE ORDER PROCEDURES

- A. A Change Order that results in added cost to the project must be approved by VCGS prior to Owner/Architect approving Change Order.
- B. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. 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 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with Continuation Sheets Submittals Schedule and Contractor's Construction Schedule.
2. Submit the Schedule of Values to Architect at earliest possible date but no later than 15 days before the date scheduled for submittal of initial Applications for Payment.
3. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Submit draft of AIA Document G703 Continuation Sheets.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Progress payments shall be submitted to Architect by the last day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit 5 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Schedule of unit prices.
 5. Submittals Schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
 6. AIA Document G707, "Consent of Surety to Final Payment."
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 9. Final, liquidated damages settlement statement.

**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC370100022**

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

CANNOT BE USED FOR BIDDING

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.
 - 3. Requests for Interpretation (RFIs).
- B. See Division 01 Section "Multiple Contract Summary" for a description of the division of Work among separate contracts and responsibility for coordination activities not in this Section.
- C. See Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.3 COORDINATION

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, 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. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
 - 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 five opaque copies of each submittal. Architect will return one copy.
 - 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Architect will record significant discussions and agreements achieved. Architect will distribute the meeting minutes to everyone concerned, including Owner, Contractor and VCGS, within five days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. LEED requirements.
 - l. Preparation of Record Documents.
 - m. Use of the premises.
 - n. Work restrictions.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Construction waste management and recycling.
 - r. Parking availability.
 - s. Office, work, and storage areas.
 - t. Equipment deliveries and priorities.
 - u. First aid.
 - v. Security.
 - w. Progress cleaning.
 - x. Working hours.
 3. Minutes: Architect will record and distribute meeting minutes to everyone concerned, including Owner, Contractor and VCGS.

- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. The Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related 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.
- D. Progress Meetings: Conduct progress meetings at biweekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of 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. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) 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) 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: Architect will record and distribute meeting minutes to everyone concerned, including Owner, Contractor and VCGS.
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.

1.6 REPORTING REQUIREMENTS

- A. The Contractor is required to check-in with the Cemetery Director (or designee) at the Cemetery on a weekly basis (or as otherwise agreed upon). The Contractor will provide the Cemetery Director with an anticipated work schedule, and the Cemetery Director will furnish the Contractor with a schedule of funerals and/or special events. This weekly check-in is mandatory and may not be accomplished by telephone or e-mail.

1.7 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. Name of Architect.
5. RFI number, numbered sequentially.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

- C. Hard-Copy RFIs: CSI Form 13.2A.

1. Identify each page of attachments with the RFI number and sequential page number.

- D. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.

- c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.
2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

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. Contractor's Construction Schedule.
 2. Submittals Schedule.
 3. Daily construction reports.
 4. Monthly Progress reports.
 5. Field condition reports.
- B. See Division 01 Section "Payment Procedures" for submitting the Schedule of Values.
- C. See Division 01 Section "Photographic Documentation" for submitting construction photographs.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Float: The measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

- E. Fagnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- F. Major Area: A story of construction, a separate building, or a similar significant construction element.

1.3 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. Preliminary Network Diagram: Submit two opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.
 - 1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.
- D. Daily Construction Reports: Submit two copies at weekly intervals.
- E. Monthly Construction Progress Report: Submit three copies along with Request for Payment.
- F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

1.4 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, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, 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 the Notice to Proceed to date of Final 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 the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include the appropriate number of 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. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.

4. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
5. Work Stages: Indicate important stages of construction for each major portion of the Work.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- E. 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. Bar Graph Schedule: Submit a comprehensive, fully developed, horizontal Bar Graph, Contractor's Construction Schedule within 10 days of date established for the Notice of Award. 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 a daily construction report recording the following information concerning events at Project site:
 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. Orders and requests of authorities having jurisdiction.
 8. Services connected and disconnected.

- B. Monthly Construction Progress Reports: Prepare a monthly construction report to be submitted along with requests for payment. Three copies of the Monthly Construction Progress Reports shall be submitted to the Architect. The Architect will distribute report to Owner and VCGS. Monthly Construction Progress Reports shall record the following information concerning events at Project site:
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. Orders and requests of authorities having jurisdiction.
 8. Services connected and disconnected.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation. 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 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 Architect 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 if applicable.
 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 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
- B. See Division 01 Section "Closeout Procedures" for submitting digital media as Project Record Documents at Project closeout.
- C. See Division 01 Section "Demonstration and Training" for submitting videotapes of demonstration of equipment and training of Owner's personnel.

1.2 SUBMITTALS

- A. Key Plan: Submit key plan of Project Site with notation of vantage points marked for location and direction of each photograph. Indicate location (Section and Field) of construction. Include same label information as corresponding set of photographs.
- B. Construction Photographs: Submit one file of each photographic view within seven days of taking photographs.
 - 1. Format: Digital. Keep all photographic images on a CD disc on site for review.
 - 2. Identification: In a corresponding log, provide the following information keyed to each photo file:
 - a. Name of Project.
 - b. Name of Architect.
 - c. Name of Contractor.
 - d. Date and time of day photograph was taken if not date stamped by camera.
 - e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - f. Unique sequential identifier.
 - 3. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.3 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including

temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.4 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in filename for each image.
 - 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
- C. Preconstruction Photographs: Before starting construction, take, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag excavation areas and construction limits before taking construction photographs.
 - 2. Take a minimum of eight photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take a minimum of eight photographs of adjoining fields to accurately record physical conditions at start of construction.

- D. Periodic Construction Photographs: Take 12, digital photographs bi-weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken. Photographs must accompany each monthly request for payment.
- E. Additional Photographs: Architect may issue requests for additional photographs, in addition to periodic photographs specified.
1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. See Division 01 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule.
- C. See Division 01 Section "Photographic Documentation" for submitting construction photographs.
- D. See Division 01 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
- E. See Division 01 Section "Closeout Procedures" for submitting warranties.
- F. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. 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. 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.

- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
- C. Processing Time: Allow enough 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 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 for review of each resubmittal.
- D. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Submittal number or other unique identifier, including revision identifier.
 - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
 - i. Number and title of appropriate Specification Section.
 - j. Drawing number and detail references, as appropriate.
 - k. Location(s) where product is to be installed, as appropriate.
 - l. Other necessary identification.
- E. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.
- F. 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.

1. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.
 - G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
 1. Transmittal Form: Use AIA Document G810 or CSI Form 12.1A.
 - H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked "Approved or Approved as noted"
 - 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: Use only final submittals with mark indicating " Approved or Approved as noted " taken by Architect.
- 1.4 CONTRACTOR'S USE OF ARCHITECT'S CAD FILES
- A. General: At Contractor's written request, copies of Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
 1. Contractor must provide Delaware Architects, LLC (DALLC) with an executed release of liability form as provide by DALLC.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- 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 printed 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 written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Manufacturer's catalog cuts.
 - e. Wiring diagrams showing factory-installed wiring.
 - f. Printed performance curves.
 - g. Operational range diagrams.
 - h. Compliance with specified referenced standards.
 - i. Testing by recognized testing agency.
4. Number of Copies: Submit three copies of Product Data, unless otherwise indicated. Architect will return two copies. Mark up and retain one returned copy as a Project Record Document.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Notation of coordination requirements.
 - j. Notation of dimensions established by field measurement.
 - k. Relationship to adjoining construction clearly indicated.
 - l. Seal and signature of professional engineer if specified.
 - m. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
 3. Number of Copies: Submit two opaque (bond) copies of each submittal. Architect will return one copy.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:

- a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of appropriate Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
- E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location.
1. Number of Copies: Submit three copies of product schedule or list, unless otherwise indicated. Architect will return two copies.
- F. Submittals Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design.

1. Number of Copies: Submit three copies of subcontractor list, unless otherwise indicated. Architect will return two copies.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 2. Certificates and Certifications: Provide a notarized 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.
 3. Test and Inspection Reports: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- C. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare 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.
- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- J. Material Test Reports: Prepare 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.

- K. Product Test Reports: Prepare written reports indicating 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.
- L. Research/Evaluation Reports: Prepare written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project.
- M. Preconstruction Test Reports: Prepare 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.
- N. Compatibility Test Reports: Prepare 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.
- O. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.
- P. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Q. Design Data: Prepare 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.
- R. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer.
- S. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Statement on condition of substrates and their acceptability for installation of product.
 2. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.

- T. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- U. Construction Photographs: Comply with requirements specified in Division 01 Section "Photographic Documentation."
- V. Material Safety Data Sheets (MSDSs): Submit information directly to Owner; do not submit to Architect.
 - 1. Architect will not review submittals that include MSDSs and will return them for resubmittal.

2.3 DELEGATED DESIGN

- 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 Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, 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. 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. 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. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
 - 1. "Approved" or "Approved as noted" indicates "Fabrication/Installation may be undertaken. Approval does not authorize changes to the Contract Sum or Contract Time" Nor does it relieve the contractor from their responsibility for review and verification that submittal meets the requirements set forth in the construction documents.
 - 2. "Revise and Resubmit" or "Rejected" indicates "Fabrication and/or installation MAY NOT be undertaken. In resubmitting, limit corrections to items marked.
 - 3. Review/approval neither extends nor alters any contractual obligations of the Architect/Engineer or Contractor.
- C. 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.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.3 REQUIRED SUBMISSIONS

- A. Contractor to submit product literature/samples for approval of the following:
 - 1. Geo-grid System
 - 2. Crushed Stone Base Material
 - 3. Sod
 - 4. Temporary Grave Site Marker

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This 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. 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.
 - 2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. See Divisions 02 through 33 Sections for specific test and inspection requirements.

1.2 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. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.
- D. Preconstruction Testing: Tests and inspections that are performed specifically for the 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 industry standards.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., 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. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.
- J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

- A. General: 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 uncertainties and 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.

1.4 SUBMITTALS

- A. Qualification Data: 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.
- B. Reports: Prepare and submit certified written reports that 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.

- C. 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.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. 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.
- C. 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.
- D. 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.
- 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 to those indicated for this Project in material, design, and extent.
- F. 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 548; 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.

- G. **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.
- H. **Laboratory Mockups:** Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 02 through 49.

1.6 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.
- B. **Tests and inspections not explicitly assigned to Owner are Contractor's responsibility.** 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.
 - 1. 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.
 - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 5. 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 Division 01 Section "Submittal Procedures."
- D. **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.

- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect 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.
- F. 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.
- G. 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.

1.7 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector 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 reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect 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 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 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. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- 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 DEFINITIONS

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

1.2 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.

1.3 ABBREVIATIONS AND ACRONYMS

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

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.

AA	Aluminum Association, Inc. (The)
AAADM	American Association of Automatic Door Manufacturers
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists (The)
ABAA	Air Barrier Association of America
ABMA	American Bearing Manufacturers Association
ACI	ACI International (American Concrete Institute)
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies, Inc. (The)
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGC	Associated General Contractors of America (The)
AHA	American Hardboard Association (Now part of CPA)
AHAM	Association of Home Appliance Manufacturers

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AI	Asphalt Institute
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
AOSA	Association of Official Seed Analysts, Inc.
APA	Architectural Precast Association
APA	APA - The Engineered Wood Association
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems
API	American Petroleum Institute
ARI	Air-Conditioning & Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (The American Society of Mechanical Engineers International)
ASSE	American Society of Sanitary Engineering
ASTM	ASTM International (American Society for Testing and Materials International)
AWCI	AWCI International (Association of the Wall and Ceiling Industry International)

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AWCMA	American Window Covering Manufacturers Association (Now WCSC)
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
BICSI	BICSI
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)
BISSC	Baking Industry Sanitation Standards Committee
CCC	Carpet Cushion Council
CDA	Copper Development Association
CEA	Canadian Electricity Association
CFFA	Chemical Fabrics & Film Association, Inc.
CGA	Compressed Gas Association
CIMA	Cellulose Insulation Manufacturers Association
CISCA	Ceilings & Interior Systems Construction Association
CISPI	Cast Iron Soil Pipe Institute
CLFMI	Chain Link Fence Manufacturers Institute
CRRC	Cool Roof Rating Council
CPA	Composite Panel Association
CPPA	Corrugated Polyethylene Pipe Association
CRI	Carpet & Rug Institute (The)
CRSI	Concrete Reinforcing Steel Institute

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CSA	Canadian Standards Association
CSA	CSA International (Formerly: IAS - International Approval Services)
CSI	Cast Stone Institute
CSI	Construction Specifications Institute (The)
CSSB	Cedar Shake & Shingle Bureau
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute)
DHI	Door and Hardware Institute
EIA	Electronic Industries Alliance
EIMA	EIFS Industry Members Association
EJCDC	Engineers Joint Contract Documents Committee
EJMA	Expansion Joint Manufacturers Association, Inc.
ESD	ESD Association
FIBA	Federation Internationale de Basketball (The International Basketball Federation)
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation)
FM Approvals	FM Approvals
FM Global	FM Global (Formerly: FMG - FM Global)
FMRC	Factory Mutual Research (Now FM Global)
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.
FSA	Fluid Sealing Association
FSC	Forest Stewardship Council
GA	Gypsum Association
GANA	Glass Association of North America
GRI	(Now GSI)

GS	Green Seal
GSI	Geosynthetic Institute
HI	Hydraulic Institute
HI	Hydronics Institute
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)
HPVA	Hardwood Plywood & Veneer Association
HPW	H. P. White Laboratory, Inc.
IAS	International Approval Services (Now CSA International)
IBF	International Badminton Federation
ICEA	Insulated Cable Engineers Association, Inc.
ICRI	International Concrete Repair Institute, Inc.
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The)
IESNA	Illuminating Engineering Society of North America
IEST	Institute of Environmental Sciences and Technology
IGCC	Insulating Glass Certification Council
IGMA	Insulating Glass Manufacturers Alliance
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA
ITU	International Telecommunication Union
KCMA	Kitchen Cabinet Manufacturers Association
LMA	Laminating Materials Association (Now part of CPA)

LPI	Lightning Protection Institute
MBMA	Metal Building Manufacturers Association
MFMA	Maple Flooring Manufacturers Association, Inc.
MFMA	Metal Framing Manufacturers Association, Inc.
MH	Material Handling (Now MHIA)
MHIA	Material Handling Industry of America
MIA	Marble Institute of America
MPI	Master Painters Institute
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc.
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International (National Association of Corrosion Engineers International)
NADCA	National Air Duct Cleaners Association
NAGWS	National Association for Girls and Women in Sport
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCAA	National Collegiate Athletic Association (The)
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NCTA	National Cable & Telecommunications Association
NEBB	National Environmental Balancing Bureau
NECA	National Electrical Contractors Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NETA	InterNational Electrical Testing Association

NFHS	National Federation of State High School Associations
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NGA	National Glass Association
NHLA	National Hardwood Lumber Association
NLGA	National Lumber Grades Authority
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NRCA	National Roofing Contractors Association
NRMCA	National Ready Mixed Concrete Association
NSF	NSF International (National Sanitation Foundation International)
NSSGA	National Stone, Sand & Gravel Association
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)
NWWDA	National Wood Window and Door Association (Now WDMA)
OPL	Omega Point Laboratories, Inc. (Now ITS)
PCI	Precast/Prestressed Concrete Institute
PDCA	Painting & Decorating Contractors of America
PDI	Plumbing & Drainage Institute
PGI	PVC Geomembrane Institute
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America)
PTI	Post-Tensioning Institute
RCSC	Research Council on Structural Connections

RFCI	Resilient Floor Covering Institute
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Deck Institute
SDI	Steel Door Institute
SEFA	Scientific Equipment and Furniture Association
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)
SGCC	Safety Glazing Certification Council
SIA	Security Industry Association
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SMPTE	Society of Motion Picture and Television Engineers
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division)
SPIB	Southern Pine Inspection Bureau (The)
SPRI	Single Ply Roofing Industry
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
STI	Steel Tank Institute
SWI	Steel Window Institute
SWRI	Sealant, Waterproofing, & Restoration Institute
TCA	Tile Council of America, Inc.

TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance
TMS	The Masonry Society
TPI	Truss Plate Institute, Inc.
TPI	Turfgrass Producers International
TRI	Tile Roofing Institute
UL	Underwriters Laboratories Inc.
UNI	Uni-Bell PVC Pipe Association
USAV	USA Volleyball
USGBC	U.S. Green Building Council
USITT	United States Institute for Theatre Technology, Inc.
WASTEC	Waste Equipment Technology Association
WCLIB	West Coast Lumber Inspection Bureau
WCMA	Window Covering Manufacturers Association (Now WCSC)
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association)
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California)
WIC	Woodwork Institute of California (Now WI)
WMMPA	Wood Moulding & Millwork Producers Association
WSRCA	Western States Roofing Contractors Association
WWPA	Western Wood Products Association

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.

BOCA BOCA International, Inc.
(See ICC)

IAPMO International Association of Plumbing and Mechanical Officials

ICBO International Conference of Building Officials
(See ICC)

ICBO
ES ICBO Evaluation Service, Inc.
(See ICC-ES)

ICC International Code Council

ICC-ES ICC Evaluation Service, Inc.

SBCCI Southern Building Code Congress International, Inc.
(See ICC)

UBC Uniform Building Code
(See ICC)

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.

CE Army Corps of Engineers

CPSC Consumer Product Safety Commission

DOC Department of Commerce

DOD Department of Defense

DOE Department of Energy

EPA Environmental Protection Agency

FAA Federal Aviation Administration

FCC Federal Communications Commission

FDA Food and Drug Administration

GSA General Services Administration

HUD Department of Housing and Urban Development

LBL Lawrence Berkeley National Laboratory

NCHR
P National Cooperative Highway Research Program
(See TRB)

NIST	National Institute of Standards and Technology
OSHA	Occupational Safety & Health Administration
PBS	Public Building Service (See GSA)
PHS	Office of Public Health and Science
RUS	Rural Utilities Service (See USDA)
SD	State Department
TRB	Transportation Research Board
USDA	Department of Agriculture
USPS	Postal Service

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.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA)
CFR	Code of Federal Regulations
DOD	Department of Defense Military Specifications and Standards
DSCC	Defense Supply Center Columbus (See FS)
FED-STD	Federal Standard (See FS)
FS	Federal Specification
FTMS	Federal Test Method Standard (See FS)
MIL	(See MILSPEC)
MIL-STD	(See MILSPEC)
MILSPEC	Military Specification and Standards
UFAS	Uniform Federal Accessibility Standards

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.

CBH State of California, Department of Consumer Affairs Bureau of Home Furnishings and
F Thermal Insulation

CCR California Code of Regulations

CPU California Public Utilities Commission
C

TFS Texas Forest Service
Forest Resource Development

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. See Division 01 Section "Execution" for progress cleaning requirements.
- C. See Divisions 02 through 33 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.
- D. See Division 31 Section "Dewatering" for disposal of ground water at Project site.

1.2 USE CHARGES

- A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- B. Water Service: Water from Owner's existing water system is available for irrigation and construction use, not cleaning of marker headstones, without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete bases for supporting posts.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations. Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Owner. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its own expense upon completion of the work.
- C. Fence: Before work operations begin, Contractor shall provide a chain link fence, six feet in height and no more, around the staging area. Provide gates as required for access with necessary hardware, including hasps and padlocks. Fasten fence fabric to terminal posts with tension bands and to line posts and top and bottom rails with tie wires spaced at maximum 15 inches. Bottom of fences shall extend to one inch above grade.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to private system indicated as directed by authorities having jurisdiction.
- C. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. It is the responsibility of the Contractor to provide water for the newly installed sod as part of this contract. The Contractor may utilize water provided by the Owner via the existing irrigation system, or tanks/water trucks filled offsite as necessary to transport water to areas where needed in order to complete the work required by this contract. Any water that the Contractor obtains from the cemetery will not need to be metered and will not be charged to Contractor.
 - 1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- F. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.

1. Provide additional telephone lines for the following:
 - a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
 2. At each telephone, post a list of important telephone numbers including police and fire departments Contractor's home office Architect's office Owner's office Principal subcontractors' field and home offices.
 3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.
- H. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail in field office.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.
 2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Contractor shall utilize existing paved and gravel roads **only**. The construction of temporary roads, paths etc. shall **not** be permitted.
- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas as shown on drawings for parking areas for construction personnel.
- E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- F. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
1. Provide temporary, directional signs for construction personnel and visitors.
 2. Maintain and touchup signs so they are legible at all times.

- G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
 - 1. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
- H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Prohibit smoking in construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This 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; product substitutions; and comparable products.
- B. See Division 01 Section "Closeout Procedures" for submitting warranties for Contract closeout.
- C. See Divisions 02 through 33 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

- A. Products: Items purchased 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, or where indicated as a product substitution, 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. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 other named manufacturers.

1.3 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 material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications 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. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. 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 lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. 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 7 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 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.

- b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- B. Comparable Product 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. 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 7 days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.
 - C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. 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 ensure compliance with the Contract Documents and to ensure 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. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.6 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: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final 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 appropriate form properly executed.
 3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that 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. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified 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 provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

- a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.
10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.
 - a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
 - b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

- A. Timing: Architect will consider requests for substitution if received within 15 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
- B. 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:
 1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 2. Requested substitution does not require extensive revisions to the Contract Documents.
 3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 4. Substitution request is fully documented and properly submitted.
 5. Requested substitution will not adversely affect Contractor's Construction Schedule.
 6. Requested substitution has received necessary approvals of authorities having jurisdiction.
 7. Requested substitution is compatible with other portions of the Work.
 8. Requested substitution has been coordinated with other portions of the Work.
 9. Requested substitution provides specified warranty.

2.3 COMPARABLE PRODUCTS

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.
 - 7. Correction of the Work.
- B. See Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.3 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work,

investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: 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 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; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

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 licensed Professional Land Surveyor, registered in the State of Delaware, 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 dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 3. Inform installers of lines and levels to which they must comply.
 4. Check the location, level and plumb, of every major element as the Work progresses.
 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 6. 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 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. A registered professional land surveyor or registered civil engineer whose services are retained and paid for by the Contractor shall be used to restore any grave section corner monuments that may be disturbed because of the Contractor's work performance.
- 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.

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.

- 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. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. 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.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 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.
- H. 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.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. 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 materials more than 7 days during normal weather or 3 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.
 - 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: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
 - 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.
- 3.7 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.

3.8 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 2 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.3 QUALITY ASSURANCE

- A. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related 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
- B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces 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.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. 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.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

- A. 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. 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 as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 5. Proceed with patching after construction operations requiring cutting are complete.
- C. 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 possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate 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 eliminate evidence of patching and refinishing.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 024119 "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, **and for disposition of hazardous waste.**

1.2 DEFINITIONS

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

1.3 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of **50** percent by weight of total non-hazardous solid waste generated by the Work. Facilitate recycling and salvage of materials.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within **7** days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons (tonnes).
 - 4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
 - 5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
 - 6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. Qualification Data: For waste management coordinator.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: LEED-Accredited Professional, certified by USGBC. Waste management coordinator may also serve as LEED coordinator.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
 - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 4. Store components off the ground and protect from the weather.
 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- B. Metals: Separate metals by type.
1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- D. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- E. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- F. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.
- G. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:

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

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

E. Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.7 SAMPLE FORMS

END OF SECTION 017419

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 Division 01 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
- C. See Division 01 Section "Photographic Documentation" for submitting Final Completion construction photographs and negatives.
- D. See Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
- E. See Divisions 02 through 33 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. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

8. Complete final cleaning requirements, including touchup painting.
9. 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, 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 01 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. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected. If more than one (1) reinspection is required all associated cost of that inspection including architect/engineering fees shall be the responsibility of the Contractor.

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.

1. Organize items applying to each major element, including categories.

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 (215-by-280-mm) 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 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 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 labels that are not permanent.
 - h. 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.
 - i. Remove excess mortar droppings, and other foreign substances.
 - j. Leave Project clean and ready for occupancy.
- C. 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 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings (As-built Drawings).
 - 2. Record Specifications (As- built Specifications).
 - 3. Record Product Data (As-built Product Data).
- B. See Divisions 02 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up Record Prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal: Submit one set of red marked as-built prints to the Architect. The Architect will approve via initials and date the prints and indicate whether general scope of changes, additional information recorded, and quality of mark-ups are acceptable as well as any other modifications are deemed necessary. If required by the Architect the Contractor shall, at no additional expense to the Owner or Architect, prepare a revised set of As-built Prints for submission and approval by the Architect. The Architect will return approved prints to the contractor to prepare additional required sets for final submittal.
 - b. Final Submittal: Submit one set of red marked As-built Prints to the Architect. As-built Prints must be identical to initial submission with required corrections.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
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 prepare the 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. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 2. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 4. 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. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 COMPLETE PROJECT RECORD DOCUMENTS

- A. Preparation: Provide one complete set of Project Record Documents to the Owner.

2.4 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

2.5 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.

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 modifications to Project Record Documents as they occur; do not wait until the 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

CANNOT BE USED FOR BIDDING

DIVISION 01
SECTION 019113
GENERAL COMMISSIONING REQUIREMENTS
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SECTION 019113 - GENERAL COMMISSIONING 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. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.
- B. Related Sections include the following:
 - 1. Division 01 Section "*HVAC Commissioning Requirements*" for specific requirements for commissioning HVAC systems.
 - 2. Division 01 Section "*Contract Closeout*" for specific requirements for closeout at substantial and final completion.
 - 3. Division 01 Section "*Contract Closeout*" for Specific Requirements for training and demonstration of systems to Owner.
 - 4. Division 01 Section "*Contract Closeout*" for Specific Requirements related to the Preparation of systems operation and maintenance manuals.

1.3 DEFINITIONS

- A. CxA: Commissioning Authority.
- B. OPR: Owner's Project Requirements.
- C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- D. TAB: Testing, Adjusting, and Balancing.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project

superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Contractor shall engage the CxA under this contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

1. Coordination meetings.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Testing meetings.
4. Demonstration of operation of systems, subsystems, and equipment.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Provide utility services required for the commissioning process.

B. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in commissioning and construction-phase coordination meetings.
2. Participate in maintenance orientation and inspection.
3. Participate in operation and maintenance training sessions.
4. Participate in final review at acceptance meeting.
5. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.
6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
7. Review and approve final commissioning documentation.
8. Certify that all pre-test work is complete and operational prior to scheduling performed testing by CxA.

C. Subcontractors shall assign representatives with expertise and authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in commissioning and construction-phase coordination meetings.
2. Participate in maintenance orientation and inspection.
3. Participate in procedures meeting for testing.

4. Participate in final review at acceptance meeting.
5. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.
6. Provide information to the CxA for developing construction-phase commissioning plan.
7. Participate in training sessions for Owner's operation and maintenance personnel.
8. Provide updated Project Record Documents to the CxA on a daily basis.
9. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 01 Section "Operation and Maintenance Data."
10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.

1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Prepare a construction-phase commissioning plan. Collaborate with Contractor and with subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.
- C. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The CxA shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.
- D. At a mutually agreed upon time, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.
- E. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.
- F. Prepare Project-specific test and inspection procedures and checklists.
- G. Schedule, direct, witness, and document tests, inspections, and systems startup.
- H. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

- I. Certify date of acceptance and startup for each item of equipment for start of warranty periods.
- J. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Division 01 Section "Project Record Documents."
- K. Review and comment on operation and maintenance documentation and systems manual outline for compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section "Operation and Maintenance Data."
- L. Assemble the final commissioning documentation, including the commissioning report and Project Record Documents.

1.8 COMMISSIONING DOCUMENTATION

- A. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
 - 2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
 - 3. Identification of systems and equipment to be commissioned.
 - 4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
 - 5. Identification of items that must be completed before the next operation can proceed.
 - 6. Description of responsibilities of commissioning team members.
 - 7. Description of observations to be made.
 - 8. Description of requirements for operation and maintenance training, including required training materials.
 - 9. Description of expected performance for systems, subsystems, equipment, and controls.
 - 10. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.
 - 11. Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase.
 - 12. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
 - 13. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.

14. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

- B. Test Checklists: CxA, with assistance of Contractor and Subcontractors, shall develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Specific checklist content requirements are specified in Division 01 Section *"HVAC Commissioning Requirements"*, *"Electrical Commissioning Requirements"* and *"Plumbing System Commissioning Requirements."* Test checklists will be jointly developed as the project progresses. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:
 1. Name and identification code of tested item.
 2. Test number.
 3. Time and date of test.
 4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
 5. Dated signatures of the person performing test and of the witness, if applicable.
 6. Individuals present for test.
 7. Deficiencies.
 8. Issue number, if any, generated as the result of test.

- C. Certificate of Readiness: Certificate of Readiness shall be signed by Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

- D. Test and Inspection Reports: CxA shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

- E. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.

- F. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.
 1. Creating an Issues Log Entry:
 - a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.

- b. Assign a descriptive title of the issue.
 - c. Identify date and time of the issue.
 - d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
 - e. Identify system, subsystem, and equipment to which the issue applies.
 - f. Identify location of system, subsystem, and equipment.
 - g. Include information that may be helpful in diagnosing or evaluating the issue.
 - h. Note recommended corrective action.
 - i. Identify commissioning team member responsible for corrective action.
 - j. Identify expected date of correction.
 - k. Identify person documenting the issue.
2. Documenting Issue Resolution:
- a. Log date correction is completed or the issue is resolved.
 - b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
 - c. Identify changes to the Contract Documents that may require action.
 - d. State that correction was completed and system, subsystem, and equipment is ready for retest, if applicable.
 - e. Identify person(s) who corrected or resolved the issue.
 - f. Identify person(s) documenting the issue resolution.
3. Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, CxA shall prepare a written narrative for review of outstanding issues and a status update of the issues log. As a minimum, CxA shall include the following information in the issues log and expand it in the narrative:
- a. Issue number and title.
 - b. Date of the identification of the issue.
 - c. Name of the commissioning team member assigned responsibility for resolution.
 - d. Expected date of correction.
- G. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the Contract Documents. The commissioning report shall include, but is not limited to, the following:
1. Lists and explanations of substitutions; compromises; variances in the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
 2. Commissioning plan.

3. Testing plans and reports.
 4. Corrective modification documentation.
 5. Issues log.
 6. Completed test checklists.
 7. Listing of off-season test(s) not performed and a schedule for their completion.
- H. Systems Manual: CxA shall gather required information and compile systems manual. Systems manual shall include, but is not limited to, the following:
1. Project Record Documents as specified in Division 01 Section "Project Record Documents."
 2. Final commissioning plan.
 3. Commissioning report.
 4. Operation and maintenance data as specified in Division 01 Section "Operation and Maintenance Data."

1.9 SUBMITTALS

- A. Test Checklists and Report Forms: CxA shall submit sample checklists and forms to Contractor quality-control manager and subcontractors for review and comment. Submit two copies of each checklist and report form.
- B. Test and Inspection Reports: CxA shall submit test and inspection reports.
- C. Corrective Action Documents: CxA shall submit corrective action documents.

1.10 QUALITY ASSURANCE

- A. Instructor Qualifications: Factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.
- B. Test Equipment Calibration: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.11 COORDINATION

- A. Coordinating Meetings: CxA shall conduct coordination meetings of the commissioning team to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.
- B. Pretesting Meetings: CxA shall conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.

- C. Testing Coordination: CxA shall coordinate sequence of testing 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.
- D. Manufacturers' Field Services: CxA and Contractor shall coordinate services of manufacturers' field services.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

- A. Training Preparation Conference: Before operation and maintenance training, CxA shall convene a training preparation conference to include Owner's operation and maintenance personnel, Contractor, and subcontractors. In addition to requirements specified in Division 01 Section "Demonstration and Training," perform the following:
 - 1. Review installed systems, subsystems, and equipment.
 - 2. Review instructor qualifications.
 - 3. Review instructional methods and procedures.
 - 4. Review training module outlines and contents.
 - 5. Review course materials (including operation and maintenance manuals).
 - 6. Inspect and discuss locations and other facilities required for instruction.
 - 7. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.
 - 8. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.
- B. Training Modules: Develop an instruction program that includes individual training modules for each system, subsystem, and equipment as specified in Division 01 Section "Demonstration and Training."

END OF SECTION 019113

DIVISION 01
SECTION 019115
HVAC COMMISSIONING REQUIREMENTS
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CANNOT BE USED FOR BIDDING

SECTION 019115 - HVAC COMMISSIONING 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. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."
- B. Related Sections include the following:
 - 1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.
- C. The following systems and/or equipment shall be commissioned:
 - 1. Air handling unit
 - 2. Condensing unit
 - 3. Duct detectors
 - 4. Automatic temperature controls

1.3 DEFINITIONS

- A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.
- B. CxA: Commissioning Authority.
- C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.
- D. TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."
- B. Contractor:

1. Attend procedures meeting for TAB Work.
2. Certify that TAB Work is complete.

C. Mechanical Contractor:

1. Attend TAB verification testing.
2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the Contract Documents, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.
 - a. Verify the following:
 - 1) Accessibility of equipment and components required for TAB Work.
 - 2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
 - 3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
 - 4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
 - 5) Air and water flow rates have been specified and compared to central equipment output capacities.
 - b. Identify discontinuities and omissions in the Contract Documents.
 - c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."
2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Automatic Temperature Control."

F. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.
2. Attend TAB verification testing.

1.5 COMMISSIONING DOCUMENTATION

- A. The following are in addition to documentation specified in Division 01 Section "General Commissioning Requirements."
- B. Test Checklists: CxA with assistance of Contractor shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 01 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:
 - 1. Calibration of sensors and sensor function.
 - 2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.
 - 3. Control sequences for HVAC systems.
 - 4. Strength of control signal for each set point at specified conditions.
 - 5. Responses to control signals at specified conditions.
 - 6. Sequence of response(s) to control signals at specified conditions.
 - 7. Electrical demand or power input at specified conditions.
 - 8. Power quality and related measurements.
 - 9. Expected performance of systems, subsystems, and equipment at each step of test.
 - 10. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.
 - 11. Interaction of auxiliary equipment.
 - 12. Issues log.

1.6 SUBMITTALS

- A. The following submittals are in addition to those specified in Division 01 Section "General Commissioning Requirements."
- B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.
- C. Certificate of Readiness: CxA shall compile certificates of readiness from Contractor certifying that systems, subsystems, equipment, and associated controls are ready for testing.
- D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Subcontractor as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."
- E. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in systems manual and commissioning report.
- F. Corrective Action Documents: CxA shall submit corrective action documents.

- G. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the Contract Documents; and that Certificates of Readiness are signed and submitted.
2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the Contract Documents; and that pretest set points have been recorded.
3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.
5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.
7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.
8. Check safety cutouts, alarms, and interlocks with duct detectors and life-safety systems during each mode of operation.
9. Annotate checklist or data sheet when a deficiency is observed.
10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:
 - a. Supply and return flow rates for constant volume systems in each operational mode.
 - b. Operation of units in both heating and cooling cycles.
 - c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
 - d. Sequences of operation of all HVAC equipment.
 - e. Duct detector fan shut down
11. Verify proper responses of monitoring and control system controllers and sensors to include the following:
 - a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check

calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.

- b. Report deficiencies and prepare an issues log entry.
12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.
- B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load. Operational modes include the following:
1. Heating/Cooling Mode.
 2. Occupied and unoccupied.
 3. Warm up and cool down.
 4. Emergency power supply.
 5. Life-safety and safety systems.
 6. Duct detectors.
 7. Fire safety.
 8. Temporary upset of system operation.
 9. Partial occupancy conditions.
 10. Special cycles.

3.2 TAB VERIFICATION

- A. TAB Subcontractor shall coordinate with CxA for work required in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing." TAB Subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.
- B. Contractor, HVAC Contractor, and CxA shall witness TAB Work.
- C. TAB Preparation:
 1. TAB Subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."
 - a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.
- D. Verification of Final TAB Report:
 1. CxA shall select, at random, 10 percent of report for field verification.
 2. CxA shall notify TAB Subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 3. Failure of an item is defined as follows:

- a. For all readings a deviation of more than 10 percent.
4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.
- E. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.
- F. CxA shall certify that TAB Work has been successfully completed.

3.3 TESTING

- A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.
- B. Perform tests using design conditions whenever possible.
 1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
 2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.
 3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.
- C. Scope of HVAC Contractor Testing:
 1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.
 2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Subcontractor, and HVAC Instrumentation and Control Contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.
- E. HVAC Instrumentation and Control System Testing:
 1. Field testing plans and testing requirements are specified in Division 23 Section "Instrumentation & Controls of HVAC & Plumbing Systems". The CxA, HVAC Contractor, Equipment Provider/Manufacturer and the HVAC Instrumentation and Control Contractor shall collaborate to prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.
- F. Energy Supply System Testing: HVAC Contractor shall prepare a testing plan to verify performance of gas and steam systems and equipment. Plan shall include the following:
1. Sequence of testing and testing procedures for each equipment item and pipe section to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in system testing plan.
 2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
- G. Heat-Generation System Testing: HVAC Contractor shall prepare a testing plan to verify performance of heating coil. Plan shall include the following:
1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings for each pipe sector showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
 2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
 3. Variable refrigerant flow equipment volts, amps, temperatures, and modes of operation.
- H. Refrigeration System Testing: HVAC Contractor shall prepare a testing plan to verify performance of refrigerant compressors and condensers, and other refrigeration systems. Plan shall include the following:
1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
 2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
 3. Variable refrigerant flow equipment volts, amps, temperatures, and modes of operation.
- I. Deferred Testing:
1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

J. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

END OF SECTION 019115

CANNOT BE USED FOR COMMISSIONING

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 PREINSTALLATION MEETINGS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Predemolition Photographs or Video: Submit before Work begins.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

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

1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous material remediation is specified elsewhere in the Contract Documents.
 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. **Engage a professional engineer to perform** an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs and/or preconstruction videotapes.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain **[fire watch and]** portable fire-suppression devices during flame-cutting operations.
 4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 5. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

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

END OF SECTION 024119

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- 3.15. EQUIPMENT BY OTHERS
- 3.16. PHASING
- 3.17. OUTAGES

SECTION 230500 COMMON WORK RESULTS FOR HVAC

PART 1. GENERAL

1.1. SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all mechanical work.
- C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.
- D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange piping, ductwork, equipment, and other work generally as shown on the contract drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with *Submittals* specified below. The right is reserved to make reasonable changes in location of equipment, piping, and ductwork, up to the time of rough-in or fabrication.
- E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.
- F. Coordinate the work under Division 23 with the work of all other construction trades.
- G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the contract documents.

1.2. PERMITS AND FEES

- A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.
- B. Permits and fees shall comply with the Division 01, *General Requirements* of the specification.

1.3. EXAMINATION OF SITE

- A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for contractors' failure to do so.
- B. Examine and verify specific conditions described in individual specifications sections.
- C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.4. CONTRACTOR QUALIFICATION

- A. Any Contractor or Subcontractor performing work under Division 23 shall be fully qualified and acceptable to the Architect/Engineer and Owner. Submit the following evidence when requested:
 - 1. A list of not less than five comparable projects which the Contractor completed.
 - 2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.
 - 3. Local and/or State License, where required.
 - 4. Membership in trade or professional organizations where required.
- B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.
- C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.5. MATERIALS AND EQUIPMENT

- A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality.
- B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.
- C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.
- D. Substitution will not be permitted for specified items of material or equipment where noted.
- E. All items of equipment furnished shall have a service record of at least five (5) years.

1.6. FIRE SAFE MATERIALS

- A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA and ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.7. REFERENCED STANDARDS, CODES AND SPECIFICATIONS

**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

- A. Specifications, Codes and Standards listed below are included as part of this specification, latest edition.
- B. AABC - Associated Air Balance Council
- C. ACCA - Air Conditioning Contractors of America
- D. AIHA - American Industrial Hygiene Association
- E. ASA - Acoustical Society of America
- F. ADC - Air Diffusion Council
- G. AMCA - Air Movement and Control Association
- H. ANSI - American National Standards Institute
- I. ARI - Air Conditioning and Refrigeration Institute
- J. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
- K. ASME - American Society of Mechanical Engineers
- L. ASPE - American Society of Plumbing Engineers
- M. ASTM - American Society for Testing and Materials
- N. AWWA - American Water Works Association
- O. CS - Commercial Standard
- P. CSA - Canadian Standards Association
- Q. CSD - Control and Safety Devices
- R. DNREC- Delaware Department of Natural Resources
- S. EPA - Environmental Protection Agency
- T. FDA - Food and Drug Administration
- U. FM - Factory Mutual
- V. IBC - International Building Code
- W. IEEE - Institute of Electrical and Electronics Engineers
- X. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry
- Y. NEC - National Electrical Code
- Z. NEMA - National Electrical Manufacturers Association
- AA. NFPA - National Fire Protection Association
- BB. NSF - National Sanitation Foundation
- CC. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
- DD. TEMA - Tubular Exchanger Manufacturers Association
- EE. UL - Underwriters' Laboratories
- FF. All mechanical equipment and materials shall comply with the codes and standards listed in the latest edition of ASHRAE HVAC Applications Handbook, Chapter entitled *Codes and Standards*.

1.8. SUBMITTALS, REVIEW AND ACCEPTANCE

- A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect to be in best interest of Owner.
- B. After acceptance of Material and Equipment List, submit three (3) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.
- C. Thoroughly review and stamp all submittals to indicate compliance with contract

requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

- D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.
- E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.
- F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.
- G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.
- H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

1.9. SHOP DRAWINGS

- A. Prepare and submit shop drawings for all mechanical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.
- B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.
- C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

D. Items and Systems

Access Doors/Panels including layouts and locations
Air Distribution Systems
Drip Pans
Duct Materials
Equipment Rails
Exterior Equipment/Duct Piping Supports
Exterior Pipe Roller Supports
Filters
Heat Pumps
Identification Systems

Material and Equipment Lists
Operations and Maintenance Manuals
Pipe Materials Including Itemized Schedules
Preliminary Testing and Balancing Reports
Roof Curbs
Split System Heat Pumps, Ductless
Test Certificates
Thermal Insulation Materials Include Table Summaries
Vibration Isolation Materials
Weatherproof Assembly Components
Wiring Diagrams, Flow Diagrams and Operating Instructions

- E. Contractor, additionally, shall submit for review any other shop drawings as required by the Architect. No item shall be delivered to the site, or installed, until the Contractor has received a submittal from the Engineer marked *Reviewed* or *Comments Noted*. After the proposed materials have been reviewed, no substitution will be permitted except where approved by the Architect.
- F. For any shop drawing requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

1.10. SUPERVISION AND COORDINATION

- A. Provide complete supervision, direction, scheduling, and coordination of all work under the Contract, including that of subcontractors.
- B. Coordinate rough-in of all work and installation of sleeves, anchors, and supports for piping, ductwork, equipment, and other work performed under Division 23.
- C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.
- D. Coordinate electrical work required under Division 23 with that under Division 26. Coordinate all work under Division 23 with work under all other Divisions.
- E. Supply services of an experienced (10 year minimum) and competent Project Manager to be in constant charge of work at site.
- F. Where a discrepancy exists within the specifications or drawings or between the specifications and drawings, the more stringent (or costly) requirement shall apply until clarification can be obtained from the Engineer. Failure to clarify such discrepancies with the Engineer will not relieve the Contractor of the responsibility of conforming to the requirements of the Contract.
- G. Failure of contractor to obtain a full and complete set of contract documents (either before or after bidding) will not relieve the contractor of the responsibility of complying with the intent of the contract documents.
- H. Coordinate installation of large equipment requiring positioning before closing in building.

1.11. CUTTING AND PATCHING

- A. Accomplish all cutting and patching necessary for the installation of work under Division

23. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.

- B. Do not cut structural members without approval from the Architect or Engineer.

1.12. PENETRATION OF WATERPROOF CONSTRUCTION

- A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, sleeves, flashings, fittings and caulking to make penetrations absolutely watertight.
- B. Where pipes penetrate roofs, flash pipe with Stoneman *Stormtite*, Pate or approved equal, roof flashing assemblies with skirt and caulked counter flashing sleeve.
- C. Furnish and install pitch pockets or weather tight curb assemblies where required.
- D. Furnish and install roof drains, curbs, vent assemblies, and duct sleeves specifically designed for application to the particular roof construction, and install in accordance with the manufacturer's instructions. The Contractor shall be responsible for sleeve sizes and locations. All roof penetrations shall be installed in accordance with manufacturer's instructions, the National Roofing Contractors Association, SMACNA, and as required by other divisions of these specifications.

1.13. CONCRETE AND MASONRY WORK

- A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 23. Perform work in accordance with requirements of other applicable Divisions of these specifications.
- B. Concrete shall test not less than 3,000 psi compressive strength after 28 days.
- C. Grout shall be non-shrink, high strength mortar, free of iron chlorides and suitable for use in contact with all metals, without caps or other protective finishes. Apply in accordance with manufacturer's instructions and standard grouting practices.

1.14. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

- A. Unless otherwise noted on the drawings, where existing mechanical work is removed, pipes, valves, ductwork, etc., shall be removed, including hangers, to a point below finished floors or behind finished walls and capped. Such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.
- B. Where work specified in Division 23 connects to existing equipment, piping, ductwork, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and to leave completed work in a finished and workmanlike condition.
- C. Where the work specified under Division 23, or under other Divisions, requires relocation of existing equipment, piping, ductwork, etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition. Where existing insulation is disturbed, replace

insulation where removed or damaged equal to existing, in type, thickness, density, finish and thermal resistance (R-value) value.

- D. Where the relocation of existing equipment is required for access or the installation of new equipment, the contractor shall temporarily remove and/or relocate and re-install as required to leave the existing and new work in a finished and workman like condition.

1.15. DEMOLITION

- A. Unless otherwise noted all existing equipment, piping, ductwork, etc., shall remain.
- B. Where existing equipment is indicated to be removed, all associated piping, conduit, power, controls, insulation, hangers, ductwork, supports and housekeeping pads, etc., patch, paint and repair walls/roof/floor to match existing and/or new finishes.
- C. Provide necessary piping, valves, traps, temporary feeds, drips, etc., as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time lengths of outages.
- D. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.
- E. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.
- F. The location of all existing equipment, piping, ductwork, etc., indicated is approximate only and shall be checked and verified. Install all new mechanical/plumbing/fire protection work to connect to or clear existing work as applicable.
- G. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.
- H. Make provisions and include in bid all costs associated with confined entry/space requirements and all other applicable OSHA regulations.
- I. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves.
- J. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirety.
- K. Existing piping, equipment, ductwork, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.
- L. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.
- M. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing refrigerants. Contractor shall include in his bid all cost associated with the evacuation, removal and disposal of all existing equipment containing refrigerants in accordance with EPA and Health Department requirements. Where existing split systems or ductless units are indicated to be relocated, extend

refrigeration piping, power, and control wiring to the same.

- N. Where piping and/or ductwork is removed, remove all pipe or ductwork hangers which were supporting the removed piping or ductwork. Patch the remaining penetration voids with like materials and paint to match existing construction.
- O. Before demolition begins, and in the presence of the Owners representative, test and note all deficiencies in all existing systems affected by demolition but not completely removed by demolition. Provide a copy of the list of system deficiencies to the Owner and the Engineer. Videotape existing conditions in each space prior to beginning demolition work.
- P. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.
- Q. All devices and equipment designated by the Owner to remain the property of the Owner shall be moved and stored by the Contractor at a location on site as designated by the Owner. It shall be the Contractor's responsibility to store all devices and equipment in a safe manner to prevent damage while stored.
- R. All existing equipment refused by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor in a timely manner and disposed of in a legal manner.
- S. Work Abandoned in Place: cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- T. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- U. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

1.16. DRIVE GUARDS

- A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.
- B. When available, guards shall be factory fabricated and furnished with the equipment. Otherwise fabricate guards of heavy gauge steel, rigidly braced, removable, and finish to match equipment served. Provide openings for tachometers. Guards shall meet local, State and O.S.H.A. requirements.

1.17. VIBRATION ISOLATION

- A. Furnish and install vibration isolators, flexible connections, supports, anchors and/or foundations required to prevent transmission of vibration from equipment, piping or ductwork to building structure. See Division 23 Section, *Vibration Control for HVAC, Plumbing and Fire Protection Equipment*.

1.18. FASTENERS/CAPS

- A. All fasteners located in public spaces including corridors, lobbies, toilet rooms, etc., shall be provided with tamper proof fasteners. Provide Pin Phillips hardware as manufactured by Challenge Industries or approved equal.

- B. For all exterior grade mounted equipment containing refrigerant install lockable caps on service valves to prevent tampering.

1.19. DEFINITIONS

- A. *Approve* - to permit use of material, equipment or methods conditional upon compliance with contract documents requirements.
- B. *Furnish and install or provide* means to supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.
- C. *Contractor* means the mechanical contractor and any of his subcontractors, vendors, suppliers, or fabricators.
- D. *Piping* includes pipe, all fittings, valves, hangers, insulation, identification, and other accessories relative to such piping.
- E. *Ductwork* includes duct material, fittings, hangers, insulation, sealant, identification and other accessories
- F. *Concealed* means hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction or in crawl space or attic.
- G. *Exposed* means not installed underground or *concealed* as defined above.
- H. *Invert Elevation* means the elevation of the inside bottom of pipe.
- I. *Finished Spaces*: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.
- J. *Review* - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.
- K. *SCR*: Silicon Controlled Rectifier: Solid state switching device to provide fast, infinitely variable proportional control.
- L. *ECM*: Electronically Commutating Motor.
- M. *Building Line*: Exterior wall of building.
- N. *Water to Wire Efficiency*: The energy applied to the water (in kW) divided by the power input (in kW) to the variable speed drive.

1.20. MINIMUM EFFICIENCY REQUIREMENTS

- A. All heating, ventilating, and air conditioning equipment shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.
- B. All piping, ductwork, and equipment insulation shall comply with ASHRAE Standard 90.1, latest edition.
- C. All service water/heating equipment shall be manufactured to provide the minimum

efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.

- D. All mechanical devices, controls, accessories, and components shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.

1.21. SYSTEM INTEGRATION

- A. For all HVAC equipment specified to be provided with packaged controls and interfaced with the automatic temperature control system, provide system integration between the equipment manufacturer and the automatic temperature control subcontractor.
- B. HVAC equipment submittals requiring system integration as defined above must identify all required system integration points.
- C. HVAC equipment manufacturers must coordinate with ATC subcontractor regarding system integration prior to submitting on the equipment.
- D. A system integration meeting must be arranged by the Mechanical Contractor and include, but not be limited to the systems integrator for the HVAC equipment manufacturer and the ATC Subcontractor. This portion of systems integration must occur prior to HVAC equipment being delivered to the project.
- E. Once the HVAC equipment is on site, a second systems integration meeting must be arranged by the Mechanical Contractor to coordinate the packaged controls with the ATC system. The HVAC equipment manufacturer's representative familiar with system integration and the ATC subcontractor familiar with programming must be present.
- F. A final system integrations meeting shall occur once all equipment is in place and ready for operation. The Mechanical Contractor, the HVAC equipment systems' integrator, and the ATC Subcontractor shall meet on site to jointly program, schedule, verify points, interlock devices, and fully set up all systems integration components.
- G. All systems integration coordination, programming, and graphics must be completed prior to requesting commissioning and/or inspections by the Engineer of Record.

PART 2. ELECTRICAL REQUIREMENTS

2.1. GENERAL MOTOR AND ELECTRICAL REQUIREMENTS

- A. Furnish and install control and interlock wiring for the equipment furnished. In general, power wiring and motor starting equipment will be provided under Division 26. Carefully review the contract documents to coordinate the electrical work under Division 23 with the work under Division 26. Where the electrical requirements of the equipment furnished differ from the provisions made under Division 26, make the necessary allowances under Division 23. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 23.
- B. All electrical work performed under Division 23 shall conform to the applicable requirements of Division 26 and conforming to the National Electric Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA & BOCA.
- C. Provide wiring diagrams with electrical characteristics and connection requirements.
- D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than five (5) horsepower.

- E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering. For extended outdoor storage, remove motors from equipment and store separately.
- F. All motors shall be furnished with 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 and efficiency.
- G. Motors located in exterior locations, wet air streams, air cooled condensers, and outdoors shall be totally enclosed weatherproof epoxy-treated type.
- H. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- I. Brake horsepower load requirement at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors.
- J. All single phase motors shall be provided with thermal protection: Internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature ratings of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

2.2. MOTORS AND CONTROLS

- A. Motors and controls shall conform to the latest requirements of IEEE, NEMA, NFPA-70 and shall be UL listed. Motor sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.
- B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG I.
- C. Motors shall be suitable for use under the conditions and with the equipment to which applied, and designed for operation on the electrical systems specified or indicated.
 - 1. Motor capacities shall be such that the horsepower rating and the rated full-load current will not be exceeded while operating under the specified operating conditions. Under no condition shall the motor current exceed that indicated on the nameplates.
 - 2. Motor sizes noted in the individual equipment specifications are minimum requirements only. It is the responsibility of the equipment manufacturers and of the Contractor to furnish motors, electrical circuits and equipment of ample capacity to operate the equipment without overloading, exceeding the rated full-load current, or overheating at full-load capacity under the most severe operating service of this equipment. Motors shall have sufficient torque to accelerate the total WR^2 of the driven equipment to operating speed.
 - 3. Motors shall be continuous duty type and shall operate quietly at all speeds and loads.
 - 4. Motors shall be designed for operation on 60 hertz power service. Unless

otherwise specified or shown, motors less than ½ horsepower shall be single phase, and motors ½ horsepower and larger shall be 3 phase unless otherwise noted.

- 5. Motors shall be mounted so that the motor can be removed without removing the entire driven unit.
- D. Single phase motors, smaller than 1/20 horsepower shall be ball or sleeve bearing; drip-proof, totally enclosed or explosion proof, as specified; 120 volts; permanent-split capacitor or shaded pole type. These motors shall not be used for general power purposes, and shall only be provided as built-in components of such mechanical equipment as fans, unit heaters, humidifiers and damper controllers. When approved by the Engineer, deviations from the specifications will be permitted as follows:
 - 1. Open motors may be installed as part of an assembly where enclosure within a cabinet provides protection against moisture.
 - 2. Motors used in conjunction with low voltage control systems may have a voltage rating less than 115 volts.
- E. Single phase motors, greater than 1/20 horsepower and less than ½ horsepower shall be ball bearing; drip-proof, totally enclosed or explosion proof, as specified, with Class A or B insulation, as standard with the motor manufacturer; 115 or 120/208/240 volts as required; capacitor start-induction run, permanent split capacitor, or repulsion start-induction run type with minimum efficiency of 70 percent and a minimum full load power of 77 percent.
- F. Except as otherwise specified in the various specification sections, 3 phase motors 60 horsepower and smaller shall be NEMA design B squirrel cage induction type meeting the requirements of this paragraph. Motors shall be drip-proof, totally enclosed or explosion proof, as specified or indicated. Insulation shall be Class B or F, at 40 degrees C ambient temperature. Drip-proof motors shall have a 1.15 service factor and totally enclosed and explosion proof motors shall have a service factor of 1.00 or higher. Motors specified for operation at 480, 240, and 208 volts shall be nameplated 460, 230, 200 volts, respectively. Efficiencies and percent power factor at full load for three phase motors shall be not less than the values listed below for premium efficiency motors:

MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
1HP and above to	85.5 percent	84 percent
1-½ HP	86.5 percent	85 percent

- G. Three phase motors ½ HP or greater shall be the Duty Master XE by Reliance Electric Company, Super-E Premium Efficiency of Baldor Motor and Drives, E-plus Efficient Standard Duty Motor of the Electric Motor Division of Gould, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corp., the equivalent product of General Electric, or approved equal.
- H. For motors serving equipment being controlled by a variable speed drive, motor shall be premium efficiency inverter duty rated.
- I. Motor frames shall be NEMA Standard T-Frames of steel, aluminum, or cast iron with

end brackets of cast-iron or aluminum with steel inserts.

- J. Control of each motor shall be manual or automatic as specified for each in the various mechanical sections. In general, and unless otherwise specified for a particular item in the various mechanical sections of the specifications, motor starters and controls shall be specified and provided under the various electrical sections of these specifications.

2.3. MOTOR INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors to support shaft regardless of shaft position.
- C. Check line voltage and phase and ensure agreement with nameplate. Check that proper thermal overloads have been installed prior to operating motors.
- D. Use adjustable motor mounting bases for belt-driven motors.
- E. Align pulleys and install belts.
- F. Tension belts according to manufacturer's written instructions.

2.4. WIRING DIAGRAMS

- A. The Contractor is responsible for obtaining and submitting wiring diagrams for all major items of equipment.
- B. Wiring diagrams shall be provided with shop drawings for all equipment requiring electric power.
- C. Provide wiring diagrams for all major mechanical items of equipment to electrical contractor and ATC subcontractor for coordination.

PART 3. EXECUTION

3.1. EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data. Portions of the work are shown only in diagrammatic form. Refer conflicts to Architect.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment giving right of way to piping installed at required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.2. SUPPORTS, HANGERS AND FOUNDATIONS

- A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.
- B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For un-insulated copper piping provide copper hanger to prevent contact of dissimilar metals. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

3.3. PROVISIONS FOR ACCESS

- A. The contractor shall provide access panels and doors for all concealed equipment, valves, strainers, dampers, filters, controls, control devices, cleanouts, damper operators, traps, and other devices requiring maintenance, service, adjustment, balancing or manual operation.
- B. Where access doors are necessary, furnish and install manufactured painted steel door assemblies consisting of hinged door, key locks, and frame designed for the particular wall or ceiling construction. Properly locate each door. Door sizes shall be a 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 24 inches x 24 inches for full body access where required. Review locations and sizes with Architect prior to fabrication. Mark each access door within finished spaces with a small color coded and numbered tab. Provide a chart or index for identification. Provide U.L. approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall be Milcor Metal Access Doors as manufactured by Inland-Ryerson, Mifab, or approved equal.
 - 1. Acoustical or Cement Plaster: Style B
 - 2. Hard Finish Plaster: Style K or L
 - 3. Masonry or Dry Wall: Style M
- C. Where access is by means of liftout ceiling tiles or panels, mark each ceiling grid using small color-coded and numbered tabs. Provide a chart or index for identification. Place markers within ceiling grid not on ceiling tiles.
- D. Access panels, doors, etc. described herein shall be furnished under the section of specifications providing the particular service and to be turned over to the pertinent trade for installation. Coordinate installation with installing contractor. All access doors shall be painted in baked enamel finish to match ceiling or wall finish.
- E. Access panels in security or detention areas shall be security type.
- F. Submit shop drawings indicating the proposed location of all access panels/doors. Access doors in finished spaces shall be coordinated with air devices, lighting and sprinklers to provide a neat and symmetrical appearance.

3.4. PAINTING AND FINISHES

- A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports,

hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.

- B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.
- C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.
- D. Protect all finishes and restore any finishes damaged as a result of work under Division 23 to their original condition.
- E. The preceding requirements apply to all work, whether exposed or concealed.
- F. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces. Do not paint manufacturer's labels or tags.

3.5. CLEANING OF SYSTEMS

- A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting fixtures, equipment, traps, strainers, and other accessory items. Blow out and flush piping until interior surfaces are free of foreign matter.
- B. Flush piping in re-circulating water systems to remove cutting oil, excess pipe joint compound, solder slag and other foreign materials. Do not use system pumps until after cleaning and flushing has been accomplished to the satisfaction of the Engineer. Employ chemical cleaners, including a non-foaming detergent, not harmful to system components. After cleaning operation, final flushing and refilling, the residual alkalinity shall not exceed 300 parts per million. Submit a certificate of completion to Engineer stating name of service company used.
- C. Maintain strainers and dirt pockets in clean condition.
- D. Clean fans, ductwork, enclosures, flues, registers, grilles, and diffusers at completion of work.
- E. Install filters of equal efficiency to those specified in permanent air systems operated for temporary heating during construction. Replace with clean filters as specified prior to acceptance and after cleaning of system.
- F. Pay for labor and materials required to locate and remove obstructions from systems that are clogged with construction refuse after acceptance. Replace and repair work disturbed during removal of obstructions.
- G. Leave systems clean, and in complete running order.

3.6. COLOR SELECTION

- A. Color of finishes shall be as selected by the Architect.
- B. Submit color of factory-finished equipment for acceptance prior to ordering.

3.7. PROTECTION OF WORK

- A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.

- B. Cover temporary openings in piping, ductwork, and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver pipes and tubes with factory applied end caps.
- C. Cover or otherwise protect all finishes.
- D. Replace damaged materials, devices, finishes and equipment.
- E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.8. OPERATION OF EQUIPMENT

- A. Clean all systems and equipment prior to initial operation for testing, balancing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.
- B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.
- C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing and balancing work. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.
- D. Do not use mechanical systems for temporary services or temporary conditioning during construction, unless approved by Owner in writing. Refer to Division 01 Section "Temporary Facilities and Controls" for temporary heating/cooling during construction.
- E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.9. IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

- A. Contractor shall submit for approval schematic piping diagrams of each piping system installed in the building. Diagrams shall indicate the location and the identification number of each valve in the particular system. Following approval by all authorities, the diagrams shall be framed, mounted under safety glass and hung in each Mechanical Room where directed. Contractor shall deliver the tracing or sepia from which the diagrams were reproduced to the Owner.
- B. All valves shall be plainly tagged. For any bypass valves, install sign indicating valve position as "Normally Open" or "Normally Closed" as required.
- C. All items of equipment, including motor starters, disconnects and ATC panels shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal).
- D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the *Record and*

Information Booklet as hereinafter specified.

- E. All lines piping and ductwork installed under this contract shall be stenciled with *direction of flow* arrows and with stenciled letters naming each pipe and ductwork and service. Refer to Division 23 Section, *HVAC Piping, Fittings, Valves, Etc.* and Division 23 Section, *HVAC Air Distribution*. Color-code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.
- F. Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit samples of equipment identification cards, piping labels, ductwork labels, and valve tags to Engineer for review prior to installation.
- G. Contractor shall demonstrate Sequences of Operation of all equipment in presence of Owner's representative, Engineer, and ATC subcontractor.

3.10. WALL AND FLOOR PENETRATION

- A. All penetrations of partitions, ceilings, roofs and floors by ducts, piping or conduit under Division 23 shall be sleeved, sealed, and caulked airtight for sound and air transfer control. Penetrations of mechanical room partitions, ceilings, and floors shall be as specified in Division 23 Section, *Vibration Control for HVAC, Plumbing and Fire Protection Equipment*.
- B. All penetration of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 07 Section, *Fire Protection, HVAC & Plumbing Penetration Firestopping*.
- C. Where piping extends through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these specifications.
- D. Provide pipe escutcheons and duct flanges for sleeved pipes and ducts in finished areas.
- E. Piping sleeves:
 - 1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.
 - 2. Twenty-two (22) gauge galvanized steel elsewhere.
- F. Ductwork sleeves: 20 gauge galvanized steel.

3.11. WARRANTY

- A. Contractor's attention is directed to warranty obligations contained in the GENERAL CONDITIONS.
- B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of equipment manufacturer's warranties shall be included in the operations and maintenance manuals.
- C. The Contractor guarantees for a one year period from the time of final acceptance by the Owner.

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.
2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.
3. That the contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The contractor shall also make good all damages caused to their work or materials in the process of complying with this section.
4. That the entire work shall be water-tight and leak-proof.

3.12. LUBRICATION

- A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Record and Information Booklet.
- B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

3.13. OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractor shall have prepared three (3) copies of the Record and Information Booklet and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.
- B. The booklet shall be bound in a three-ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: *Operations and Maintenance Manuals – Delaware New Castle County Detention Center Six Heat Pump Replacements and Kitchen Dry Storage - HVAC*. No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out. Provide divider tabs and table of contents for organizing and separating information.
- C. Provide the following data in the booklet:
 1. As first entry, an approved letter indicating the starting/ending time of Contractor's warranty period.
 2. Maintenance operation and lubrication instructions on each piece of equipment furnished.
 3. Complete catalog data on each piece of heating and air conditioning equipment furnished including approved shop drawing.
 4. Manufacturer's extended limited warranties on equipment including but not limited to air conditioning compressors, heat pumps.
 5. Chart form indicating frequency and type of routine maintenance for all mechanical equipment. The chart shall also indicate model number of equipment, location and service.
 6. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
 7. Provide supplier and subcontractor's names, address, and phone number.

8. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.
 9. Provide and install in locations as directed by the Owner, valve charts including valve tag number, valve type, valve model number, valve manufacturer, style, service and location. Each valve chart shall be enclosed in a durable polymer based frame with a cover safety glass.
 10. Copy of the approved balancing report including duct leakage data.
 11. ATC systems including as-built ATC drawings of systems including internal of all panels.
 12. Access panel charts with index illustrating the location and purpose of access panels.
 13. Approved Health and Electrical Certificates.
 14. Start-up reports for equipment.
 15. Water treatment test reports.
 16. Provide and install in locations as directed by Owner, filter charts, including filter type, size, model number, manufacturer, quantity and size for each filter utilized on the project. Filter charts shall be enclosed in a durable polymer based frame with a cover safety glass.
 17. Insert color graphic with embedded parameters for ATC system into record and information booklet.
 18. Filter charts indicating equipment served, size, and type of filter required.
- D. Submit Record and Information Booklets prior to anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Record and Information booklets be reviewed and approved.

3.14. PIPING SYSTEMS TESTING

- A. The entire new HVAC piping systems shall be tested hydrostatically before insulation covering is applied and proven tight under the following gauge pressures for a duration of four (4) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Condenser Water Supply & Return Piping	100 psi
Refrigerant Piping	400 psig with Nitrogen

- B. Ductwork pressure testing shall be as specified in another division of these specifications.
- C. Testing and acceptance thereof shall be in accordance with local requirements and shall meet approval of authority having jurisdiction. Submit certificates and approved permits and insert one (1) copy in the *Operations and Maintenance Manuals*.
- D. Refrigerant piping shall be tested utilizing nitrogen per equipment manufacturer's requirements.

3.15. EQUIPMENT BY OTHERS

- A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.
- B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections. Failure to do so will not relieve this contractor of any

responsibility for improper equipment operation.

3.16. PHASING

- A. Refer to Architectural Specifications and contract drawings for any required phasing.
- B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities having jurisdiction.
- C. Provide dust barriers/partitions, penetration closures, etc, to ensure safety of building occupants and protection of existing surroundings.
- D. The Building shall remain watertight at all times.
- E. Refer to phasing plans for additional requirements.
- F. Provide necessary piping, valves, steam traps, drips, piping, conduit, controllers, ATC wiring, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Provide steam traps, drips, valves, etc., to maintain existing steam system in operation until all equipment is connected to the hot water system. Temporarily feed new systems with existing system where required or shown on contract drawings.
- G. At completion of the first phase the ATC System shall be sufficiently complete to turn over HVAC equipment. All wiring, testing, programming, graphics, and ATC computer shall be completed and operational for all equipment in each phase prior to Owner taking ownership of the same.
- H. Within thirty days of Award of Contract, the Contractor shall submit a minimum of six (6) copies of the proposed Phasing Plan (Drawings and detailed written description) to the Architect for review and approval based on the general and specific requirements indicated on the Drawings and Specifications. The phasing plan shall reflect the work of all trades. The phasing plan shall be updated as often as needed (i.e. major deviations and/or modified sequence of events) and reviewed during each progress meeting so the facility and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.
- I. Due to phased construction, some systems must be operated at part load conditions until later phases are completed.
- J. While work is in progress, except for designated short intervals during which connections are made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

3.17. OUTAGES

- A. Provide a minimum of fourteen (14) days notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.
- B. Submit *Outage Request form*, attached at end of his Section, to Owner for approval.

END OF SECTION

CANNOT BE USED FOR BIDDING

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE: _____

END OUTAGE -- TIME: _____ DATE: _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____
(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ___ NO ___ BY: _____ DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER : _____

OWNER'S PRESENCE REQUIRED: _____

YES: ___ NO: ___ NAME: _____

POINT OF CONTACT: _____ PHONE: _____

**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

**DIVISION 23 SECTION 230505
HVAC PIPING, FITTINGS AND VALVES
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SECTION 230505 - HVAC PIPING, FITTINGS AND VALVES

PART 1. GENERAL

1.1. SUMMARY

- A. The conditions of the contract and other general requirements apply to the work specified in

this section. All work under this section shall also be subject to the requirements of Division 23 Section, *Common Work Results for HVAC* and Division 01, *General Requirements*.

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

1.2. SYSTEM DESCRIPTION CONDITIONS

- A. Provide all labor and materials necessary to furnish and install all piping systems on this project as herein specified and/or shown on the drawings. Final connections to equipment furnished in other sections of the specifications shall be included under this section.
- B. All piping and insulation installed in ceiling plenums must be plenum rated and comply with NFPA and International Building Code (IBC).
- C. 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.
- D. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- E. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- F. Provide pipe hangers and supports in accordance with ASTM B31.9 and MSS SP69 unless indicated otherwise.
- G. Use spring loaded "silent" check valves on discharge of all pumps.
- H. Use 3/4 inch (20 mm) ball valves with cap and chain for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
- I. At all runout piping serving equipment, use swing joints with elbows to prevent excessive movement of piping due to expansion.

1.3. QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulation. Provide certificate of compliance from authority having jurisdiction indicating approval of welders.
- C. Welders Certification: In accordance with ASME Section 9.
- D. Maintain one copy of each document on site.

1.4. DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under as hereinbefore specified.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed systems.

1.5. ENVIRONMENTAL REQUIREMENTS

- A. Do not install underground piping when bedding is wet or frozen.

1.6. EXTRA MATERIALS

- A. Provide one (1) repacking kit for each size valve.

PART 2. PRODUCTS

2.1. PIPE MATERIALS

- A. All materials, unless otherwise specified, shall be new and of the best quality of their respective kinds, and shall conform to the requirements and ordinances of local, state and insurance authorities having jurisdiction.

1. Condenser Water Piping (Inside of Building):

- a). Pipe: Schedule 40 Black steel pipe, ASTM A53
inch and smaller - Type F, ASTM A53 steel (CW) with threaded joints

2 inch and larger - Grade B, Type E, ASTM A53 steel (ERW) with welded,
flanged or grooved joints.
- b). Fittings & Joints: 2-1/2 inches & larger, schedule 40 wrought steel ASTM
Std. B16.9 long radius welding; 2 inches & smaller 125 lb. std. cast iron
screwed, ASTM Standard B16.4. Joints shall be threaded or AWS D1.1
welded. Victaulic or approved equal grooved joints shall be acceptable.
- c). Flanges: Wrought steel Class 150 welding neck. ASTM Standard B16.5.
- d). Groove: MI or ductile iron. Rolled form grooves only. Cut grooves are
prohibited.
- e). Gate Valves: 2-1/2 inches & larger - IBBM, 150 lb. OS&Y flanged; 2 inches
& smaller - 150 lb. Bronze body bronze trim.
- f). Ball Valves: Shut-off valves 2 inches and smaller shall be ball valves. Ball
valves shall be 150 lbs, bronze body, standard port, 2 piece body, TFE
seats with bronze trim. Ball valves shall be threaded end or solder end as
required to accommodate piping. Ball valves shall be as manufactured by
Conbraco, Crane, Apollo, Nibco, Watts or approved equal.
- g). Balancing Valves: DeZurik Series 100, Fig. 118 or approved equal, cast
iron construction, stainless steel bearings, nickel seats (3 inches and larger)
non-lubricated, eccentric plug with chlorobutyl rubber or Bunz-N resilient
faced plugs suitable for 250 degrees F, semi-steel screwed with fig. 159,
removable lever and open. nut for valves 3 inches and smaller. For valves

4-inch and larger, provide gear operators and flanged connections. Provide chain operated valves for sizes 4-inches and larger located 10 feet-0 inches or more above finished floor. Chains shall extend to within 6 inch-0 inches above finished floor. All valves shall have adjustable memory stop. Chain wheel and guide shall be galvanized.

- h). Extended Valve Stems: Provide and install round collar type extended valve stems on all valves installed in insulated piping. Valve stem and collar shall be selected to suit insulation thickness and maintain valve handles outside of insulation.

2. Refrigeration Piping:

- a). Tube Size $\frac{3}{4}$ -inch & Smaller:

ASTM B280, copper tube; Type ACR, soft annealed temper fittings; cast copper-alloy fittings for flared copper tubes; flared joints. Fittings shall be ASME B16.22, wrought copper. Joints shall be bronzed, AWS A5.8, BCUP silver/phosphorous/copper alloy with melting range 1190 to 1480 degrees F.

- b). Tube Size $\frac{7}{8}$ inch through 4-1/8inches:

Copper tube, Type ACR, soft annealed temper; wrought-copper, solder-joint fittings; solder joints.

- c). Soldered Joints: Solder joints using silver-lead solder, ASTM B 32, Grade 96 TS.

- d). Brazed Joints: Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal.

- e). Flexible connectors: 500-psig (3450-kPa) minimum operating pressure; stainless-steel core and high-tensile stainless-steel-braid covering; dehydrated, pressure tested, minimum 7 inches (180 mm) long.

- f). Diaphragm Packless Valves:

500-psig (3450-kPa) working pressure and 275 degrees Fahrenheit (135 degrees C) working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.

- g). Packed-Angle Valves: 500-psig (3450-kPa) working pressure and 275 degrees Fahrenheit (135 degrees C) working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.

- h). Check Valves: Smaller Than NPS 1 (DN 25): 400-psig (2760-kPa) operating pressure and 285 degrees Fahrenheit (141 deg Celsius) operating temperature; cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve shall be straight-through pattern, with solder-end connections.

- i). Check Valves: NPS 1 (DN 25) and Larger: 400-psig (2760-kPa) operating pressure and 285 degrees Fahrenheit (141 deg Celsius) operating

temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.

- j). Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.
- k). Solenoid Valves: Comply with ARI 760; 250 deg Fahrenheit (121 deg Celsius) temperature rating and 400-psig (2760-kPa) working pressure; forged brass, with polytetrafluoroethylene valve seat, 2-way, straight-through pattern, and solder-end connections; manual operator; fitted with suitable NEMA 250 enclosure of type required by location, with 1/2-inch (16-GRC) conduit adapter and 24-V, normally closed holding coil.
- l). Pressure-Regulating Valves:

Comply with ARI 770; pilot operated, forged brass or cast bronze, stainless-steel bottom spring, pressure-gage tapings, 24-V dc standard coil, and wrought-copper fittings for solder-end connections; suitable for refrigerant specified.
- m). Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.

3. Cooling Coil A/C Condensate Drain Piping:

- a). Pipe & Fittings: All A/C condensate drain piping shall be constructed of Type L copper tubing, with sweat fittings made with 95-5 solder. Washout plugs (cleanouts) shall be strategically located to allow periodic flush out of system. At a minimum, provide washout plugs at equipment connections and at direction changes of 90 degrees F or greater.
- B. Steel pipe shall be similar and equal to National Tube Company, Grinnell, Republic, or Bethlehem black or zinc-coated (galvanized) as hereinafter specified. Pipe shall be free from all defects which may affect the durability for the intended use. Each length of pipe shall be stamped with the manufacturer's name.
- C. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.

2.2. PIPE HANGERS, ROLLER SUPPORTS, ANCHORS, GUIDES, AND SADDLES

- A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260 for pipe 3/4-inch and larger, and Figure 65 for pipe 2-inches and smaller, or approved equal. Adjustable pipe stanchion with U-bolt shall be Grinnell Company's Figure 191. Pipe roller supports shall be Grinnell's Figure 181 or Figure 271. Exterior pipe hangers shall be galvanized or stainless steel construction. For copper piping in direct contact with the hanger, hanger construction shall be copper coated to prevent contact of dissimilar metals similar to Grinnell's Figure CT-65. Hanger spacing and rod sizes for steel and copper pipe shall not be less than the following:

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
3/4 & 1	6	5	3/8
1 - 1/2	6	8	3/8
2	8	8	3/8
2 - 1/2	10	9	1/2

- B. Anchors, guides, and roller supports shall be installed in accordance with the contract drawings and manufacturer's recommendations to provide pipe support and control pipe movement for all piping systems. Anchors and guides shall be securely attached to the pipe support structure. Submit shop drawing for proposed pipe support structure for guides and anchors for approval of the Structural Engineer. Pipe alignment guides shall be Fig. 255 Grinnell, or as approved equal. Guides shall be sized to accommodate the pipe with insulation. Guides shall be steel factory, fabricated, with bolted two section outer cylinder and base for alignment of piping and two section guiding spider for bolting to pipe.
- C. Hangers for pipe sizes 1/2 to 1 1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
- D. Hangers for cold pipe sizes 2 inches (50 mm) and over: Carbon steel, adjustable, clevis.
- E. Hangers for cold pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
- F. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.
- G. Vertical Support: Steel riser clamp.
- H. Copper pipe support: Carbon steel ring, adjustable, copper plated.
- I. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- J. 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.

2.3. VALVES

- A. Provide parts list and assembly drawings (exploded view) for all valves in shop drawing submittals. Provide valves of the same type by the same manufacturer.

2.4. UNIONS, FLANGES, AND COUPLINGS

- A. Unions in steel pipe 2-inches and smaller shall be malleable iron with brass inserted seats designed for a working pressure of 150 psig.
- B. Unions in copper pipe 2-inches and smaller shall be sweat fittings with bronze seats designed for a working pressure of 125 psig.

2.5. PIPING SPECIALTIES

- A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of connections to heat pumps, all vibrating equipment, and elsewhere as shown. Pump flexible connections shall be utilized at pumps and hose kits at heat pumps. Refer to Division 23 Section, *Vibration Controls for HVAC, Plumbing and Fire Protection Equipment* for specifications.

2.6. ESCUTCHEONS

- A. Provide chromium plated escutcheons properly fitted and secured with set screws on all exposed piping which passes through walls, floors or ceilings of finished spaces.
- B. All escutcheon plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface. Plastic escutcheon plates will not be accepted.

2.7. DIELECTRIC CONNECTIONS:

- A. Furnish and install electrically insulated dielectric unions or flanges, as manufactured by EPCO Sales, Inc., at the following locations:
 - 1. Where steel piping systems join copper piping.
 - 2. Where copper tube connects to domestic water storage tanks, water heaters, heat exchangers, expansion tanks, and other steel vessels.
 - 3. Avoid the installation of steel nipples, cast iron or steel valves and specialties, or other ferrous components in predominately copper piping systems. Where such installation is necessary, isolate the component with dielectric connections. Do not mix steel pipe and copper tube in the same run of pipe or in the same section of a piping system.

2.8. SLEEVES

- A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, roof structure members or other building parts. Sleeves shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.
- B. Sleeves through floors shall be flush with the floor except for sleeves passing through Equipment Rooms which shall extend 3/4-inch above the floor. Refer to Division 23 Section, *Vibration Controls for HVAC, Plumbing and Fire Protection Equipment* for mechanical equipment room penetrations additional requirements. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves. Each trade shall be responsible for drilling existing floors and walls for necessary sleeve holes. Drilling methods and tools shall be as hereinbefore specified.
- C. Sleeves through walls and floors shall be sealed with a waterproof caulking compound.
- D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

2.9. WATER PROOF PIPE PENETRATION SEALS

- A. Provide and install waterproof pipe penetration seals at all pipes that enter the building below grade or through exterior wall.

- B. Link seals are to be Metraflex Metraseals, Model MS, Linkseal, or approved equal, black EPDM seal material, glass reinforced plastic pressure plates, zinc plated nuts and bolts, seals are to be resistant to sunlight and ozone, pressure rated to make a hydrostatic seal of up to 20 psig and up to 40 feet of head, temperature rated from -40 degrees F to 250 degrees Fahrenheit.

2.10. TRANSITION FITTINGS

A. General Requirements:

- 1. Same size as pipes to be joined.
- 2. Pressure rating at least equal to pipes to be joined.
- 3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Plastic-to-Metal Transition Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a). Charlotte Pipe and Foundry Company.
 - b). Harvel Plastics, Inc.
 - c). Spears Manufacturing Company.
- 2. Description: PVC or CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.

D. Plastic-to-Metal Transition Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a). Colonial Engineering, Inc.
 - b). NIBCO INC.
 - c). Spears Manufacturing Company.
- 2. Description: PVC or CPVC four-part union. Include brass threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

PART 3. EXECUTION

3.1. GENERAL PIPING INSTALLATION REQUIREMENTS

- A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All horizontal mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building

and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment on devices not to block access to doors, windows, manholes, or other access openings. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment, coils, etc., and installed so that there will be no interference with the installation of the equipment, ducts, etc. All valves and specialties shall be placed to permit easy operation and access and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be installed so as to avoid air or liquid pockets throughout the work. Ends of pipe shall be reamed so as to remove all burrs.

- B. All piping shall be graded to convey entrained air to high points where automatic air vents shall be provided. The size of supply and return pipes for each piece of equipment shall in no case be smaller than the outlets in the equipment.
- C. All piping shall be run to provide a minimum clearance of 2-inches between finished covering on such piping and all adjacent work. Group piping wherever practical at common elevations.
- D. All valves, strainers, caps, and other fittings shall be readily accessible.
- E. All branches from water mains shall be taken from the top of the supply mains at an angle of forty-five (45) degrees above the horizontal, unless otherwise directed. Branches feeding down shall be taken from the side or bottom of the main on water mains only. All connections shall be carefully made to insure unrestricted circulation, eliminate air pockets or trapped condensate, and permit the complete drainage of the system.
- F. Cutoff valves shall be provided on each branch line from the mains on all heating/air conditioning lines.
- G. Shut-off valves shall be installed at the inlet and outlet of each coil and piece of equipment to permit isolation for maintenance and repair. Units having multiple coils shall have separate valves for each coil.
- H. Unions shall be installed on all bypasses, ahead of all traps, at all connections to equipment, where shown on drawings or where required to facilitate removal of equipment whether shown or not.
- I. Spring clamp plates (escutcheons) shall be provided where pipes are exposed in the building and run through walls, floors, or ceilings. Plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface.
- J. If the size of any piping is not clearly evident in the drawings, the Contractor shall request instructions for the Engineer as to the proper sizing. Any changes resulting from the Contractor's failure to request clarification shall be at his expense. Where pipe size discrepancies or conflicts exist in the drawings, the larger pipe size shall govern.
- K. Install all valves with stem upright or horizontal, not inverted.
- L. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.
- M. Provide clearance for installation of insulation and access to valves and fittings.
- N. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

- O. All water containing pipes shall be routed clear of combustion air dampers and louvers to prevent freezing condition when dampers are open.
- P. Provide manual air vents at top of piping systems.

3.2. VALVE INSTALLATION REQUIREMENTS

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.
- G. Install valves as indicated, according to manufacturer's written instructions.
- H. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- I. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- J. Locate valves for easy access and provide separate support where necessary.
- K. Install valves in horizontal piping with stem at or above the center of the pipe.
- L. Install valves in a position to allow full stem movement.
- M. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.
- N. Install flow control valves with clearances from center line of valve to ceiling to allow servicing as required by manufacturer.

3.6. REFRIGERANT PIPING AND ACCESSORIES INSTALLATION REQUIREMENTS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.

- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed below ground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section, "Common Work Results for HVAC".
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section, "Common Work Results for HVAC".

- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section, "Common Work Results for HVAC".
- U. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6m) long.
 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- V. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
1. NPS ½ (DN 15): Maximum span, 60 inches (1500mm); minimum rod size, ¼ inch (6.4mm).
 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500mm); minimum rod size, ¼ inch (6.4mm).
 3. NPS 1 (DN 25): Maximum span, 72 inches (1800mm); minimum rod size, ¼ inch (6.4mm).
- W. Furnish and install complete refrigerant piping systems between the indoor units and outdoor units. Support piping in accordance with Division 23 Section, *HVAC Piping, Fittings, Valves, Etc.* Piping shall be sized as recommended by unit manufacturer taking into account length of vertical and horizontal runs, and refrigerant type. Provide and install dual sets of refrigerant piping on all units required to have dual independent circuits.
- X. Furnish and install all required piping accessories including, but not limited to, thermal expansion valves, Sporlan, or approved equal; Packless isolation valves at condenser and evaporator coil, Henry or approved equal, charging valve with chained seal cap, Henry or approved equal, sight glasses, Henry or approved equal; filter dryer with replaceable cartridge, sporland, or approved equal, liquid line solenoid valve I20V/1/60 Hz., Sporlan, or approved equal. Contractor shall provide traps and double suction risers if required by equipment manufacturer. Pitch piping for proper oil return. Submit shop drawings on all components, and piping arrangements.
- Y. All accessories shall be ARI rated. Furnish required nitrogen and refrigerant to fully test and charge system. Flood piping system with nitrogen when brazing.
- Z. Refrigerant piping shall be Type 1 hard temper (ACR) copper tubing with wrought copper colder fittings. Make joints with silver solder and non-corrosive flux.
- AA. Refrigerant piping shall be cleaned, dehydrated and evacuated. Piping shall be evacuated and held to less than 2.5 mm Hg vacuum for a period of not less than 12 hours without appreciable pressure rise. Vacuum shall then be broken with refrigerant or dry nitrogen and re-evacuated to 2.5 mm Hg vacuum for an additional 12 hours. Piping test to be witnessed by Owner's representative and documented in writing. Submit results of tests to Architect/Engineer.

- BB. All refrigerant/suction lines sets shall be fully insulated. Exterior pipe insulation shall be fully jacketed as specified in Division 23 Section, *HVAC Insulation*.
- CC. Follow ASHRAE 15, latest edition procedures for charging and purging of systems and for disposal of refrigerant.
- DD. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- EE. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- FF. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- GG. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- HH. Fully charge completed system with refrigerant after tested.
- II. Provide electrical connection to solenoid valves.
- JJ. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.
- KK. Install strainers in main liquid line where multiple expansion valves with integral strainers are used.
- LL. Install strainers in suction line of steel pipe.
- MM. Install moisture-liquid indicators in liquid lines between filter-driers and thermostatic expansion valves and in liquid line to receiver.
- NN. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.
- OO. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
1. Test refrigerant piping, specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
 2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
 - a). System shall maintain test pressure at the manifold gage throughout duration of test.
 - b). Test joints and fittings by brushing a small amount of soap and glycerin solution over joint.
 - c). Fill system with nitrogen to raise a test pressure of 150 psig (1035 kPa) or higher as required by authorities having jurisdiction.
 - d). Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- PP. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- QQ. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating

suction pressure.

- RR. Adjust set-point temperature of the conditioned air or chilled-water controllers to the system design temperature.
- SS. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Check compressor oil level above center of sight glass.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves, except bypass valves that are used for other purposes.
 - 5. Check compressor-motor alignment, and lubricate motors and bearings.
- TT. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.
- UU. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.
- VV. Charge system using the following procedures:
 - 1. Install core in filter-dryer after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 - 4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

3.7. PIPE JOINTS INSTALLATION REQUIREMENTS

- A. **Welded Joints:** Joints in piping 2-1/2-inches and larger shall be fusion welded. Welding shall be in accordance with recommendations of the American Welding Society. Welding fittings shall conform in physical and chemical properties to the latest revisions of the American Society for Testing Materials.
- B. Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9 as applicable, for shop and project site welding of piping work. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB). Submit welders qualifications for approval.
- C. **Screwed Joints:** All screwed joints shall be made with tapered threads properly cut. Screwed joints shall be made perfectly tight with a stiff mixture of graphite and oil, applied with a brush to the male threads on the fittings.
- D. **Soldered Joints and Copper Piping:** Joints in copper piping shall conform to the following

minimum standards.

1. The pipes shall be cut to a length making certain that the ends are square, using a fins hacksaw blade or tube cutter. The ends of all pipes shall be reamed and all burrs removed.
 2. The outside end of the pipe and the cut end of the fitting shall be cleaned with steel wool, sand cloth, or steel wire brush. All dark spots shall be removed.
 3. The flux shall be applied evenly and sparingly to the outside end of the pipe and the inside of the outer end of the fitting until all surfaces to be jointed are completely covered. The piping and fitting shall be slipped together and reworked several times to insure an even distribution of the flux.
 4. The correct amount of solder per joint for each size pipe shall be used in accordance with the manufacturer's recommendations.
 5. Solder joints shall be made by using a direct flame from a torch.
 6. On pipe sizes larger than ¼-inch, the fittings and valves in the pipe shall be moved or tapped with a hammer when the solder starts to melt to insure an even distribution of the solder.
 7. The excess solder shall be removed while it is still in the plastic state leaving a fillet around the cup of the fitting.
 8. Solder joints shall be suitable for working pressure of 100 psig and for working temperature of not less than 250 degrees F. The type of solder and flux used will be submitted for approval. Type 95-5 shall be the minimum standard.
 9. Lead and antimony-based solders shall not be used for potable water systems. Brazing and silver solders are acceptable.
- E. Where copper piping joins steel piping, approved bronze adapters shall be used.
- F. Prohibited Connections: No direct weld, soldered, or brazed connections, without unions or flanges, shall be made to valves, strainers, apparatus, or related equipment. Right and left couplings, long threads, or caulking of pipe threads or gasket joints will not be permitted.
- 3.8. HANGERS , SUPPORTS, ANCHORS, GUIDES INSTALLATION REQUIREMENTS
- A. General: All hangers shall be of an approved type arranged to maintain the required grading and pitching of lines to prevent vibration and to provide for expansion and contraction. Provide protection saddles between hangers and insulation on heating water insulated pipe. Saddles shall be Grinnells Figure 173/273 or approved equal. Provide approved spacers between saddles and pipe where flexible insulation is specified. Provide insulation protection shields for insulated piping without saddles. Shield shall be Grinnell Figure 167 or as approved equal.
 - B. Spacing: Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping. For cast iron soil pipe, one hanger shall be placed at each hub or bell.
 - C. Vertical Lines: Shall be supported at their bases, using either a suitable hanger placed in a

horizontal line near the riser, or a base type fitting set on a pedestal, foundation or support. All vertical lines extending through more than one floor level shall be supported at each floor with a riser clamp. Riser clamp shall be Grinnell Co.'s Figure 261, or approved equal. All vertical drops to pump suction elbows shall be supported by floor posts.

- D. Racks and Brackets: All horizontal piping on vertical walls shall be properly supported by suitable racks securely anchored into the wall construction. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction. Washer plates (Fib. 60, 60L) and other miscellaneous attachments, fasteners, etc., shall be Grinnell or as approved equal. All exterior hanger and bracket systems in their entirety shall be galvanized.
- E. Pipe Hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer.
- F. Select hangers and components for loads imposed. Secure rods with double nuts.
- G. Support of horizontal piping shall allow for vertical adjustment after installation of piping.
- H. Support overhead piping with clevis hangers.
- I. Do not support all parallel piping from the same joist. Stagger all supports in accordance with the structural engineer's recommendations.
- J. Install guides on piping adjoining expansion fittings and loops.
- K. Attach guides to pipe and secure to building structure.
- L. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- M. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.
- N. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.
- O. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.
- P. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.
- Q. Refer to structural documents for appropriate connection/attachment materials to building.

3.9. PIPING IDENTIFICATION INSTALLATION

- A. All piping shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color code and system identification shall comply with ANSI Standards and piping identification system shall comply with ASME A13.1-81., scheme for the identification of piping systems and ASHRAE Fundamentals Handbook, latest edition.
- B. Markings shall be plain block letters, stenciled on pipes, and shall be located near each branch connection, near each valve, and at least every 10 feet on straight runs of pipe.

Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such manner as to be easily legible from the floor. Pipe identification schedule shall be as follows:

OUTSIDE DIAMETER OF PIPE OR COVERING (INCHES)	LENGTH OF COLOR FIELD (INCHES)	SIZE OF LETTERS (INCHES)
½ to 1 ¼	8	½
1-½ to 2	8	¾

3.10. CLEANING PIPING AND EQUIPMENT

- A. All condensate, condenser water systems shall be cleaned by filling with a solution of one (1) pound of trisodium phosphate to each 50 gallons of water and circulating this solution for a period of six (6) hours during which time the system shall reach operating temperature. The systems shall then be flushed with fresh water and refilled with fresh water and/or where indicated antifreeze solution and purged of all air.
- B. All condensate, condenser water, piping system shall be flushed clean with fresh water. See Division 22 Sections, *Plumbing Fixtures* and *Plumbing Equipment* for domestic potable water cleaning and sterilization.
- C. Any equipment, such as coils that have small tubing, shall be bypassed to prevent deposition of debris from the piping. Water balancing shall not be scheduled until the completion of the cleaning and treatment process.

END OF SECTION

DIVISION 23 SECTION 230548
VIBRATION CONTROLS FOR HVAC EQUIPMENT

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**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

**SECTION 230548 - VIBRATION CONTROLS FOR HVAC, PLUMBING AND FIRE PROTECTION
EQUIPMENT**

PART 1 RELATED DOCUMENTS

1.1 GENERAL

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to work of this section.
- B. All work under this section shall also be subject to the requirements of Division 23 Section, *Common Work Results for HVAC*.

1.2 SUMMARY

- A. Provide all labor and materials necessary to furnish and install vibration control systems on this project as herein specified and/or shown on the drawings.
- B. Mount all mechanical equipment on suitable vibration isolators so as to prevent transmission of vibration into or through the building structure. Isolators shall be as manufactured by Mason Industries, Inc., Korfund, Inc., Amber Booth, or approved equal, and shall be selected by the isolator manufacturer for each item of equipment in accordance with requirements hereinafter specified.
- C. The equipment manufacturer shall supply all pump and motor bases, fan and motor bases, cradles, isolation pipe/duct hangers, spring and/or neoprene isolators, neoprene pads, flexible connectors, etc. as a coordinated package by a single manufacturer.
- D. Select isolators for uniform static deflections according to distribution of weight; and for not less than the indicated isolation efficiency with the lowest rotational speed of equipment as the disturbing frequency.
- E. Isolators and bases shall be stable during stopping and starting of equipment without transverse or eccentric movement of equipment, and shall be designed to resist horizontal forces of equipment which may operate unbalanced.
- F. In general, select isolators on the basis of criteria as specified in the ASHRAE Applications Handbook, Latest Edition.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.
- B. Product Data: Provide schedule of vibration isolator type with location and load on each.
- C. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.
- D. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.4 PROJECT RECORD DOCUMENTS

- A. Record actual locations of hangers including attachment points.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Isolators shall be the equivalent of the following types by Mason Industries, Inc., Korfund, Inc. or approved equal.

2.2 CORROSION PROTECTION FOR STEEL PARTS

- A. Where steel parts are exposed to weather or humid environments provide hot-dipped galvanized coating of at least 2 ounces of zinc per square foot of surface. Coat springs with neoprene.

2.3 SPRING MOUNTS AND SOUND PADS

- A. Provide all spring mounts with leveling devices, minimum .25 inch thick neoprene sound pads, and zinc chromate plated hardware.
- B. All sound pads shall be size for minimum deflection of .05 inch; meet requirements for neoprene pad isolators.

2.4 SPRINGS

- A. All springs shall have minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between .3 and .6 of maximum deflection.

2.5 NEOPRENE

- A. Grade durometer 40, 50 OR 60 AND OIL RESISTANT.

2.6 FLOOR MOUNTED ISOLATORS:

- A. Neoprene Isolation Pads: Provide pads at least ¼ " thick with cross-ribbed or waffle design. For concentrated loads provide steel bearing plates bonded or cold cemented to the pads. Neoprene isolation pads shall be Type Super W.
- B. Neoprene Isolators: Rubber (neoprene)-in-shear mounting: Provide molded neoprene isolators having steel base plates with mounting holes and, at the top, steel mounting plates with mounting holes or threaded inserts. Provide elements of type and size coded with molded letters or color-coded for capacity identification. Embed metal parts completely in neoprene. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". Bolt holes shall be provided for these areas where bolting is required. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mounting to compensate for the over-hang. Mountings shall be type ND or rails type DNR.

2.7 SPRING ISOLATORS

- A. General: Provide spring isolators or protected spring isolators that are adjustable and laterally stable with free-standing springs of horizontal stiffness at minimum 80 percent of the vertical (axial) stiffness. For machine-attached and floor-attached restraining elements, separate from metal-to-metal contact by neoprene cushions 1/8 inch thick minimum. Provide neoprene acoustic friction pads at least ¼ inch thick.

2.8 SUSPENSION ISOLATORS

- A. General: Provide hangers with suspension isolators encased in open steel brackets. Isolate hanger rods from isolator steel brackets with neoprene-lined opening.

- B. Suspension Neoprene Isolators: Provide double-deflection elements with minimum 3/8 inch deflection.
- C. Suspension Spring Isolators: Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing thru a 30° arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30° capability. Hangers shall be type 30N.

2.9 FLEXIBLE CONNECTORS FOR PIPING

- A. General: Straight or elbow flexible connectors rated for temperatures, pressures, and fluids to be conveyed. Provide flexible connectors with the strength 4 times operating pressure at highest system operating temperature. Provide elbow flexible connectors with a permanently set angle.
- B. Elastomeric Flexible Connectors: Flexible neoprene connectors shall be manufactured of multiple plies of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Connectors up to and including 1 ½ " diameter may have threaded ends. Connectors 2" and larger shall be manufactured with floating galvanized flanges recessed to lock the connector's raised face neoprene flanges. Hoses shall be installed on the equipment side of the shut-off valves. Connectors shall be rated a minimum of 150 psi at 220°F. Flanged equipment shall be directly connected to neoprene elbows in the size range 2 ½ " through 12" if the piping makes a 90° turn at the equipment. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. 12" and larger sizes operating above 100 psi shall employ control cables with end fittings isolated by means of ½ " thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.

Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies.

Elbows shall be Mason-Flex type MFNEC, straight connectors Mason-Flex type MFTFU or MFTNC, and control cable assemblies type ACC.

- C. Metal Flexible Connectors: Fabricated of Grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover. Sizes 3" and larger shall be flanged. Sizes 2 ½ " and smaller shall have male nipples. Lengths shall be as indicated:

Nominal (Inches)	Diameter	Length (Inches)
½ "		12"
¾"		12"
1 ½ "		12"
1 ½ "		12"

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to

the equipment shafts wherever possible. Hoses shall be type BSS.

2.10 ACOUSTICAL FLOOR, CEILING AND WALL SEALS

- A. Provide acoustical floor, ceiling and wall seals where piping passes through mechanical equipment room/fan room walls, floors or ceilings and any noise sensitive areas. The vibration isolator manufacturer shall provide a split seal consisting of two bolted pipe halves with 3/4" or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240°F, 10# density fiberglass shall be used in lieu of the sponge. Seals shall be type SAWS.

2.11 RISER SUPPORTS, ANCHORS AND GUIDES (ACOUSTICAL PIPE ANCHOR)

- A. Vibration isolator manufacturer shall provide an all directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA.

2.12 NEOPRENE PAD ISOLATORS

- A. Rubber or neoprene waffle pads.
1. 30 durometer
 2. Minimum 2 inch (13mm) thick
 3. Maximum loading 40 psi (275 kPa)
 4. Height of ribs shall not exceed 0.7 times width.
- B. Configuration: ½ inch (13mm) thick waffle pads bonded each side of ¼ inch (6 mm) thick steel plate.

2.13 RUBBER MOUNTS

- A. Molded rubber designed for 0.6 inches (13 mm) deflection with threaded insert.

PART 3 EXECUTION

3.1 GENERAL PROVISIONS

- A. Install vibration-and-noise isolation materials and equipment as indicated and in accordance with machinery manufacturer's instructions.
- B. Where neoprene elements of vibration isolator may be subjected to high pipe temperatures above 160°F, provide metal heat shields or thermal isolators.
- C. Vertical Stops: For machinery affected by wind pressure or having an operational weight different from installed weight, provide resilient vertical limit stops which prevent spring extension when weight is removed. Provide vertical stops for machinery containing liquid, such as water chillers, evaporative coolers, boilers, and cooling towers. Spring isolated or protected spring isolated machinery must rock and move freely within limits of stops or seismic restraint devices.
- D. Machinery: Provide vibration isolators, flexible connectors and seismic snubbers in accordance

with manufacturer's recommendations. Machinery with spring isolators or protected spring isolators shall rock or move freely within limits of stops or seismic snubber restraints.

- E. **Stability:** Isolators shall be stable during starting and stopping of machinery without traverse and eccentric movement of machinery that would damage or adversely affect the machinery or attachments.
- F. **Lateral Motion:** The installed vibration isolation systems for each piece of floor or ceiling mounted machinery shall have a maximum lateral motion under machinery start up and shut down conditions of not more than ¼ -inch. Restrain motions in excess by approved spring mountings.
- G. **Unbalanced Machinery:** Provide foundation suspension systems specifically designed to resist horizontal forces for machinery with large unbalanced horizontal forces. Vibration isolator systems shall conform to the machinery manufacturer's recommendations.
- H. **Nonrotating Machinery:** Mount nonrotating machinery in systems which includes rotating or vibrating machinery on isolators having the same deflection as the hangers and supports for the pipe connected to.
- I. **Roof and Upper Floor Mounted Machinery:** On the roof or upper floors, mount machinery on isolators with vertical stops. Rest isolators on beams or structures designed and installed in accordance with the SMACNA ASMM Plate 61.
- J. **Vibration isolation ceiling hangers** shall be installed so that the hanger rods do not touch the sides of the isolator housing, thereby seriously degrading the vibration isolation performance. Vibration isolation ceiling hangers shall be located so that the hanger housing may rotate 360° without touching any object.
- K. **Electrical Connections:** Provide flexible conduit or multiple conductor cable connections for machinery with sufficient extra length to permit 2 inch minimum displacement in any direction without damage.
- L. **Systems Not To Be Vibration Isolated:** Do not provide vibration isolation for electrical raceways and conduits or for fire protection, storm, sanitary, and domestic water piping systems which do not include pumps or other vibrating, rotating, or pulsating equipment including control and pressure reducing valves.
- M. Install in accordance with manufacturer's instructions.
- N. Install isolation for motor driven equipment.
- O. Install spring hangers without binding.
- P. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- Q. 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.
- R. Connect wiring to isolated equipment with flexible hanging loop.

3.2 FLEXIBLE PIPE CONNECTORS

- A. Provide flexible connectors in accordance with manufacturers instructions where piping systems serving vibration isolated equipment and as shown on the drawings. Flexible connectors shall be installed near the connection to the equipment. Where liquid pulsation dampening is required,

flexible connectors with spherical configuration may be used. Provide restraints for pipe connectors at pumps to prevent connector failure upon pump start-up.

- B. Provide flexible connectors at connections of air compressors to piping systems.

3.3 ISOLATION FOR SPECIFIC EQUIPMENT

- A. The vibration isolator manufacturer shall provide isolators for all pieces of equipment provided for the job. Isolator shall be selected by the isolator manufacturer on the basis of criteria as specified in the ASHRAE Applications Handbook, latest edition, unless a more stringent requirement is indicated on the drawings.
- B. Condensing Units: All condensing units shall be supported on stable steel springs in series with ribbed neoprene pads and structural rails selected for not less than 2.5" deflection under full operating load. All exterior isolators for condensing units shall be hot dipped galvanized including all hardware. Mason Industries Type SLF springs or as approved equal. Provide neoprene coated springs.
- C. All horizontal heat pumps shall be suspended using hangers incorporating steel springs in series with neoprene selected for not less than 1" static deflection under full load (Mason Industries Type 30N or equivalent).
- D. Ductless Units: Indoor ductless units shall be supported with rubber grommet type suspension isolators. Outdoor ductless units or water cooled ductless units shall be supported on ribbed neoprene pads resting on roof curbs (roof application) or concrete pad.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

DIVISION 23 SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC AND PLUMBING

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC AND PLUMBING

PART 1. GENERAL

1.1. GENERAL

- A. This section covers performance testing, adjusting and balancing of heating, ventilating, air conditioning and domestic re-circulating systems as specified in Division 23 Section, *Heating, Ventilating, and Air Conditioning Equipment* and in Division 22 Section, *Plumbing Fixtures and Plumbing Equipment*.
- B. For *Common Work Results of HVAC*, See Division 23. See Division 01 for *General Requirements*.
- C. The mechanical contractor shall select and employ an impartial, independent balancing agency to provide testing and balancing services for the heating, ventilating and air conditioning (HVAC) systems and other specified systems of this project.
- D. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC and plumbing systems, as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results.
- E. The items requiring testing, adjusting, and balancing include, but are not limited to, the following:

Air Systems:

Coils (Air Temperatures & Static Pressure Drops)
Ductless Split System Units (Indoors and Outdoor units)
Hot Gas Re-heat Coils
Heat Pumps

Hydronic Systems:

Coils

1.2. EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. 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 dampers 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. Proper strainer baskets are clean and in place.
 14. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.
- 1.3. QUALIFICATIONS OF THE BALANCE AGENCY
- A. The balancing agency shall be a member of the Associated Air Balance Council (AABC) and have an engineer certified by the National Examining Board.
 - B. The certified test and balance engineer shall be responsible for supervision and certification for the total work herein specified.
 - C. All final reports shall be signed and officially stamped by the certified test and balance engineer.
- 1.4. PRE-BALANCING CONFERENCE
- A. Convene a conference one week prior to commencing work of this Section with all appropriate individuals.
- 1.5. STANDARDS
- A. The balancing agency shall perform the services specified herein in accordance with the Associated Air Balance Council's National Standards, including revisions, to the date of the contract.
 - B. All terms in this specification shall have their meaning defined as stated in the National Standards.
 - C. ADC: Test Code for grills, registers, and diffusers.
 - D. ASHRAE III: Practice for measurement, testing, adjusting and balancing of building heating, ventilation, air conditioning, and refrigeration systems.
 - E. NEBB: Procedure standards for testing, adjusting, and balancing of environmental systems.
 - F. SMACNA: HVAC systems testing, adjusting, and balancing.
 - G. AABC: Associated Air Balance Council

1.6. COORDINATION

- A. It will be necessary for the balancing agency to perform its services in close coordination with the mechanical contractor.
- B. The plans and specifications have indicated meters, valves, dampers, and other devices for the purpose of adjusting the system to obtain optimum operating conditions. It will be the responsibility of the mechanical contractor to install these devices in a manner that will leave them accessible and readily adjustable. The balancing agency shall provide guidance if there is a questionable arrangement of a control or balancing device.
- C. The general contractor, mechanical contractor, temperature control contractor and suppliers of the HVAC equipment shall all cooperate with the balancing agency to provide all necessary data on the design and proper application of the system components.
- D. For heat pumps, the manufacturer's start-up agency and Test and Balance Engineer shall assist each other with obtaining proper flow rates and refrigerant pressures.

1.7. INSTALLATION TOLERANCE

- A. Unless otherwise indicated, all air devices shall be adjusted to within plus or minus 10 percent of design. All fans shall be adjusted to within plus or minus 5 percent of design. All pumps and Hydronic equipment shall be adjusted to within plus or minus 5 percent of design.

1.8. RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR

- A. The mechanical contractor shall sufficiently complete the installation and start all HVAC systems to insure they are working properly and shall perform all other items as described hereinafter to assist the balancing agency in performing the testing and balancing of the HVAC system.
- B. Record equipment manufacturer's standard start-up information and submit to Engineer for review. Testing and balancing work shall not commence on any equipment until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.
- C. Air Distribution Systems
 - 1. Verify installation for conformity to design.
 - 2. Ensure that air-handling systems, units, and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., are blanked and/or sealed to eliminate excessive bypass or leakage of air.
 - 3. Ensure that all fans are operating and free of vibration. All fans and drives shall be checked for proper fan rotation and belt tension. Overload protection shall be of proper size and rating. A record of motor current and voltage shall be made to verify that the motors do not exceed nameplate rating. Record thermal overload ratings for all motors in the Test and Balance Report.
 - 4. Make any necessary changes to the sheaves, belts, and dampers, as required by the balancing agency, at no additional cost to the owner.
 - 5. Install clean filters.

6. For heat pumps, provide refrigerant suction and discharge pressure to Test and Balance Engineer for inclusion in the final TAB Report.
 - D. Water Circulating Systems
 1. Verify installation for conformity to design.
 2. Ensure that systems are clean, with the proper strainer screens installed for normal operation.
- 1.9. NOTIFICATION FOR TESTING AND BALANCING WORK TO BEGIN
- A. The mechanical contractor shall notify the balancing agency in writing when all heating, ventilating, and air conditioning systems are complete and ready for testing and balancing. The mechanical contractor shall attest that he has completed all items as herein described.
 - B. The following must be completed prior to start of system balancing:
 1. All duct work and associated grilles/registers/diffusers installed and completed.
 2. Piping systems completed, flushed and filled.
 3. Equipment properly started by qualified personnel or start-up technicians.
 4. Ceiling tiles installed.
 5. Automation system (temperature controls) installed and completed for both air and water systems.
 6. All equipment controlled in automatic ("Auto") mode.
 7. Access granted to the balancing contractor to the automation/controls system provided.
- 1.10. DEFICIENCIES
- A. Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible person.
 - B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected Contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.
- 1.11. ADJUSTING
- A. Ensure recorded data represents actual measured observed conditions.
 - B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
 - C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
 - D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring all sensors to specified settings.

- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- F. Check and adjust systems approximately six months after final acceptance and submit report.
- G. Permanently mark the locations of all duct traverses on the outside duct insulation.

PART 2. PRODUCTS (NOT APPLICABLE)

PART 3. EXECUTION

3.1. GENERAL

- A. Perform all testing and balancing in complete accordance with AABC National Standards for Field Measurements and Instrumentation.
- B. Furnish all test instruments and equipment. All instruments must have been calibrated within six (6) months prior to use and shall be checked for accuracy prior to and during the work.
- C. Review all systems designs and equipment, manufacturers' data, and be completely familiar with the work before proceeding.
- D. Report all malfunctions or deficiencies to the contractor so that corrective action can be taken. Test and Balance Report shall not be submitted for review until all malfunctions or deficiencies are corrected. Repeat tests where required until design conditions are achieved.
- E. Where systems or equipment cannot be balanced or adjusted to design conditions, determine the cause and submit a complete report to the Engineer.
- F. Retest or rebalance the system as required during the warranty period.
- G. Test and balance all systems under adequate load condition. If, in the opinion of the Engineer, there is insufficient load to properly test and balance the systems, perform sufficient preliminary balancing and adjustment to permit operation of the systems until such time as final testing and balancing can be done. Provide in writing the future date when systems shall be tested under sufficient load.
- H. At project completion provide a complete set of ½ scale drawings indicating the locations of all duct traverses.

3.2. EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.

- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems – Duct Design". Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens and indicated perforations.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine operating safety interlocks and controls on HVAC equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3. AIR SYSTEM PROCEDURES

- A. The balancing agency shall perform the following testing and balancing functions in accordance with the Associated Air Balance Council's National Standards:
 - 1. Fan Speeds - Test and adjust fan RPM to achieve design CFM requirements.
 - 2. Current and Voltage - Measure and record motor current and voltage. Check and record thermal overload ratings for all motors.
 - 3. Pitot-Tube Traverse - Perform a Pitot-tube traverse of main supply, return and exhaust ducts to obtain total CFM. If a Pitot-tube traverse is not practical, the summation of the outlets or inlets may be used. An explanation why a traverse was not made must appear on the appropriate data sheet.
 - 4. Static Pressure - Test and record system static pressures, including suction and

discharge static pressure of each fan. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make fan RPM allowances for 50 percent loading of filters.

5. Air Temperature - Take wet-bulb and dry-bulb air temperatures on the entering and leaving side of each cooling coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.
6. Main Ducts - Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
7. Tolerances - Test and balance all fans to within 5 percent of design requirements.
8. Identification - Identify the location and area of each grille, diffuser, register, and terminal box. This information shall be recorded on air outlet data sheets.
9. Description - Record the size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.
10. Test and Balance Engineer shall witness and record all leakage testing of ductwork. Leakage test data shall be included in final Test and Balance Reports.
11. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
12. For heat pumps, assist start-up organization or manufacturer's representative with start-up. Record air flow rates, water flow rates and electrical characteristics prior to refrigerant pressure measurement and settings.

3.4. WATER SYSTEM PROCEDURES

- A. The various water circulating systems shall be filled, purged of air, and put into operation before hydronic balancing by the mechanical contractor.
- B. The flow of water through all coils shall be adjusted by manipulating balancing valves until the rated pressure drop through the coil or metering device is obtained. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- C. The balancing agency shall perform the following testing and balancing functions in accordance with the AABC National Standards.
- D. All Hydronic equipment pumps shall be Tested and Balanced as described below:
 1. Strainers - Request that the mechanical contractor clean all strainers.
 2. Air Vents - Check all air vents at the high points of the water system and determine if they are installed and operating.
 3. Valves - Set all balancing valves to the full-open position for balancing.
 4. Tolerances - Proceed to balance all coils to within 5 percent of design requirements.
 5. Marking - Mark all settings and record all data after completing the flow readings and coil adjustments.

6. Test and verify proper operation of oil sensors at elevator pit sump pump and report results.
- E. Heat Pump Test Forms - Record the following items on each geothermal heat pump test form:
1. Manufacturer model number, serial numbers.
 2. All design and manufacturer's rated data.
 3. Service and location.
 4. Actual pressure drop and design pressure drop of condenser/evaporator coils.
 5. Entering and leaving water fluid of condenser/evaporator coils.
 6. Temperature control settings.
 7. Electrical characteristics.
- F. Coils:
1. Tolerances - Test, adjust, and balance all hydronic coils within 5 percent of design requirements.
 2. Verification - Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.

3.5. LIFE SAFETY CONTROLS TESTING PROCEDURES

- A. The TAB agency shall test and record life safety control operation on the HVAC equipment. It shall verify the installation of required smoke detectors in air handling equipment (AHE), and shall verify operation of the smoke detector by activating the smoke detector and observing air handler shutdown. With the controls and alarm contractors, the TAB agency shall verify the operation of interconnected systems such as the AHU smoke detector's activation of the fire alarm system and the alarm system's activation of the life safety control sequences. Record results of tests within TAB report.

3.6. VERIFICATION OF TEMPERATURE CONTROL

- A. The balancing agency shall be assisted by the temperature control contractor in verifying the operation and calibration of all temperature control systems. The following tests shall be conducted:
1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset.
 2. Verify that all controlling instruments are calibrated and set for design operating conditions.
 3. Verify the accuracy of the final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

3.7. TEST AND BALANCE REPORTS

- A. The test and balance report shall be complete with logs, data, and records as required herein. All logs, data, and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the balancing agency's certified test and balance engineer.
- B. Three (3) copies of the test and balance report are required and shall be submitted to the Engineer. If, in the opinion of the Engineer, test results or portions thereof are incomplete or inconclusive, repeat necessary portions of the work to the satisfaction of the Engineer.
- C. The report shall contain the following general data in a format selected by the balancing agency:
 - 1. Project Number
 - 2. Contract Number
 - 3. Project Title
 - 4. Project Location
 - 5. Project Architect
 - 6. Project Mechanical Engineer
 - 7. Test & Balance Agency
 - 8. Test & Balance Engineer
 - 9. General Contractor/Construction Manager
 - 10. Mechanical Subcontractor
 - 11. Dates tests were performed
 - 12. Certification
 - 13. Duct Leakage Tests
 - 14. Phone Numbers of all Individuals Listed Above
- D. The test and balance report shall be recorded on report forms conforming to the recommended forms in the AABC National Standards.

3.8. TEST REPORT FORMS

- A. Air Moving Equipment and Fan Test Forms - Submit fan curve showing design and operating points of operation. Also, record the following on each heat pump equipment test form:
 - 1. Manufacturer, model number, serial number, arrangement.
 - 2. All design and manufacturer-rated data.
 - 3. Total actual CFM by traverse if practical. If not practical, the sum of the outlets

may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.

4. Suction and discharge static pressure of each fan, as applicable. Include pressure drops across coils, filters, mixing boxes, and similar devices.
 5. Outside-air, return-air, and exhaust air total CFM.
 6. Actual operating current, voltage and brake horsepower of each fan motor. For packaged equipment, this includes supply fans, relief air fans, and condenser fans.
 7. Final RPM of each fan.
 8. Fan and motor sheave manufacturer, model, size, number of grooves, bore, and center distance.
 9. Belt size, quantity and make.
 10. Static-pressure controls final operating set points (if applicable).
 11. Total and external static pressure.
- B. Heating and Cooling-Coil Test Forms - Record the following items on each test form:
1. Manufacturer, location, service.
 2. All design and manufacturer's rated data.
 3. Rated and actual water pressure drop through each coil and related GPM.
 4. Rated and actual static pressure drop across each coil.
 5. Rated and actual entering and leaving water temperatures across each coil.
 6. Wet-bulb and dry-bulb temperatures entering and leaving each cooling coil; dry-bulb temperatures entering and leaving each heating coil.
 7. Air flow (Design and Actual).
 8. For DX-coil, provide design and actual saturated suction temperature.
 9. For DX-Coil, provide suction and discharge pressures.
- C. Electric Motors Test Forms: (Applies to all motors, including pumps, fans and HVAC equipment)
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.
 9. Thermal overload settings
- D. Duct Traverse Test Forms:
1. System zone/branch.
 2. Duct size.
 3. Area.
 4. Design velocity.
 5. Design air flow.
 6. Test velocity.
 7. Test airflow.
 8. Duct static pressure.
 9. Air temperature.
 10. Air correction factor.
- E. Duct Leakage Test Forms:
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.
- F. Ductless Unit Test Forms:
1. Manufacturer
 2. Type, air conditioning, heat pump
 3. Identification number
 4. Location
 5. All design and manufacturer's rated data.
 6. Rated and actual entering and leaving dry bulb temperatures.
 7. Rated and actual entering and leaving wet bulb temperatures.
 8. Air flow (design and actual)
 9. Provide actual saturated suction temperature.
 10. Actual operating current, voltage and brake horsepower of each fan motor.
 11. Final fan RPM.
- G. Water to Air Heat Pump Test Form – Record the Following Items on Each Heat Pump Test Form:
1. Manufacturer model number, serial numbers.
 2. All design and manufacturer's rated data.
 3. Design and actual fluid pressure and related GPM.
 4. Ground loop entering and leaving temperatures, design and actual.
 5. Electrical characteristics, design, and actual.
 6. Suction pressure (provided by start-up agency).
 7. Discharge pressure (provided by start-up agency).
 8. Fan speed, static pressure voltage, amp draw.
 9. Wet Bulb and dry Bulb temperatures entering, leaving coil design, actual.
 10. For units with hot gas re-heat, entering/leaving temperatures at hot gas coil.

END OF SECTION

DIVISION 23 SECTION 230600
HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT
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SECTION 230600 - HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT

PART 1 GENERAL

1.1 GENERAL

- A. The Conditions of the Contract and other General Requirements apply to the work specified in this section. All work under this section shall also be subject to the requirements of Division 23 Section, *Common Work Results for HVAC* and Division 01 Section *General Requirements*.

1.2 DESCRIPTION

- A. The work to be performed shall include all labor, materials and equipment necessary to furnish and install complete, all mechanical equipment as shown on drawings, hereinafter specified or reasonably implied, and leaving the same in satisfactory operation condition. It is the intent that systems be installed complete with all items necessary to accomplish this purpose.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate assembly, equipment dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- B. Product Data:
1. Provide literature which indicates dimensions, weights, capacities, ratings, performance, gages and finishes of materials, and electrical characteristics and connection requirements.
 2. Provide data of filter media, filter performance data, filter assembly, and filters frames.
 3. Provide fan curves with specified operating point clearly plotted.
 4. Submit sound power level data for both fan outlet and casing radiation at rated capacity. Submit sound power levels by octave band or sound pressure levels by octave band for all equipment.
 5. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

1.4 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of General Requirements.
- B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- C. Store all equipment in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

- D. Comply with manufacturer's installation instructions for rigging, unloading and transporting equipment.
- E. Protect all motors, shafts, and bearings from weather and construction dust.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate any equipment for any purpose, temporary or permanent, until ductwork/piping is clean, filters/strainers are in place, bearings lubricated, and equipment has been test run under observation.

PART 2 PRODUCTS

2.1 DUCTLESS SPLIT SYSTEM AIR CONDITIONER (INVERTER TYPE) (CEILING CASSETTE TYPE)

- A. The air conditioning systems shall be a Mitsubishi split type system, Sanyo, LG, Daikin, Samsung, or approved equal. The system shall consist of a compact ceiling mounted packaged evaporator section and matching Slim Line air cooled outdoor unit. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label. All wiring to be in accordance with the National Electric Code (N.E.C.). The units shall be rated in accordance with ARI Standard 210 and bear the ARI label. A full charge of R-410A for 100 feet of refrigerant tubing shall be provided in the condensing unit. A dry nitrogen holding charge shall be provided in the evaporator. System SEER shall meet or exceed 1992 Federal Standards.
- B. The units shall have a manufacturer's warranty for a period of two (2) years from date of installation. The compressor shall have a warranty of six (6) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of Mitsubishi Electronics America, Inc. This warranty does not include labor. Manufacturer shall have ten years experience in the U.S. market.
- C. Capacity shall be as scheduled on the contract drawings.
- D. The indoor unit shall be completely factory assembled and wired. The casing shall be galvanized sheet with grey heat insulation. This unit shall fit in the ceiling and have the capability of attaching a branch supply duct as well as a fresh air duct. The evaporator fan shall be an assembly with a high performance, fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings. The indoor unit shall have an adjustable air outlet system offering 4-way air flow, 3-way air flow, or 2-way air flow. The auto air swing vanes shall automatically swing up and down for uniform air distribution. Return air shall be filtered by a long-life filter to provide approximately 2,500 hours of use in a normal office environment before cleaning. The indoor unit shall be covered with a flat panel which protrudes only 1 inch below the ceiling to provide a neat and clean installation. The coils shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan shall extend under the coil and piping. An integral drain pan pump capable of lifting condensate 12 inches shall be provided. The unit electrical power requirements shall be as indicated on the contract drawings.
- E. The control system shall consist of two (2) microprocessors interconnected by a single

non polar two wire cable as supplied. Wiring shall run from indoor unit to controller direct. NO SPLICES. When running longer lengths or more than one set of remote controller wires together, a double insulated, two wire cable equivalent to that provided e.g. Belden 9407 cable, is mandatory or used shielded two wire cable. One microprocessor shall be factory wired and located within the indoor unit. It shall have the capability of sensing return air temperature and indoor coil temperature; receive and process commands from the remote controller; provide emergency operations, and control the outdoor unit. The microprocessor within the wall mounted remote controller shall provide automatic cooling, display set point and room temperature; a 24-hour on/off timer so that automatic operation can be set on the timer at one-hour intervals from one to twenty-four hours; have self-diagnostic function display; check mode for memory of most recent problem; control operation of the air sweep louvers; and provide on-off and system/mode function switching. Normal operation of the remote controller provides individual system control in which one remote controller and one indoor unit are installed in the same room. The remote controller shall have the capability of controlling up to a maximum of 50 systems at a maximum developed control cable distance of 1650 feet. The control voltage between the remote controller and the indoor unit shall be 12 volts, D.C.. The control voltage between the indoor unit and the outdoor unit shall be 12 volts, D.C. Both 12VDC shall be generated from the indoor unit microprocessor board. The system shall be capable of automatic restart when power is restored after power interruption. System shall include twenty function self diagnostics including total hours of compressor run time.

- F. The outdoor unit shall be completely factory assembled, piped, and wired. The casing shall be fabricated of galvanized steel, bonderized and finished with baked enamel. The unit shall be furnished with one (1) direct drive, propeller type fan arranged for horizontal discharge. The motor shall have inherent protection, be of the permanently lubricated type and resiliently mounted for quiet operation. Each fan shall be provided with a raised guard to prevent contact with moving parts. The variable speed compressor shall be of the high performance, rotary type with crankcase heater, accumulator and internal thermal overloads. The variable speed compressor shall be mounted so as to avoid the transmission of vibration. The refrigeration system shall be equipped with high pressure switch and have the capability to operate with a maximum height difference of 130 feet and overall refrigerant tubing length of 130 feet between indoor and outdoor sections without the need for line size changes, traps or additional oil. Refrigerant flow from the condenser to be controlled by means of a capillary tube. The condenser coil shall be nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall be inner grooves for high efficiency heat exchange. The coil shall be protected with an integral metal guard. The units shall be controlled by the microprocessor located in the matching indoor unit. A built-in, low-ambient controller shall allow cooling to 0 degrees F outdoor temperature. The unit electrical power requirements shall be as scheduled on the contract drawings. The outdoor condensing unit shall be placed on vibration isolators and mounted on roof-top equipment rail or concrete pad as indicated.
- G. High condensate water safety shutdown: Each indoor units detection unit shall be interlocked to alarm and stop the outdoor unit if a high condensate water level is sensed.

2.2 EXTERIOR EQUIPMENT/DUCT SUPPORT

- A. Exterior Equipment Supports shall be Pate Model ES suitable for roof construction. Equipment supports shall be constructed of 18 gauge galvanized steel, unitized construction with integral base plate, continuous welded corner seams, pressure treated wood nailer counterflashing and lag screws. Units shall be internally reinforced.

2.3 EXTERIOR PIPE ROLLER SUPPORTS

- A. Furnish and install pipe roller supports for all exterior chilled water piping as indicated on contract drawings. Pipe roller supports shall be constructed of heavy gauge galvanized steel, continuous welded corner seams, 2 x 4 treated wood nailer, heavy gauge galvanized steel counterflashing with galvanized steel channel track attached.
- B. Roller assembly shall consist of galvanized steel channel track, galvanized steel fittings, washers, nuts, and painted cast iron roller. Installation shall permit both vertical and horizontal adjustment. Units shall be Pate Model RAC or approved equal.

2.4 WATER TO AIR GROUND SOURCE HEAT PUMPS (HORIZONTAL SUSPENDED UNITS)

- A. Provide water-to-air ground source heat pumps of the size, capacity, efficiency, and electrical characteristics as indicated on the Contract Drawings. Units shall be Model GEHA or GEVA as manufactured by Trane, Enfinity as manufactured by McQuay, Water Furnace, Florida Heat Pump, Mammoth, Climate Master, Bryant, Johnson Controls, or approved equal. Unit dimensions shall not exceed that which is required for proper installation above ceilings allowing for service and maintenance.
- B. Units shall be ARI 330 certified for use as extended range heat pumps for geothermal closed loop applications.
- C. Equipment shall be completely assembled, piped, internally wired and test operated at the factory. Units shall be both ETL and ISO-ARI 13256-1 listed and labeled prior to leaving the factory. Service and caution area labels shall be also be placed on the unit in their appropriate locations.
- D. Cabinet:
 - 1. The cabinet shall be constructed of galvanized steel, with exposed edges rounded. Service to the refrigerant and controls shall be provided through a single access panel at the front of the unit.
 - 2. Insulation for the internal parts and surfaces exposed to the conditioned air stream shall be made of moisture resistant insulation.
 - 3. The insulation shall be ½ inch thick dual density bonded glass fiber. The exposed side shall be a high density erosion proof material suitable for use in airstream up to 4500 feet per minute (FPM). Insulation shall meet the Underwriters Laboratories Fire Hazard Classification:
 - a. Flame Spread = 20
 - b. Fuel Contributed = 15
 - c. Smoke Developed = 0
 - 4. Access for inspection and cleaning of the unit drain pan, coils and fan section shall be provided. The unit shall be installed for proper access. Procedures for proper access inspection and cleaning of the unit shall be included in the maintenance manual.
 - 5. Furnish units with 30 percent efficient, 1 inch thick, pleated disposable air filters and a factory installed combination filter rack/return air duct collar. The filter rack shall be field convertible to bottom filter removal. Where return air devices are indicated to be provide with filters and filter racks, do not provide filters/filter racks with heat pumps.

6. Filter racks shall be gasketed and air tight to prevent leakage.
- E. Sound Attenuation:
1. Sound attenuation shall be applied as a standard feature in the product design.
 2. The sound reduction package shall include a compressor discharge muffler, vibration isolation to the compressor and water-to-refrigerant coil, unit base stiffeners, insulated metal compressor enclosure, and a second stage of vibration isolation to the compressor and water-to-refrigerant base pan.
 3. The unit shall be tested and rated in accordance with ARI 260P.
 4. Furnish and install sound attenuation blankets on all compressors to reduce noise.
- F. Refrigeration System
1. The unit shall include a high efficiency scroll compressor. External vibration isolation shall be provided by rubber mounting devices located underneath the mounting base of the compressor. A second isolation of the refrigeration assembly shall be supported under the compressor mounting base. Where scheduled provide multistage units.
 2. Internal thermal overload protection shall be provided. Protection shall be provided against excessive discharge pressure operation by means of a high pressure switch. Loss of charge protection shall be provided by a low pressure switch.
 3. Heat Exchanger: The water-to-refrigerant heat exchanger shall be of a high quality coaxial coil for maximum heat transfer. The cupro-nickel coil shall be deeply fluted to enhance heat transfer and minimize fouling and scaling. The coil shall have a working pressure of 450 psig of both the refrigerant and water sides. The factory shall provide rubber isolation to the heat exchanging device to enhance sound attenuation.
 4. Reversing Valve: The reversing valve shall be a pilot operating sliding piston type with replaceable encapsulated magnetic coil. This valve shall be energized in cooling.
 5. Tubing: The refrigerant tubing shall be of 99 percent pure copper. This system shall be free from contaminants and conditions such as drilling fragments, dirt and oil. All refrigerant and water lines shall be insulated with an elastomeric insulation that has a 3/8 inch thick wall wherever air is introduced to the assembly.
 6. Refrigerant Metering: The equipment shall be provided with a (TXV) thermal expansion valve to allow operation of the unit with entering fluid temperature from 25 degrees F to 125 degrees F.
 7. Schrader Connections: The refrigerant access ports shall be factory supplied on the high and low pressure sides for easy refrigerant pressure or temperature testing.
 8. Refrigerant type shall be HFC-410A. Units shall be shipped fully charged with the

appropriate refrigerant and oil.

9. All refrigerant piping and heat exchangers shall be factory insulated to minimize heat transfer and eliminate condensation.

G. Air-to-Refrigerant Coil:

1. The air-to-refrigerant coil shall contain copper tubes mechanically expanded into evenly spaced aluminum fins. All coils are to be leak tested. Pressure testing shall be performed at 450 psig operating pressure and the leak test at 125 psi operating pressure with helium. In addition, the tubes are to be completely evacuated of air prior to shipment.
2. The refrigerant coil distributor assembly shall be of orifice style with round copper distributor tubes. The tubes shall be sized consistently with the capacity of the coil. Suction headers shall be fabricated from rounded copper pipe.
3. A thermostatic expansion valve shall be factory selected and installed for a wide range of control.
4. Air conditioned condensate pan shall slope a minimum of ¼" in two (2) directions and shall be fully insulated and constructed of corrosion resistance materials.

H. Drain Pan

1. The condensate pan shall be constructed of high impact plastic to prevent corrosion and sweating. The bottom of the drain pan shall be sloped on two planes to provide complete drainage of water from the pan. The unit shall be supplied with a standard solid-state electronic condensate overflow protection. Water level detection shall comply with U.L. 508. Drain pan shall be insulated to prevent condensation.

I. Electrical

1. The factory or field tested and installed control box shall contain all necessary devices to allow heating and cooling operation of the equipment to occur from a remote wall thermostat or zone sensor. Thermostats and zone sensors shall be furnished under Division 23 Section, *Instrumentation and Controls of HVAC and Plumbing Systems*. The devices shall be as follows:
 - a. 24 VAC Energy Limiting Class II, 50VA breaker type transformer (minimum)
 - b. 24 VAC contactor for compressor control
 - c. 18 Pole terminal strip located inside the control box behind the service access panel. This terminal strip shall be used for low voltage (thermostat/zone sensor) connections.
 - d. An electrically operated safety lockout relay shall prevent cycling of the compressor during adverse conditions of operation. This device shall be reset either at the remote thermostat/zone sensor, or by cycling power to the unit.
 - e. A high pressure switch shall protect the compressor against operation at refrigerant system pressure in excess of 395 psig.
 - f. A low pressure switch shall prevent compressor operation under low charge or catastrophic loss of charge situations.
 - g. Factory installed wire harness.

J. Controls

1. Terminal Unit Controller: This system shall utilize ATC Contractor furnished and mounted DDC controls for operation of a complete building system on a Comm 4 link. The TUC control package shall include a 75 VAC transformer. The controller shall provide anti-short cycle compressor protection, random start, heating/cooling status, occupied/unoccupied mode, as well as fan and filter status options. Optional wiring from the factory for condensate overflow shall be provided. Five LEDs (light emitting diodes) shall also be included for diagnostics of the equipment.
2. BAS Communication Interface: There shall be a BAS Communication Interface that ties into the Unit Control Processor. This system shall provide the following diagnostic information: Communication Network Status at each unit, Mode of Operation, System Cooling and Heating Setpoints, Local Cooling and Heating Setpoints, Compressor Operational Status, Reversing Valve Status, Zone Temperature, Discharge Air Temperature, Leaving Water Temperature, Fan Mode, Fan Status, and Compressor Fault Status.
3. Controls: Factory or Field wired, control shall perform the following:
 - a. Random start of all water source heat pumps.
 - b. Anti-short cycle protection shall prevent rapid cycling of the compressor during changeover from heat to cooling or vice-a-versus.
 - c. A two wire twisted pair shall be able to perform the following functions when connected to the control system: load shedding. Emergency shutdown. Time of day scheduling. Alarm shutdown as a result of: Loss of water flow. High water temperature. Low water temperature.
 - d. Delays shall prevent the reversing valve from changing status against large differentials in pressures within the hermetically sealed system.
 - e. A single common alarm output shall be provided to: Initiate an alarm at the EMS.
 - f. The control system shall monitor the current to the compressor contactor via a high pressure switch. If this switch activates and causes a loss of current to the contactor during a compressor "on mode", then the control system shall shutdown the water source heat pump and cause the common alarm output to be energized.
 - g. The controls shall monitor the low refrigerant pressure and if it activates during the compressor "on mode", then the controls shall shutdown the water source heat pump and cause the common alarm output to be energized.
 - h. A freeze protection thermostat shall sense leaving water temperature. If the water temperature falls below the set point, the controls shall shutdown the water source heat pump and cause the common alarm output to be energized.
 - i. The control system shall visually display the following alarm conditions via the BAS. High pressure, Low refrigerant temperature, Condensate overflow.
 - j. The control system shall require a manual reset to restore normal operation after any of the following alarm conditions: high pressure, low refrigerant temperature, or condensate overflow.
 - k. The control system shall visually display the status of the water source heat pump at all times. Definition of all possible status shall be indicated at the BAS.

- I. The control system shall provide a field service input for diagnostic purposes.
 - a. Condensate overflow switch shall be provided to lock out the compressor operation when a high level of water is detected. All water lines, refrigerant lines, hot gas lines and condensate lines shall be fully insulated with 1-inch closed cell insulation.
4. DDC terminal unit controller for each heat pump shall be furnished by the Automatic Temperature Control Contractor for factory installation by the water to air ground source heat pump manufacturer or field installation by the Automatic Temperature Control Contractor.
5. The DDC terminal unit controller shall be shipped by the Automatic Temperature Control Contractor to the water to air ground source heat pump manufacturer for installation at the factory. At Contractor's option, the DDC terminal unit controllers may be installed in the field.
6. The cost of factory or field mounting, wiring, and any factory testing and programming of the terminal unit controller shall be included by the water to air ground source heat pump manufacturer.
7. The Automatic Temperature Control Contractor shall coordinate with manufacturer to ensure the delivery of factory or field installed controls and proper installation according to the project schedule.
- K. Motors: The motors shall be multi-speed permanent split capacitor type with thermal overload protection. Where required, standard static or high static shall be selected and wired from the factory to match performance criteria. The motor shall contain a quick-disconnect plug and permanently lubricated bearing.
- L. Fans: The fans shall be placed in a draw-through configuration. They shall be constructed of corrosion resistant galvanized material.
- N. Orifice Ring: Removal of the motor and fan wheel shall be made with the assistance of factory provided orifice ring device. This device shall attach the wheel and motor to the fan housing in one assembly providing single side service access.
- P. Warranty: The unit shall be warranted by the manufacturer against defects in material and factory workmanship for one year. The refrigerant circuit including motor-compressor, expansion device, all heat exchangers in contact with refrigerants, and reversing valve (less solenoid coil) shall be warranted for four additional years.
- Q. Supply Fan Control: Provide fan speed switch, dial, or auxiliary transformer to allow field adjustment of supply air fans during testing/balancing. Supply fan airflow rate shall be limited such that airflow rate shall operate within manufacturers required range to prevent unstable operation and/or freezing of evaporator coil. Clearly label supply fan control and provide directions for proper use of the same.

2.5 WATER TO AIR GROUND SOURCE HEAT PUMPS (HORIZONTAL OR VERTICAL UPRIGHT WITH HOT GAS RE-HEAT FOR DEHUMIDIFICATION)

- A. Provide water-to-air ground source heat pumps of the size, capacity, efficiency, and electrical characteristics as indicated on the Contract Drawings. Units shall be as manufactured by Water Furnace, Florida Heat Pump, Mammoth, Climate Master, Johnson Controls, or approved equal. Unit dimensions shall not exceed that which is

required for proper installation above ceilings allowing for service and maintenance.

- B. Units shall be ARI 330 certified for use as extended range heat pumps for geothermal closed loop applications.
- C. Equipment shall be completely assembled, piped, internally wired and test operated at the factory. Units shall be both ETL and ISO-ARI 13256-1 listed and labeled prior to leaving the factory. Service and caution area labels shall be also be placed on the unit in their appropriate locations.
- D. Cabinet:
1. The cabinet shall be constructed of galvanized steel, with exposed edges rounded. Service to the refrigerant and controls shall be provided through a single access panel at the front of the unit.
 2. Insulation for the internal parts and surfaces exposed to the conditioned air stream shall be made of moisture resistant insulation.
 3. The insulation shall be ½ inch thick dual density bonded glass fiber. The exposed side shall be a high density erosion proof material suitable for use in airstream up to 4500 feet per minute (FPM). Insulation shall meet the Underwriters Laboratories Fire Hazard Classification:
 - a. Flame Spread = 20
 - b. Fuel Contributed = 15
 - c. Smoke Developed = 0
 4. Access for inspection and cleaning of the unit drain pan, coils and fan section shall be provided. The unit shall be installed for proper access. Procedures for proper access inspection and cleaning of the unit shall be included in the maintenance manual.
 5. Furnish units with 30 percent efficient, 1 inch thick, pleated disposable air filters and a factory installed combination filter rack/return air duct collar. The filter rack shall be field convertible to bottom filter removal.
- E. Sound Attenuation:
1. Sound attenuation shall be applied as a standard feature in the product design.
 2. The sound reduction package shall include a compressor discharge muffler, vibration isolation to the compressor and water-to-refrigerant coil, unit base stiffeners, insulated metal compressor enclosure, and a second stage of vibration isolation to the compressor and water-to-refrigerant base pan.
 3. The unit shall be tested and rated in accordance with ARI 260P.
 4. Install sound attenuation blanket on compressor and piping.
- F. Refrigeration System
1. The unit shall include a high efficiency scroll compressor. External vibration isolation shall be provided by rubber mounting devices located underneath the mounting base of the compressor. A second isolation of the refrigeration assembly shall be supported under the compressor mounting base. Where

scheduled, provide multistage units.

2. Internal thermal overload protection shall be provided. Protection shall be provided against excessive discharge pressure operation by means of a high pressure switch. Loss of charge protection shall be provided by a low pressure switch.
3. Heat Exchanger: The water-to-refrigerant heat exchanger shall be of a high quality coaxial coil for maximum heat transfer. The cupro-nickel coil shall be deeply fluted to enhance heat transfer and minimize fouling and scaling. The coil shall have a working pressure of 450 psig of both the refrigerant and water sides. The factory shall provide rubber isolation to the heat exchanging device to enhance sound attenuation.
4. Reversing Valve: The reversing valve shall be a pilot operating sliding piston type with replaceable encapsulated magnetic coil. This valve shall be energized in cooling.
5. Tubing: The refrigerant tubing shall be of 99 percent pure copper. This system shall be free from contaminants and conditions such as drilling fragments, dirt and oil. All refrigerant and water lines shall be insulated with an elastomeric insulation that has a 3/8 inch thick wall wherever air is introduced to the assembly.
6. Refrigerant Metering: The equipment shall be provided with a (TXV) thermal expansion valve to allow operation of the unit with entering fluid temperature from 25 degrees Fahrenheit to 125 degrees Fahrenheit.
7. Schrader Connections: The refrigerant access ports shall be factory supplied on the high and low pressure sides for easy refrigerant pressure or temperature testing.
8. Refrigerant type shall be HFC-410A. Units shall be shipped fully charged with the appropriate refrigerant and oil.
9. Furnish units with hot gas re-heat coil, hot gas control valve, hot gas temperature sensor, humidity sensor, and controls.
10. All refrigerant piping and heat exchangers shall be factory insulated to minimize heat transfer and eliminate condensation.

G. Air-to-Refrigerant Coils:

1. The air-to-refrigerant coils shall contain copper tubes mechanically expanded into evenly spaced aluminum fins. All coils are to be leak tested. Pressure testing shall be performed at 450 psig operating pressure and the leak test at 125 psi operating pressure with helium. In addition, the tubes are to be completely evacuated of air prior to shipment.
2. The refrigerant coil distributor assembly shall be of orifice style with round copper distributor tubes. The tubes shall be sized consistently with the capacity of the coil. Suction headers shall be fabricated from rounded copper pipe.
3. A thermostatic expansion valve shall be factory selected and installed for a wide range of control.

4. Air conditioned condensate pan shall slope a minimum of ¼" in two (2) directions and shall be fully insulated and constructed of corrosion resistance materials.
5. Provide separate downstream hot gas re-heat coil for dehumidification/re-heat.

H. Drain Pan

1. The condensate pan shall be constructed of high impact plastic to prevent corrosion and sweating. The bottom of the drain pan shall be sloped on two planes to provide complete drainage of water from the pan. The unit shall be supplied with a standard solid-state electronic condensate overflow protection. Water level detection shall comply with U.L. 508. Drain pan shall be insulated to prevent condensation.

I. Electrical

1. The factory or field tested and installed control box shall contain all necessary devices to allow heating and cooling operation of the equipment to occur from a remote wall thermostat or zone sensor. Thermostats and zone sensors shall be furnished under Division 23 Section *Instrumentation and Controls of HVAC and Plumbing Systems*. The devices shall be as follows:
 - a. 24 VAC Energy Limiting Class II, 50VA breaker type transformer (minimum)
 - b. 24 VAC contactor for compressor control
 - c. 18 Pole terminal strip located inside the control box behind the service access panel. This terminal strip shall be used for low voltage (thermostat/zone sensor) connections.
 - d. An electrically operated safety lockout relay shall prevent cycling of the compressor during adverse conditions of operation. This device shall be reset either at the remote thermostat/zone sensor, or by cycling power to the unit.
 - e. A high pressure switch shall protect the compressor against operation at refrigerant system pressure in excess of 395 psig.
 - f. A low pressure switch shall prevent compressor operation under low charge or catastrophic loss of charge situations.
 - g. Factory installed wire harness.
 - h. Dehumidification mode of operation with hot gas re-heat.

J. Controls

1. Terminal Unit Controller: This system shall utilize ATC Contractor furnished and mounted DDC controls for operation of a complete building system on a Comm 4 link. The TUC control package shall include a 75 VAC transformer. The controller shall provide anti-short cycle compressor protection, random start, heating/cooling status, occupied/unoccupied mode, as well as fan and filter status options. Optional wiring from the factory for condensate overflow shall be provided. Five LEDs (light emitting diodes) shall also be included for diagnostics of the equipment.
2. BAS Communication Interface: There shall be a BAS Communication Interface that ties into the Unit Control Processor. This system shall provide the following diagnostic information: Communication Network Status at each unit, Mode of Operation, System Cooling and Heating Setpoints, Local Cooling and Heating

Setpoints, Compressor Operational Status, Reversing Valve Status, Zone Temperature, Discharge Air Temperature, Leaving Water Temperature, Fan Mode, Fan Status, and Compressor Fault Status.

3. Controls: Factory or Field wired, control shall perform the following:
 - a. Random start of all water source heat pumps.
 - b. Anti-short cycle protection shall prevent rapid cycling of the compressor during changeover from heat to cooling or vice-a-versus.
 - c. A two wire twisted pair shall be able to perform the following functions when connected to the control system: load shedding. Emergency shutdown. Time of day scheduling. Alarm shutdown as a result of: Loss of water flow. High water temperature. Low water temperature.
 - d. Delays shall prevent the reversing valve from changing status against large differentials in pressures within the hermetically sealed system.
 - e. A single common alarm output shall be provided to: Initiate an alarm at the EMS.
 - f. The control system shall monitor the current to the compressor contactor via a high pressure switch. If this switch activates and causes a loss of current to the contactor during a compressor "on mode", then the control system shall shutdown the water source heat pump and cause the common alarm output to be energized.
 - g. The controls shall monitor the low refrigerant pressure and if it activates during the compressor "on mode", then the controls shall shutdown the water source heat pump and cause the common alarm output to be energized.
 - h. A freeze protection thermostat shall sense leaving water temperature. If the water temperature falls below the set point, the controls shall shutdown the water source heat pump and cause the common alarm output to be energized.
 - i. The control system shall visually display the following alarm conditions via the BAS. High pressure, Low refrigerant temperature, Condensate overflow.
 - j. The control system shall require a manual reset to restore normal operation after any of the following alarm conditions: high pressure, low refrigerant temperature, or condensate overflow.
 - k. The control system shall visually display the status of the water source heat pump at all times. Definition of all possible status shall be indicated at the BAS.
 - l. The control system shall provide a field service input for diagnostic purposes.
 - aa. Condensate overflow switch shall be provided to lock out the compressor operation when a high level of water is detected. All water lines, refrigerant lines, hot gas lines and condensate lines shall be fully insulated with 1-inch closed cell insulation.
4. DDC terminal unit controller for each heat pump shall be furnished by the Automatic Temperature Control Contractor for factory installation by the water to air ground source heat pump manufacturer or field installation by the Automatic Temperature Control Contractor.
5. The DDC terminal unit controller shall be shipped by the Automatic Temperature Control Contractor to the water to air ground source heat pump manufacturer for installation at the factory. At Contractor's option, the DDC terminal unit controllers may be installed in the field.

6. The cost of factory or field mounting, wiring, and any factory testing and programming of the terminal unit controller shall be included by the water to air ground source heat pump manufacturer.
7. The Automatic Temperature Control Contractor shall coordinate with manufacturer to ensure the delivery of factory or field installed controls and proper installation according to the project schedule.
- K. Motors: The motors shall be multi-speed permanent split capacitor type with thermal overload protection. Where required, standard static or high static shall be selected and wired from the factory to match performance criteria. The motor shall contain a quick-disconnect plug and permanently lubricated bearing.
- L. Fans: The fans shall be placed in a draw-through configuration. They shall be constructed of corrosion resistant galvanized material.
- N. Orifice Ring: Removal of the motor and fan wheel shall be made with the assistance of factory provided orifice ring device. This device shall attach the wheel and motor to the fan housing in one assembly providing single side service access.
- P. Warranty: The unit shall be warranted by the manufacturer against defects in material and factory workmanship for one year. The refrigerant circuit including motor-compressor, expansion device, all heat exchangers in contact with refrigerants, and reversing valve (less solenoid coil) shall be warranted for four additional years.
- Q. Supply Fan Control: Provide fan speed switch, dial, or auxiliary transformer to allow field adjustment of supply air fans during testing/balancing. Supply fan airflow rate shall be limited such that airflow rate shall operate within manufacturers required range to prevent unstable operation and/or freezing of evaporator coil. Clearly label supply fan control and provide directions for proper use of the same.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Verify structure, mounting supports and membrane installations are completed to the proper point to allow installation of roof mounted equipment, where applicable.
- C. Examine rough-in requirements for all piping systems to verify actual locations of piping connections prior to installation.
- D. Verify that electrical work installation is in accordance with manufacture's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until electrical work is acceptable to equipment installer. Coordinate sizes of all thermal overloads with Division 26.
- E. Do not proceed until unsatisfactory conditions have been corrected.
- F. Provide wiring diagrams of all equipment as specified in Division 23 Section, *Common Work Results for HVAC*.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install all equipment in accordance with manufacturer's installation instructions, in accordance with state and local code requirements, and in accordance with the contract drawings. Install all equipment plumb and level, to tolerances as required by the manufacturer of each item of equipment. Maintain manufacturer recommended clearances around and over all equipment.
- B. Coordinate vibration isolation requirements with all equipment in accordance with Division 23 Section, *Vibration Controls for HVAC, Plumbing and Fire Protection Equipment*.
- C. Coordinate all electrical requirements with Division 26.
- D. Coordinate all indoor and outdoor equipment pad locations and sizes with approved shop drawing submittals. Provide operating weights of equipment to Structural Engineer for review. Coordinate equipment pad locations and sizes with the Concrete Contractor or General Contractor. Furnish anchor bolts which are to be inserted in concrete pads to concrete installer.
- E. Verify piping arrangements of all equipment with the contract drawings. Piping details shall be strictly adhered to concerning valves, fittings, components, etc. At coils, where a rebuildable and repairable autoflow valve is installed in the line without the need for draining or shutting of the water, the same may be utilized as the isolation valve and additional shut-off valve is not required.
- F. Connect all equipment, devices and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.
- G. Testing: After installing HVAC equipment, devices and components and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
- H. Remove and replace malfunctioning units with new units and retest.
- I. All mechanical penetrations or terminations in exterior walls shall be flashed and caulked watertight.
- J. Arrange for equipment such as heat pumps to be shipped to project in modules where space constraints require the same. Field erect components as required.

3.3 FIELD QUALITY CONTROL

- A. Where indicated provide the services of a factory authorized service representative to examine the field assembly of components, installation, piping, electrical connections, controls, and clearances. Submit factory start-up check list to Engineer for information purposes. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.
- B. Where factory start-up of equipment is not specified, provide field start-up by qualified

technician to examine the field assembly of components, installation, piping, electrical connections, controls and clearances. Record equipment manufacturers standard start-up information and submit to Engineer for review. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.

- C. Charge all refrigerant systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.
- D. Fill all hydronic systems with water after flushing and test for leaks. Repair leaks and replace lost water. Coordinate with water treatment contractor.
- E. Submit to Engineer a written table of all relief valve and make-up water valve settings for each system. Provide an additional copy in the Operations and Maintenance Manuals.
- F. Verify proper motor sizes, voltages, thermal overloads, nameplate data, etc. All equipment voltages and current shall be recorded to insure that motors are operating below their service factors. Test and Balance Engineer shall record electrical data before continuous or permanent operation.

3.4 DEMONSTRATION

- A. Where indicated, provide the services of a factory authorized service representative to provide start-up and to demonstrate and train the Owner's maintenance personnel.
- B. Place equipment into operation and adjust controls and safeties. Replace damaged or malfunctioning components and controls.
- C. Training:
 - 1. Train the Owner's maintenance personnel on start-up and shut-down procedures, trouble shooting procedures, lubrication, servicing procedures and preventative maintenance schedules/procedures. Review with the Owner's personnel, the contents of the operation and maintenance data specified in Division 23 Section, *Common Work Results for HVAC*.
 - 2. Submit operation and maintenance data as soon as possible prior to project close-out. Operations and maintenance data shall be submitted to the Owner for review and comment prior to submission to the Engineer.
 - 3. Schedule training with the Owner through the Architect and/or Engineer with at least seven (7) days prior notice.
- D. Contractor shall demonstrate removal and replacement of filters at all pieces of equipment with filters in the presence of the Owners representative.

3.5 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan and equipment interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering air face.

3.6 DUCTLESS UNITS EQUIPMENT INSTALLATION REQUIREMENTS

- A. Mount indoor and outdoor units as detailed on contract drawings.
- B. Supply initial charge of refrigerant and oil as required.
- C. Install all interlock and control wiring between indoor units, outdoor units thermostats, and condensate pumps.
- D. Install indoor ceiling cassette on vibration isolators.
- E. Install outdoor units on concrete pads as indicated on drawings.
- F. Comb out fins on condensing unit where deformed or bent. Replace or repair broken fins.
- G. Install condensate lift pumps, float switches, alarm, unit shut down wiring and detection block units per manufacturer's recommendations.

3.7 WATER SOURCE HEAT PUMP EQUIPMENT INSTALLATION REQUIREMENTS

- A. Examine areas and conditions for compliance with requirements for installation tolerances, other specific conditions, and other conditions affecting performance of water-source heat pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine piping and electric rough installations for water-source heat pumps to verify actual locations of piping connections before installation.
- C. Install water-source heat pumps according to manufacturer's written instructions.
- D. Install units level and plumb, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Install water-to-water heat pumps on vibration isolation pads and concrete housekeeping pads.
- E. Piping Connections: Drawings indicate the general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 - 1. Connect supply and return piping to heat pump with unions and shutoff valves.
 - 2. Connect refrigerant piping to fan coil units and heat pumps. Size and install refrigerant piping per heat pump unit manufacturer.
 - 3. Connect heat-pump drain pan to nearest indirect waste connection, or as indicated.
 - 4. For large vertical console units, install pipe in pipe passage to allow left hand or right hand pipe entry as indicated.
- F. Duct Connections: Connect supply and return ducts to heat pumps with flexible duct connections. Provide transitions to match unit duct-connection size. Completely seal and insulate where ductwork connects to unit and filter rack.
- G. Install electrical devices furnished by manufacturer but not specified to be factory mounted.
- H. Connect low voltage safety switch wiring to heat pumps where air conditioning

condensate pumps are indicated.

- I. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- J. Replace filters used during construction. Seal all return air ducts to filter racks. Seal air tight all filter racks.
- K. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of water-source heat pumps, including piping and electrical connections. Report results in writing.
 - 1. Test and adjust controls and safeties.
 - 2. Replace damaged and malfunctioning controls and equipment.
 - 3. Test and record refrigerant pressures, air flow rates, water flow rates, electrical characteristics. Start-up company and Test and Balance Engineer must both be present during start-up to simultaneously record the above data.
- L. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
 - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 2. Review data in the maintenance manuals specified in Division 01.
 - 3. Schedule training with Owner, through Architect, with at least 7 days' advance notice.
- M. Maintain minimum of 24 inches clear space at heat pump filter access. Provide manufacturer required clearances for service at ATC control panel, fan section, compressor section and electrical section. Maintain sufficient clear space below units to allow lowering and raising of units in the future.
- N. All water source heat pumps shall be provided with auto-restart in the event of a power outage. Units shall automatically be enabled to re-start when power is restored.

END OF SECTION

DIVISION 23 SECTION 230701
HVAC INSULATION

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SECTION 230701 - HVAC INSULATION

PART 1. GENERAL

1.1. REFERENCE

- A. The Conditions of the Contract and other General Requirements apply to the work specified in this Section. All work under this Section shall be subject to the requirements of Division 23 Section, *Common Work Results for HVAC*.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section

1.2. DESCRIPTION

- A. All piping, ductwork and equipment installed under this Contract shall be covered as specified.

1.3. SCOPE

- A. The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for the correct fabrication and installation of thermal insulation applied to all piping, equipment, and duct systems, in accordance with applicable project specifications and drawings, subject to the terms and conditions of the contract.

1.4. STANDARDS

- A. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or use:
 - 1. American Society for Testing of Materials Specifications:
 - a). ASTM C 547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation".
 - b). ASTM C 533, "Standard Specification for Calcium Silicate Pipe & Block Insulation".
 - c). ASTM C 55, "Standard Specification for Mineral Fiber Blanket and Felt Insulation".
 - d). ASTM C 585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)".
 - e). ASTM C 612, "Standard Specification for Mineral Fiber Block and Board Thermal Insulation".
 - f). ASTM C 1136, "Standard Specification for Barrier Material, Vapor, "Type 1 or 2 (Jacket only)".
 - g). ASHRAE 90.1 "Energy efficient design of new buildings except low-rise residential buildings", latest edition.

- B. Insulation materials, including all weather and vapor barrier materials, closures, hangers, supports, fitting covers, and other accessories, shall be furnished and installed in strict accordance with project drawings, plans, and specifications.

1.5. SYSTEM PERFORMANCE

- A. Insulation materials furnished and installed hereunder should meet the minimum economic insulation thickness requirements of the North American Insulation Manufacturers' Association (NAIMA) (formerly known as TIMA), to ensure cost-effective energy conservation performance. Alternatively, materials should meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1, (latest edition) and "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), latest edition. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor. As minimum, all insulation thicknesses shall be as hereinafter specified.
- B. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of any one of the following specifications:
 - 1. American Society for Testing of Materials ASTM E 84
 - 2. Underwriters' Laboratories, Inc. UL 723
 - 3. National Fire Protection Association NFPA 255

1.6. QUALITY ASSURANCE

- A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications listed in Section 1.4 above.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

1.7. DELIVERY AND STORAGE OF MATERIALS

- A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.
- B. The Contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The Contractor shall also use all means necessary to protect work and materials installed by other trades.
- C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the Contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer in writing for technical assistance.

- D. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements. Protect all insulation from water, construction traffic, dirt, chemical and mechanical damage.

PART 2. PRODUCTS

2.1. GENERAL

- A. All materials to be insulated shall be thoroughly cleaned, after completion of successful tests, and shall be covered as specified below. Fiberglass insulation shall be Owens-Corning, Manville, Armstrong, or P.P.G, or as approved equal.

2.2. PIPE INSULATION MATERIALS

- A. Unless otherwise noted, insulation shall be one piece or half sectional molded fibrous glass with "K" rating of .23 at 75 degrees Fahrenheit mean temperature, for service temperatures between -60 degrees Fahrenheit and +450 degrees Fahrenheit with all service jacket. Pipe insulation shall be fiberglass SSL II with double closure system as manufactured by Owens Corning, Johns Manville, Knauf or approved equal.
- B. Exterior refrigerant pipe insulation shall be Armacell, or approved equal, foam insulation with exterior field applied aluminum jacketing. Interior refrigerant piping shall be Armacell or approved equal foam insulation. Where interior refrigerant piping is exposed also install field applied PVC jacketing.
- C. Unless otherwise noted, pipe insulation jacket shall be factory-applied vinyl coated, embossed and reinforced vapor barrier laminate, with a perm rating of not more than 0.02 perms. All hot and cold, concealed and exposed butt strips shall be of the same material as the jacket. Jacket and butt strips shall be sealed with field-applied Benjamin Foster adhesive. Jacket and butt strips shall be off-white color and shall be equivalent to Owens-Corning Fiberglass 25-ASJ.
- D. For fittings on all piping, valves and flanges, apply fiberglass molded or segmented insulation equal in thickness to the adjoining insulation and securely fasten in place using wire. Apply a skin coat of insulating cement to produce a smooth surface. After cement is dry, apply a light coat of fitting mastic, UL labeled, Type C, for cold water piping. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of Type C mastic over the reinforcing cloth, working it to a smooth finish. As an option to the above fittings, a polyvinyl chloride fitting cover may be supplied.
- E. All pipe insulation, jackets, or facings, and adhesives used to adhere jacket or facing to the insulation, including fittings and butt strips, shall have non-combustible fire and smoke hazard system rating and label as tested by ASTM E-84, NFPA 225, and UL 73, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Accessories such as adhesives, mastic cements, tapes and cloth for fittings shall have the same ratings as listed above. All products or their shipping cartons shall bear the Underwriter's label indicating that flame and smoke ratings do not exceed the above criteria.
- F. For piping having a vapor barrier insulation and for all insulated piping requiring supports, hangers and supports shall be installed outside the insulation. Wherever hangers and supports are installed outside the insulation, pipe insulation protecting shields shall be provided. Where insulation is a load bearing material, of sufficient strength to support the weight of the piping, pipe shields one-third the circumference of the insulation and of a length not less than three times the diameter of the insulation (maximum length 24-inches) shall be provided. Insulation of 7-1/4 pound or greater density will be considered as load bearing for pipe sizes up to and including 2-inches. Where insulation is not of sufficient strength to

support the weight of the piping, a half section of high density fiberglass or foam inserts, shall be provided. Vapor barrier and finish shall be applied as required to match adjoining insulation. In addition, shields shall be furnished as specified above.

- G. For piping located outside of the building, an corrugated aluminum weatherproof jacketing system shall be provided. This system shall be Micro-Lot ML as manufactured by Manville, Polyweld by Pabco Metals Corp., Childers, or as approved equal, and installed per the manufacturer's recommendations. Where outdoor piping is receiving electric heat tape, the insulation shall be oversized so that the heat tape is not compressed tightly to the pipe. Pipe jacketing shall be corrugated (3/16-inch) deep aluminum, .016-inch thickness of H-14 temper with aluminum strapping of .75-inch width and .020 inch thickness with moisture barrier. Aluminum jacketing elbows shall be smooth, .016-inch thickness and 1100 alloy. All jacketing shall have an integrally bonded moisture barrier over the entire surface in contact with the insulation. Longitudinal joints shall be applied so they will shed water and shall be sealed completely. Circumferential joints shall be closed using preformed butt strips following manufacturer's recommendations for securement. Jacket seams shall be located on the bottom side of the horizontal piping. Where project has walk-in boxes provided by a Food Service Supplier, insulate and jacket all refrigerant and freezer refrigerant pipes.
- H. All disturbed piping insulation in existing areas shall be re-insulated with insulation type, density, and thickness as specified for new piping. Insulation damaged due to new work and demolition only shall be replaced unless otherwise noted.
- I. On cold systems such as refrigerant piping cooling coil drain piping, vapor barrier performance is extremely important. All penetrations of the ASJ and exposed ends of insulation must be sealed with vapor barrier mastic. The ASJ must be protected with either a mastic coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion.
- J. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of fiberglass pipe insulation, Fiberglass pipe and tank insulation, Fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Where applicable, Victaulic PVC fitting valve and coupling covers shall be utilized. Victaulic PVC covers shall be installed with matching pipe insulation jacketing material, vinyl tape solvent weld adhesive and appropriate fasteners.
1. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable weather or vapor-resistant mastic as dictated by the system location and service. Finish valve installation with a Tyvac jacket with ends that secure to adjacent piping.
 2. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.
 3. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion. All gauge and thermometer penetrations and extensions shall be correctly sealed and insulated to prevent surface condensation.

- K. All piping shall be supported in such a manner that neither the insulation or the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing must be such that the circumferential joint may be made outside the hanger. On cold systems, vapor barrier must be continuous, including material covered by the hanger saddle.
 - 1. Piping systems 3-inches (7.5cm) in diameter or less, insulated with Fiberglass insulation, may be supported by placing saddles of the proper length and spacing, as designated in Owens-Corning Pub. 1-IN-12534, under the insulation. Hangers saddles shall be minimum 16 gauge with a saddle arc of 120 degrees minimum.
 - 2. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.
 - 3. Thermal expansion and contraction of the piping and insulation system shall generally be taken care of by utilizing double layers of insulation and staggering both longitudinal and circumferential joints. Where long runs are encountered, expansion joints may be required where single layers of insulation are being used and should be so noted on the contract drawings.
 - 4. On vertical runs, insulation support rings shall be used.

2.3. PIPING INSULATION THICKNESSES SCHEDULE

- A. All piping shall be insulated with pipe insulation of the thicknesses indicted below:

PIPING INSULATION THICKNESS SCHEDULE SERVICES	THICKNESS
Condenser Water Piping	1 ½ -inch thickness
All Drain Piping from Cooling Coils/Evaporators	½-inch thickness
All Refrigerant Piping	1 ½ -inch thickness

- B. All existing piping to remain shall have existing insulation and hangers removed to allow new insulation to be installed. Where existing hangers would penetrate new insulation vapor barrier then hangers shall be also replaced. Where existing pipes to remain are exposed, install jacketing on the new insulation and label the same.

2.4. DUCTWORK INSULATION MATERIALS AND THICKNESSES

- A. Insulate all supply, return, and outside air intake ductwork with fiberglass exterior duct insulation with factory-applied foil facing. All exposed fiberglass duct insulation shall be 1-1/2-inch rigid or non-flexible board type 3.0 pcf minimum density, 0.23 max. "K" factor at 75 degrees F mean temperature, with white vinyl A.S.J. vapor barrier facing. All concealed fiberglass duct insulation shall be 1-1/2-inch flexible blanket type, 1.0 pcf minimum density. All concealed insulation shall be 0.27 max. "K" factor at 75 degrees F mean temperature with reinforced foil-scrim Kraft vapor barrier facing.
- B. Refer to Division 23 Section, *HVAC Air Distribution System* and contract drawings for location of all sound-lined ductwork. Sound-lined ductwork from the discharge or supply side of all heat pumps shall require external insulation in addition to internal lining specified hereinafter. All other ducts indicated to be provided with interior lining shall not require additional exterior insulation.

- C. Where a vapor barrier is required, all joints, seams, tears, punctures, and other penetrations shall be closed with 3-inch (7.5cm) pressure-sensitive tape matching the facing or with vapor barrier mastic reinforced with 3-inch (7.5cm) glass scrim tape.
- D. Contractor-applied internal linings shall be as specified and installed as hereinafter specified.
- E. All disturbed ductwork insulation in existing areas shall be re-insulated with insulation type and thickness as specified for new ductwork. Duct insulation damaged due to installation of new work and demolition only shall be replaced.

2.5. ACCESSORY MATERIALS

- A. Accessory materials installed as part of insulation work under this section shall include, but not be limited to:
 - 1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
 - 2. Field-applied jacketing materials - sheet metal, plastic, canvas, fiber glass cloth, insulating cement; PVC fitting covers, PVC jacketing.
 - 3. Support Materials - Hanger straps, hanger rods, saddles.
 - 4. Fasteners, weld pins/studs, speed clips, insulation washers.
 - 5. Metal mesh or expanded metal lagging.
- B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

2.6. FIELD-APPLIED JACKET

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a). Johns Manville; Zeston.
 - b). P.I.C. Plastics, Inc.; FG Series.
 - c). Proto PVC Corporation; LoSmoke.
 - d). Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: Color-code jackets based on system.
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a). Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

5. Factory-fabricated tank heads and tank side panels.

PART 3. EXECUTION

3.1. WORKMANSHIP

- A. The Contractor shall take special care to prevent soiling equipment below or adjacent to areas being insulated. He shall be completely responsible for removing insulation cement splashes and smears and all surfaces that he mars or otherwise soils or defaces, and he will be totally responsible for restoring these damaged surfaces to their like-new condition when delivered to the site.

3.2. SITE INSPECTION

- A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.
- B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturers' recommendations.
- C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.3. PREPARATION

- A. Ensure that all pipe and equipment surfaces over which insulation is to be installed are clean and dry.
- B. Ensure that insulation is clean, dry, and in good mechanical condition with all factory-applied vapor or weather barriers intact and undamaged. Wet, dirty, or damaged insulation shall not be acceptable for installation.
- C. Ensure that pressure testing of piping or duct systems has been completed prior to installing insulation.

3.4. INSTALLATION

- A. Piping Systems
1. General:

- a). Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
- b). Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
- c). Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

- d). Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tear or other damage. Seal all tears, punctures and other penetrations of the pipe insulation vapor barrier facing.
 - e). On exposed piping, locate insulation and cover seams in least visible location.
2. Fittings: Cover valves, fittings, unions, flanges, strainers, flexible connections, expansion joints, pump bodies, strainers, blowdowns, backflow preventers, autoflow valves and similar items in each piping system using one of the following:
 - a). Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
 - b). Insulation cement equal in thickness to the adjoining insulation.
 - c). PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.
 3. Penetrations: Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.
 4. Joints:
 - a). Butt pipe insulation against hanger inserts. For hot pipes, apply 3-inch (7.5cm) wide vapor barrier tape or bank over butt joints. For cold piping, apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3-inch (7.5cm) wide vapor barrier tape or band.
 - b). All pipe insulation ends shall be tapered and sealed, regardless of service.
- B. Ductwork Insulation:
1. General:
 - a). Before installing insulation, ensure that all seams and joints in ductwork have been sealed and leak tested by the contractor responsible for the duct system. Before applying duct insulation, air ducts shall be clean and dry.
 - b). Install insulation in accordance with manufacturer's published instructions and recognized industry practice to ensure that it will serve its intended purpose.
 - c). Install insulation materials with smooth and even surfaces. Butt joints firmly together to ensure complete and tight fit over surfaces to be covered.
 - d). Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage. All staples used on ductwork insulation shall be coated with suitable sealant to maintain vapor barrier integrity and covered with pressure sensitive vapor barrier tape.

- e). Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and exposed joints. All portions of duct designated to receive duct wrap shall be completely covered with duct wrap.
- f). To ensure installed thermal performance, duct wrap insulation shall be cut to "stretch-out" dimensions. Maintain specified duct insulation thickness and vapor barrier at all fittings, obstructions, and duct flanges.
- g). A 2-inch (50mm) piece of insulation shall be removed from the facing at the end of the piece of duct wrap to form an overlapping stapling and taping flap.
- h). Install duct wrap insulation with facing outside so that the tape flap overlaps the insulation and facing at the other end of the piece of duct wrap. Adjacent sections of duct wrap insulation shall be tightly butted with the 2-inch (50mm) stapling and taping flap overlapping. If ducts are rectangular or square, install so insulation is not excessively compressed at corners. Seams shall be stapled approximately 6-inches (150mm) on center with 2-inch (13mm) (min) steel outward clinching staples.
- i). Seams, joints and staples shall be sealed with pressure-sensitive tape matching the insulation facing (either plain foil or FRK backing stock) or glass fabric and mastic. Cloth duct tape of any color or finish using reclaimed rubber adhesives shall not be utilized on duct wrap insulation. Adjacent sections of duct wrap shall be tightly butted with the 2-inch (50mm) tape flap overlapping.
- j). Where rectangular ducts are 24-inch (600mm) in width or greater, duct wrap insulation shall be additionally secured to the bottom of the duct with mechanical fasteners such as pins and speed clip washers, spaced on 18-inch (425mm) centers (maximum) to prevent sagging of insulation.
- k). Seal all tears, punctures and other penetrations of the duct wrap facing using one of the above methods to provide a vapor tight system.
- l). Upon completion of installation of duct wrap and before operation is to commence, visually inspect the system and verify that it has been correctly installed.
- m). Open all system dampers and turn on fans to blow all scraps and other loose pieces of material out of the duct system. Allow for a means for removal of such material.
- n). Check the duct system to ensure that there are no air leaks through joints.
- o). No ductwork insulation shall be supported utilizing tie wire or bailing wire. Penetrations of ductwork insulation vapor barrier are prohibited.
- p). Bevel and terminate insulation at access doors. Paint edges with vapor barrier mastic.
- q). Install insulation board between volume dampers and sheet metal standoffs.
- r). Provide removable insulation section at all pitot tube traverse points. Insulation section shall contain tether that attaches to adjacent ductwork.

2. Penetrations: Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise specified.
3. Duct Wrap Insulation: Duct wrap insulation shall be applied with all joints butted firmly together. All joints in the insulation covering shall be sealed with adhesive. Duct wrap insulation shall be secured to bottom of rectangular or oval ducts over 24 inches (60cm) wide with mechanical fasteners on 16-inch (40 cm) (approx.) centers to prevent sagging.
4. Duct Lining Insulation: Duct liner insulation shall be applied with all joints tightly butted using 90 percent coverage of adhesive meeting the requirements of ASTM C 916 plus mechanical fasteners spaced according to the liner manufacturer's schedule for the interior width of the plenum, housing, or air shaft. (Also refer to Division 23 Section, *HVAC Air Distribution System*.)

3.5. FIELD QUALITY ASSURANCE

- A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.6. PROTECTION

- A. Replace damaged insulation which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.7. SAFETY PRECAUTIONS

- A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.
- B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

3.8. INSULATION COVERING

- A. Unless otherwise noted, all exposed pipe insulation required to be insulated shall be jacketed with a PVC Jacketing with fitting covers. PVC jacket shall be color fade resistant, white high gloss, U.S.D.A. authorized as manufactured by Proto Corporation or approved equal. PVC jacketing shall be high impact, ultraviolet resistant PVC. Minimum thickness shall be 20 mils, roll stock ready for shop or field cutting and forming.
- B. Exposed areas include, but are not limited to, all mechanical equipment rooms/fan rooms, mezzanines, and penthouses exposed in an occupied space.
- C. Where PVC jackets are indicated, install with 1 inch overlap at longitudinal seams and end joints, for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Exterior exposed pipe insulation required to be insulated shall be jacketed with a corrugated aluminum jacketing system as previously described.

END OF SECTION

CANNOT BE USED FOR BIDDING

DIVISION 23 SECTION 233000
HVAC AIR DISTRIBUTION

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SECTION 233000 - HVAC AIR DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. For General Mechanical Requirements, see Division 23 Section, "Common Work Results for HVAC" and Division 01, "General Requirements".
- B. The fabrication and installation of all ductwork, together with related equipment, shall comply with the standards of the National Fire Protection Association, as set forth in NFPA Standard No. 90A, as well as with the requirements of the Sheet Metal and Air Conditioning Contractors' National Association, Inc., and the latest edition of the ASHRAE Guide.
- C. All duct sizes shown are net inside clear dimensions. Where internal duct lining is used, increase duct sizes accordingly to provide the indicated net free area. Unless otherwise indicated size runouts, drops, and connections to grilles, registers, diffusers, fans, coils, louvers, filters, and other equipment to the full size of the equipment connection.
- D. Minor changes may be made in duct sizes where required to fit the available space, provided the indicated net free area and approximate aspect ratio are maintained.
- E. Smoothly transition all ductwork to prevent excessive or unnecessary turbulence or pressure loss.

1.2 REFERENCES

- A. ASTM A 36 - Structural Steel.
- B. ASTM A 90 - Weight of coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- C. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.
- D. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- E. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- F. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- G. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.
- H. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
- I. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- J. AWS D9.1 - Welding of Sheet Metal.
- K. NBS PS 15 - Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.

- L. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- M. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- N. SMACNA - HVAC Air Duct Leakage Test Manual.
- O. UL 181 - Factory-Made Air Ducts and Connectors.
- P. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- Q. NFPA 70 - National Electrical Code.
- R. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3 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.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the projects specified in this section with minimum five (5) years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum five (5) years experience.

1.5 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA- 90A.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturer.
- B. Maintain temperatures during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 DUCTWORK

- A. Unless otherwise indicated or specified, fabricate ductwork of galvanized sheet steel, stainless steel, or aluminum conforming to Commercial Designation 3003 Temper H14 and Duct Sheet. Duct gages, jointing and reinforcement shall conform to Tables 4, 5, 6 and 7, as applicable, Chapter I of the latest *ASHRAE Guide and Data Book*. Construction details shall conform to Section I and Section II, as applicable, of *Duct Manual and Sheet Metal Construction for Ventilation and Air Conditioning Systems* as published by Sheet Metal and Air Conditioning Contractors' Association, Inc.
- B. Erect sheet metal ductwork in a first-class, workmanlike manner secured in place rigidly and permanently. Provide suitable hangers, securely attached to building construction with bolts, clips or inserts. Hangers shall be structural shapes, flat bars, or formed strap hangers; use of wire will not be permitted. Hangers shall not pass through or be inside duct. Support vertical ducts passing through floors by angles riveted to duct and resting

either on floor or on brackets secured to building construction. All space around ducts where they pass through any walls, floors, ceilings, or roofs shall be sealed tight with incombustible inert material. Do not arrange ducts so as to impair the effectiveness of fireproofing around structural members. Provide sheet metal flanged collars around exposed ducts passing through walls, floors, or ceilings to provide finished appearance. Seal all duct joints and seams including supply, return, outside air, combustion air, relief air, ventilation air and exhaust ductwork with *Hardcast Sealing System* as manufactured by Hardcast, Inc., or approved equal.

- C. Flexible connections of neoprene or other NFPA approved non-inflammable fabric shall be provided in the duct system at all fan inlet and outlet connections.
- D. Provide cut turning vanes in all duct turns where centerline radius is located. Turning vanes shall be air-foil type with extended trailing edges. Fabricate to comply with SMACNA Sheet Metal Construction for Ventilation and Air Conditioning Systems Manual.
- E. Provide duct collars and angle iron framework for mounting of automatic dampers.
- F. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- G. 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 are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- I. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4-inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.
- J. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- K. Fasteners: Rivets, bolts, or sheet metal screws.
- L. Hanger Rods: ASTM A36 - Galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCT SYSTEMS

- A. All supply, return, fresh air intake, ductwork shall be constructed for low pressure service (2 inch W.G.).

2.3 DUCT CONSTRUCTION

- A. Rectangular and/or Round Ductwork (Low Pressure):
 - 1. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G-90 Zinc coating in conformance with ASTM A90.
 - 2. Make allowance for internal duct lining where required. Sizes shown on the

drawings are inside clear dimensions.

3. Determine duct gauges for the longest duct side and use for all four sides. Joints and reinforcing requirements apply to the longest duct side.
4. Reinforce all ducts to prevent buckling, vibration, or noise as recommended in the referenced construction standards, and as required to suit the installed conditions.
5. Do not cross break duct which will receive rigid insulation covering.
6. Where tap sizes of divided-flow fittings are not indicated, make branch and main/connection sizes proportional to their respective air flows and maintain uniform transverse velocities in the fitting.
7. Make radius elbows and radius tee connection with throat radius equal to or greater than the width of the duct. Use vaned elbows where shown and where radius elbows will not fit the space, and in all square bends.
8. Turning vanes shall be the air-foil type with extended trailing edges, 36-inch maximum vane length. Where longer vanes are required, use two or more sets of vanes with intermediate runners securely fastened together.
9. Bolt, screw, rivet, or spot weld reinforcing members securely to the duct on not less than 6-inch centers.
10. Where ducts are open-ended without grilles, registers, or other means of stiffening, reinforce and stiffen the open end with standing seams or an angle frame. Provide rolled edges to prevent any exposed sharp edges.
11. Paint all cut ends on galvanized angles, rods, and other uncoated surfaces with aluminum paint.
12. Where ductwork is not painted or otherwise finished, remove all exposed traces of joint sealers, manufacturer's identification and other markings.
13. Aluminum sheet shall be 3003 H14 alloy or duct sheet, 16,000 psi minimum tensile strength, and capable of being formed to a Pittsburgh lock seam.
14. Reinforcing members for aluminum ductwork shall be galvanized steel or aluminum unless otherwise indicated. Where aluminum reinforcing is used, size the member in accordance with ASHRAE recommendations to have rigidity equivalent to listed mild steel angle sizes.
15. Where aluminum ductwork is used, make allowance for increased thermal expansion. Particularly avoid direct contact between aluminum and concrete or masonry walls subject to dampness.
16. Determine duct gauges per SMACNA based on duct size and pressure indicated.

2.4 FLEXIBLE DUCT

- A. Where indicated, flexible ductwork shall be Type SLR-25C as manufactured by General Flex Corporation, or as approved equal, insulated fully, UL listed as Class 1 Air Ducts, Standard 181, NFPA 90A and NFPA 90B with scuff-resistant polyethylene connector jacket and suitable for use in return air plenums.

- B. Limit flexible duct runs to 5 feet maximum. Install flexible ducts, using all recommended fittings, couplings, and accessories. Support ducts with wide straps spaced so that horizontal runs do not sag more than 2-1/2 inches in 5 feet. Internally seal all joints and connections, cover with duct tape, and fasten with metal duct strap clamps. Bends of 180 degrees in flexible duct are prohibited.

2.5 DUCT ACCESS DOORS

- A. Furnish and install adequately sized duct access doors at motor-operated dampers, duct coils, and other locations where indicated and required for duct access. Doors shall be the continuous piano-hinged type with approved latches and neoprene compression-type gaskets with 1 inch thick fiberglass double skin and shall be Ruskin Model ADH22, Air Balance, Inc., FSA-100 or as approved equal. Stiffen ductwork at door openings. Where doors are installed in insulated ductwork, provide equivalent insulation in the door assembly. Where access doors are installed in the fire-rated partitions, provide *Fire Seal* access doors as manufactured by Air Balance, Inc., or approved equal, UL approved, meeting the rating of the enclosure in which the access door is installed.
- B. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

2.6 OPEN END DUCTS (OED)

- A. Whether indicated on plans or not, all open-ended ducts shall be provided with a protective screen.
- B. All open-ended ducts shall be furnished with a 12 gauge 1/2 inch x 1/2 inch aluminum mesh screen. Screens shall be permanently installed in a removable frame, and the frame shall be attached to the open-ended duct in a neat, workmanship-like manner without any exposed edges or sharp surfaces.
- C. Screen shall be attached to a 3/4 inch x 1/8 inch continuous galvanized perimeter frame. Install duct stiffeners greater than 16 inches in any direction at open-ended ducts.

2.7 DRIP PANS

- A. Furnish and install suitable watertight, aluminum drip pans where water or drain piping is routed over electrical switchgear, transformers, computers, elevator machine equipment, dry storage rooms, etc. Each drip pan shall have a 1 inch copper type *M* drain piped to discharge where shown on drawings; or, if not shown, to discharge over nearest available open drain. Size and arrangement shall be as approved by Engineer. Sides shall be minimum 1.5 inches deep.
- B. Drain pans shall be of 16 gauge welded construction. Provide drawings of typical drain pan construction for approval before construction. See Submittals in Division 01 Section, "Product Requirements".

2.8 DUCT SEALANTS AND ADHESIVES

- A. All ductwork shall be sealed, including low pressure exhaust systems. Transverse joints and longitudinal seams in duct systems shall be sealed with a duct sealant of the type specified hereinafter in Section 1, 2, or 3, or with a tape sealing system as specified in Section 4. Spiral lockseams are not longitudinal seams and do not require duct sealant. All seams and joints shall require duct sealant suitable for the pressure rating and installation application. All sealants shall exceed 500 hours without becoming brittle under ASTM-D572 test conditions (oxygen bomb), unless specified otherwise. No

surface preparation or solvent cleaning shall be necessary to remove light coatings of oil and dust before applying sealant unless specified otherwise. Flanged joints shall be sealed according to Section 5. Construction joints that are not fully welded shall be sealed according to Section 6. Adhesive to secure insulation to metal surfaces shall be that specified in Section 7.

1. Assembly joints to be installed indoors shall be sealed with United Duct Sealer or equivalent, which is a solvent-based (polymeric rubber) sealant formulated to withstand temperatures from -29 degrees F to +150 degrees F. Sealant shall have a UL Classification marking with a flame spread of 15 and smoke developed of 0 when applied to inorganic reinforced cement board, both at a coverage of 31 square feet per gallon. Sealant shall exceed 750 hours without becoming brittle under ASTM-D572 test conditions (oxygen bomb).
2. Assembly joints to be installed indoors and outdoors shall be sealed with UNI-WEATHER™ duct sealer or equivalent, which is a solvent-based (Neoprene-phenolic mastic) sealant formulated to withstand temperatures from -20 to +300 degrees Fahrenheit. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 5 and smoke developed of 5 when applied to inorganic reinforced cement board, both at a coverage of 53 square feet per gallon. Sealant shall exceed 1,000 hours under ASTM-D572 test conditions (oxygen bomb) without becoming brittle and 500 hours in QUV accelerated-exterior-aging apparatus without degradation (under ASTM-C732 test conditions).
3. Assembly joints to be installed indoors shall be sealed with UNI-GRIP™ duct sealer or equivalent, which is a water-based (vinyl-acrylic polymer) sealant formulated to withstand temperatures from -25 degrees to +200 degrees Fahrenheit. Surfaces to be sealed should be clean, dry, and free from oil, grease, and dirt. Sealant shall be nonflammable (wet) and fire retardant. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 5 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 0 when applied to inorganic reinforced cement board, both at a coverage of 40 square feet per gallon.
4. Assembly joints shall be sealed with UNI-CAST® tape sealing system or equivalent, which is a combination of an adhesive activator and woven-fiber tape impregnated with a gypsum mineral compound. Modified acrylic/silicone activator (MTA-20 for indoor use) reacts exothermically with the tape to form a hard, airtight seal. Sealant shall be formulated to withstand temperatures from -40 degrees F to +200 degrees Fahrenheit. Combination of tape and MTA-20 adhesive shall have a flame spread and smoke developed of 0. Do not use for outdoors.
5. Flanged joints to be installed indoors shall be sealed with UNI-GASKET™ flange sealer or equivalent, which has a synthetic elastomer base and is formulated to withstand temperatures from -20 degrees F to +150 degrees F. Sealant shall have a UL Classification marking with a flame spread of 5 and smoke developed of 5 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 5 when applied to inorganic reinforced cement board, both at a coverage of 80 square feet per gallon.
6. Where duct fittings are constructed with standing seam or spot-welded techniques, all construction joints shall be sealed with UNI-WELD™ metal cement or equivalent, which is composed of neoprene rubber, resins, and inert

reinforcing material dispersed in a petroleum distillate. Sealant shall be formulated to withstand temperatures from -20 degrees F to +225 degrees F. Sealant shall have a UL Classification marking with a flame spread of 0 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 0 when applied to inorganic reinforced cement board, tested as applied in two 1/8 inch beads 8 inches on center.

7. Where insulation is to be secured to metal surfaces, the adhesive used shall be UNI-TACK™ duct liner adhesive or equivalent, which is a water-based, vinyl-acrylic copolymer formulated to withstand temperatures from -20 degrees Fahrenheit to +160 degrees Fahrenheit. Adhesive shall have a UL Classification marking with a flame spread of 0 and smoke developed of 0 when applied to 18-gauge galvanized steel and a flame spread of 0 and smoke developed of 0 when applied to inorganic reinforced cement board, both at a coverage of 267 square feet per gallon.
- B. Manufacturers: Duct Mate, United McGill, Semco, Elgen, Childers, Benjamin Foster, or as approved equal.

PART 3 EXECUTION

3.1 DUCT INSTALLATION REQUIREMENTS

- A. Coordinate ductwork with other work and install ducts at proper elevations and locations to maintain indicated ceiling heights and clearances. Provide all elbows, transitions, offsets, connections, and other fittings necessary to fit the work into place or to connect to equipment or diffusers. Method of duct support connection to structure and slabs shall be approved by Structural Engineer, and Shop Drawings shall be submitted.
- B. Substantially support ductwork with structural shapes, flat bars, or formed strap hangers securely attached to the building structure by means of bolts, clamps, or inserts. Support vertical ducts by angles attached to the duct and resting on the floor or supported by brackets or hangers attached to the building structure. Strap hangers shall be 16-gauge minimum galvanized steel formed under the bottom edge of duct. Use square ¼ inch thick washers tight against the bend on upper strap attachments to horizontal surfaces. Place all supports external to the ductwork and out of the air stream. Provide additional supports at coils and other concentrated loads. Arrange supports so that duct weight is not transmitted to ceilings, fans or other equipment.
- C. Prevent direct contact between ductwork and building surfaces or other equipment. Where ducts pass through walls, partitions, floors, ceilings, or roofs, pack and seal the space around the duct with an approved fire-safe inert material. Provide flanged duct escutcheons at all exposed ducts that pass through walls, partitions, floors, and ceilings.
- D. Use galvanized (compatible) corrosion-resistant hangers, supports, brackets, and hardware.
- E. Furnish and install NFPA-approved duct connections where shown and at all connections to fans, air handling units, and similar rotating equipment. Use glass-reinforced neoprene fabric, roll-formed to sheet metal strips or flanges. Support adjacent ductwork to provide sufficient slack in the connection.
- F. See NFPA 90A, and latest publication of SMACNA. Prevent direct contact between ductwork and building surfaces or other equipment. The opening in the construction around the duct shall not exceed one-inch average clearance on all sides. Where ducts pass through walls, partitions, floors, ceilings, or roofs, pack and seal the space around

the duct with an approved fire-safe inert material capable of preventing the passage of flame and hot gases sufficiently to ignite cotton waste when subjected to the same NFPA 251 Time-Temperature Conditions required for fire barrier penetration. All exposed duct penetrations shall be finished with a sheet metal field erected flange escutcheon to form a neat appearance.

- G. Coordinate duct installation with the requirements of Division 23 Section, "Vibration Controls for HVAC, Plumbing & Fire Protection Equipment".
- H. Install in accordance with manufacturer's instructions.
- I. Install and seal ducts in accordance with SMACNA *HVAC Duct Construction Standards - Metal and Flexible*.
- J. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- K. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot 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.
- L. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- M. Use crimp joints, with or without bead, for joining round duct sizes eight (8) inches and smaller with crimp in direction of air flow.
- N. Use double nuts and lock washers on threaded rod supports.
- O. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork systems.

3.2 ACCESSORY INSTALLATION REQUIREMENTS

- A. Install accessories in accordance with manufacturer's instruction, NFPA 90A, and SMACNA *HVAC Duct Construction Standards - Metal and Flexible*.
- B. Provide duct test holes where required for testing and balancing purposes. Review locations with Test and Balance Engineer prior to installation.
- C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators. Refer to Division 23 Section, "Vibration Control for HVAC and Plumbing Systems".
- D. Install duct accessories according to applicable details shown in SMACNA's *HVAC Duct Construction Standards--Metal and Flexible* for metal ducts.
- E. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- F. Adjust duct accessories for proper settings.

3.3 CLEANING

- A. Clean duct system and force air at high velocity through ducts to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which

may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

- B. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.
- C. Ductwork shall be cleaned in accordance with "Duct Cleanliness for New Construction (SMACNA 2000)", and shall achieve a "Basic" cleanliness level.

3.4 LEAKAGE TESTS

- A. All low pressure sheet metal ductwork shall undergo leakage tests at 2 inch W.G. Tests shall be accomplished under this section and witnessed as specified under Division 23 Section, "Testing, Adjusting, and Balancing for HVAC and Plumbing".
- B. Leakage from each duct system shall not exceed 5 percent for low pressure systems and 1 percent for medium pressure systems of the normal air handling capacity of the system. If the system ductwork is tested in sections, the leakage shall not exceed ½ of 1 percent of the CFM to be handled by that section, and the total leakage of the system shall not exceed 1 percent of the total system CFM. Test pressure shall not exceed the pressure limits of the duct construction as defined in SMACNA *High Pressure Duct Construction Standards*. Repair all leaks which are audible, regardless of the leakage rate of the duct system as a whole, by remaking the entire defective joint or seam. Spot sealing of ducts in place *will not* be acceptable.
- C. All duct accessories, including but not limited to volume dampers, ATC sensors, duct detectors, duct coils shall be installed prior to duct leakage testing.
- D. Submit a complete report of the ductwork leakage tests to the Architect and include final approved copies in test and balance reports.

3.5 DUCTWORK IDENTIFICATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. All ductwork shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color Code and System Identification shall comply with ANSI Standards.
- C. Marking shall be plain block letters, stenciled on ductwork (above and below ceilings) and shall be located near each branch connection and at least every ten feet on straight runs of ductwork. Where ductwork is aligned adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner as to be easily legible from the floor.
- D. Identify ductwork with plastic nameplates or stenciled painting. Identify with air handling unit identification and area served.
- E. Length of color field for ductwork shall be 32 inches. Lettering shall be minimum 3-1/2 inches high.

END OF SECTION

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SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL
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SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Foam Duct Sealant.
5. Grout.
6. Plywood Backboards.
7. Common electrical installation requirements.

- B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all electrical work.

- C. Unless otherwise specified, all submissions shall be made to, and acceptances and approvals made by the Architect and the Engineer.

- D. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with Article "Submittals" specified below. The right is reserved to make reasonable changes in location of equipment, boxes, conduit/wiring, and devices, up to the time of rough-in or fabrication.

- E. Conform to the requirements of all rules, regulations and codes of local, state and federal authorities having jurisdiction.

- F. Coordinate the work under Division 26 with the work of all other construction trades.

- G. Be responsible for all construction means, methods, techniques, procedures, and phasing sequences used in the work. Furnish all tools, equipment and materials necessary to properly perform the work in first class, substantial, and workmanlike manner, in accordance with the full intent and meaning of the Contract Documents.

- H. Arrange conduit, wiring, equipment, and other work generally as shown, providing proper clearances and access. Carefully examine all Contract Drawings and fit the work in each location without substantial alteration. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawings for approval in accordance with Article "Submittals" as hereinafter specified. The right is reserved to make reasonable changes in location of equipment, conduit and wiring up to the time of rough-in or fabrication.

1.3 PERMITS AND FEES

- A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.
- B. Permits and fees shall comply with Division 01 Section, *General Requirements*.
- C. Notify Inspection Authorities to schedule inspections of work.
- D. Notify Architect in advance of scheduled inspections.
- E. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections

1.4 EXAMINATION OF SITE

- A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for Contractor's failure to do so.
- B. Examine and verify specific conditions described in individual Specifications sections.
- C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.5 INTERPRETATION OF DOCUMENTS

- A. Any discrepancies between Drawings, Specifications, Drawings and Specifications, or within Drawings and Specifications shall be promptly brought to the attention of the Owner during the bidding period. No allowance shall subsequently be made by reason of failure to have brought said discrepancies to the attention of the Owner during the bidding period or of any error on the Bidder's part.
- B. The locations of products shown on Drawings are approximate. Place the devices to eliminate all interference with above-ceiling ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the Owner.
- C. All general trades and existing conditions shall be checked before installing any outlets, power wiring, etc.
- D. Equipment sizes shown on the Drawings are estimated. Before installing any wire or conduit, obtain the exact equipment requirements and install wire, conduit, or other item of the correct size for the equipment actually installed. However, wire and conduit sizes shown on the Drawings shall be taken as a minimum and shall not be reduced without written approval from the Owner.
- E. Where variances occur between the Drawings and Specifications or within either document itself, the item or arrangement of better quality, greater quality, or higher cost shall be included in the Contract Price. The Engineer will decide on the item and manner in which the work shall be installed.
- F. Contract Drawings are generally diagrammatic and all offsets, fittings, transitions, and accessories are not necessarily shown. Furnish and install all such items as may be required to fit the work to the conditions encountered. Arrange conduits, equipment, and other work generally as shown on the Contract Drawings, providing proper clearance and access. Where departures are proposed because of field conditions or other causes, prepare and submit detailed Shop Drawings for approval in accordance with Article "Submittals" as herein after

specified. The right is reserved to make reasonable changes in location of equipment, conduit/wiring, and devices, up to the time of rough-in or fabrication.

- G. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Architect, Engineer, and Owner.
- H. Perform the work in a first-class, substantial and workmanlike manner. Any materials installed which do not present an orderly and neat workmanlike appearance shall be removed and replaced when so directed by the Engineer, at the Contractor's expense.
- I. The complete set of Architectural, Mechanical, and Electrical Drawings and Specifications apply to this work. The successful Bidder shall familiarize himself with all other related documents.

1.6 MATERIALS AND EQUIPMENT

- A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality.
- B. Where material or equipment is identified by proprietary name, model number and/or manufacturer, furnish named item, or its equal, subject to approval by Engineer. Substituted items shall be equal or better in quality and performance and must be suitable for available space, required arrangement, and application. Submit all data necessary to determine suitability of substituted items, for approval.
- C. The suitability of named item only has been verified. Where more than one item is named, only the first named item has been verified as suitable. Substituted items, including items other than first named shall be equal or better in quality and performance to that of specified items, and must be suitable for available space, required arrangement and application. Contractor, by providing other than the first named manufacturer, assumes responsibility for all necessary adjustments and modifications necessary for a satisfactory installation. Adjustments and modifications shall include but not be limited to electrical, structural, support, and architectural work.
- D. Substitution will not be permitted for specified items of material or equipment where noted.
- E. All items of equipment furnished shall have a service record of at least five (5) years.

1.7 ELECTRICAL WORK UNDER OTHER DIVISIONS

A. Mechanical Equipment and Systems

- 1. In general, power wiring and motor starting equipment for mechanical equipment and systems are furnished and installed under Electrical Division 26.
- 2. Certain mechanical units are furnished from the factory with starters, contactors, transformers, fuses, wiring, etc., required for fans, pumps, etc. When this equipment is supplied from the factory, the Electrical Contractor must supply power circuit(s) to the unit and a disconnecting means. Coordinate with Mechanical Contractor so that one and only one, set of starters, fuses, switches, etc., is provided and installed.
- 3. In general, control and interlock equipment for HVAC systems (including associated wiring, conduit, transformers, relays, contacts, etc.) is furnished under Division 23. Division 26 shall install and connect all such equipment as necessary.
- 4. Controls, wiring, conduit, transformers, etc., for smoke, fire, and motor-operated dampers are provided under Division 23. Division 26 shall install and connect all such equipment.

- B. Carefully review the Contract Documents and coordinate the electrical work under the various Divisions.

1.8 FIRE SAFE MATERIALS

- A. Unless otherwise indicated, materials and equipment shall conform to UL, NFPA and ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of 25 and smoke developed of 50.

1.9 REFERENCED STANDARDS, CODES AND SPECIFICATIONS

- A. Specifications, Codes and Standards listed below are included as part of this Specification, latest edition:

- 1. ADA - Americans with Disabilities Act
- 2. ANSI - American National Standards Institute
- 3. ASTM - American Society for Testing and Materials
- 4. CSA - Canadian Standards Association
- 5. EPA - Environmental Protection Agency
- 6. FM - Factory Mutual
- 7. IBC - International Building Code
- 8. IEEE - Institute of Electrical and Electronics Engineers
- 9. NEC - National Electrical Code
- 10. NECA - National Electrical Contractors Association
- 11. NEMA - National Electrical Manufacturers Association
- 12. NFPA - National Fire Protection Association
- 13. OSHA - Occupational Safety and Health Act
- 14. UL - Underwriters' Laboratories

- B. Electrical construction materials shall, where a listing is normal for the particular class of material, be listed in *Electrical Construction Materials List* of the Underwriters' Laboratories, Inc. (U.L.) and shall bear the listing label. Electrical equipment shall, where a listing is normal for the particular class of equipment, be listed in the *Electrical Appliance and Utilization Equipment List* of the Underwriters' Laboratories, Inc. (U.L.) and shall bear the listing label. Materials and equipment listed and labeled as "approved for the purpose" by other nationally recognized testing laboratory, inspection agency or approved organization (such as E.T.L. or Factory Mutual) shall be acceptable.

1.10 SUBMITTALS

- A. Product Data: For items specified in Part 2 of this Section.

1.11 SUBMITTALS, REVIEW AND ACCEPTANCE

- A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect, to be in best interest of Owner.
- B. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.
- C. Submittals will be reviewed for general compliance with design concept in accordance with Contract Documents, but dimensions, quantities, or other details will not be verified.

- D. Identify submittals, indicating intended application, location and service of submitted items. Refer to Specification sections or paragraphs and Drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action and maintaining the Specification requirements if differences have not been clearly indicated in the submittal.
- E. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.
- F. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.
- G. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold Contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

1.12 SHOP DRAWINGS

- A. Prepare and submit Shop Drawings for all electrical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the Contract Drawings, or where the proposed installation differs from that shown on Contract Drawings.
- B. Submit Product Data and Shop Drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable Specification paragraph number and Drawing number.
- C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

Items and Systems

1. Conductors and Cables - 600V or Less
2. Conduit and Raceway
3. Disconnect (Safety) Switches - Fused/Non-Fused
4. Enclosed Circuit Breakers
5. Equipment Nameplates/Labels
6. Firestopping Materials
7. Fuses, 600V or Less
8. Ground Conductors
9. Hangers and Supports
10. Identification Products
11. Junction and Pull Boxes, Standard Sizes
12. Motor Controllers
13. Motor Starters
14. Operation and Maintenance Manual
15. Outlet and Device Boxes
16. Panelboard Circuit Directories
17. Receptacles
18. Record Drawings
19. Sleeves

20. Toggle/Snap Switches

- D. Submittals shall include, but not be limited to, the following information: size, type, functional characteristics, compliance with standards in Division 26, required service access which shall be suitable for intended location and use, electrical service connections and requirements, and deviations from Contract Document requirements.
- E. Submit for approval any other shop drawings as required by the Architect, Engineer, or Owner. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.
- F. For any shop drawing requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold Contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return for any reason.
- G. Prepare and submit a detailed schedule of values indicating the Contract costs for the major work items. Provide additional detail and information as requested by the Owner.

1.13 DEFINITIONS

- A. *Approve*: To permit use of material, equipment or methods conditional upon compliance with contract documents requirements.
- B. *Building Line*: Exterior wall of building.
- C. *Concealed*: Hidden from sight in chases, formed spaces, shafts, hung ceilings, embedded in construction or in crawl space or attic.
- D. *Conduits* include conduit, all fittings, identification, and other accessories relative to such conduit.
- E. *Contractor*: The Electrical Contractor and any of his subcontractors, vendors, suppliers, or fabricators.
- F. *EPDM*: Ethylene-propylene-diene terpolymer rubber
- G. *Exposed*: Not installed underground or *concealed* as defined above.
- H. *Finished Spaces*: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.
- I. *Furnish and install or provide*: To supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.
- J. *Location, Damp*: Locations protected from water and not subject to saturation with water or other liquids, but subject to moderate degrees of moisture. Examples of such locations include interior locations such as basements, crawlspaces, attics, cold-storage rooms, etc...
- K. *Location, Dry*: A location not normally subject to dampness or wetness. A dry location may temporarily be subject to dampness or wetness during building construction.
- L. *Location, Wet*: Locations subject to saturation with water or other liquids, locations exposed to weather, and installations underground or in concrete slabs or masonry in direct contact with the

Earth. Examples of such locations include all exterior locations (including those under canopies, roofed open porches, etc...) commercial kitchens, and vehicle washing areas.

M. *NBR*: Acrylonitrile-butadiene rubber.

N. *Review*: Limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

1.14 RECORD DRAWINGS

A. Upon completion of the electrical installations, the Contractor shall deliver to the Architect one complete set of prints of the electrical Contract Drawings which shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design. They shall be suitable for use in preparation of Record Drawings.

B. Contractor shall incorporate all sketches, addendums, value engineering, change orders, etc., into record drawings prior to delivering the same to the Architect.

1.15 WARRANTY

A. Contractor's attention is directed to warranty obligations contained in the General Conditions.

B. The above shall not in any way void or abrogate equipment manufacturer's guarantee or warranty. Certificates of equipment manufacturer's warranties shall be included in the operations and maintenance manuals.

C. The Contractor guarantees for a two year period from the time of final acceptance by the Owner:

1. That the work contains no faulty or imperfect material or equipment or any imperfect, careless, or unskilled workmanship.
2. That all work, equipment, machines, devices, etc. shall be adequate for the use to which they are intended, and shall operate with ordinary care and attention in a satisfactory and efficient manner.
3. That the Contractor will re-execute, correct, repair, or remove and replace with proper work, without cost to the Owner, any work found to be deficient. The Contractor shall also make good all damages caused to their work or materials in the process of complying with this section.
4. That the entire work shall be water-tight and leak-proof.

1.16 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared six (6) copies of the Operations and Maintenance Manual and deliver these copies of the manual to the Owner. The manual shall be as specified herein. The manual must be approved and will not be accepted as final until so stamped.

B. The manual shall be bound in a three-ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: *Operations and Maintenance Manual – Delaware New Castle County Detention Center Six Heat Pumps Replacements and Dry Storage- Electrical*. No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out. Provide divider tabs and table of contents for organizing and separating information.

- C. Provide the following data in the manual:
1. As first entry, an approved letter indicating the starting/ending time of Contractor's warranty period.
 2. Maintenance operation and lubrication instructions on each piece of equipment furnished.
 3. Complete catalog data on each piece of electrical equipment furnished including approved Shop Drawing/Submittal with Engineer's Comments (if any).
 4. Manufacturer's extended limited warranties on equipment.
 5. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
 6. Provide supplier and subcontractor's names, address, and phone number.
 7. Catalog data of all equipment, starters, etc. shall include wiring diagrams, parts list and assembly drawing.
 8. Approved Electrical Certificates.
 9. Start-up reports for equipment.
- D. Submit Operations and Maintenance Manual prior to anticipated date of Substantial Completion for Engineer review and approval. Substantial Completion requires that Operations and Maintenance Manuals be reviewed and approved.
- E. Deliver all instruction materials to the Owner prior to the formal instruction period.
- F. Upon completion of all work, thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electrical equipment and systems.
- G. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance.
- H. Instructions shall be given only by experts in the equipment or system and shall include descriptions and demonstrations of procedures of operation, data record keeping, etc.
- I. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 4-hour period.
- J. Where specified in technical sections, provide longer periods required for specialized equipment.
- K. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.
- L. The Operations and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.
- M. Schedule the general and specialized instruction periods for a time agreed upon by the Owner.

PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.3 FOAM DUCT SEALANT

- A. Description: Two-part, high-expansion foam duct sealant to keep water, acids, dust, gases, insects and rodents out of ducts (conduits).
- B. 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. American Polywater Corporation
- C. Basis of Design: FST Foam Sealant by American Polywater Corporation.
- D. The foam duct sealant shall be a two-part "blown" urethane foam with 98% closed cell content.
- E. The foam duct sealant shall have a compressive strength of 300 pounds (ASTM D1691), a tensile strength of 250 pounds (ASTM D1623), and a flexural strength of 450 pounds (ASTM D790).
- F. The foam duct sealant shall be compatible with common cable jacket materials. The cured foam shall be an inert solid that does not affect jacket materials.
- G. The foam duct sealant shall withstand temperatures from -20 degrees Fahrenheit to 200 degrees Fahrenheit and shall not lose function in direct sunlight
- H. The foam duct sealant shall be chemically resistant to gasoline, oils, dilute acids and bases, and most unsaturated hydrocarbons.
- I. The foam duct sealant shall foam and react in five to ten minutes at 70 degrees Fahrenheit.
- J. When installed, the sealant shall be capable of holding 7.25 psi air pressure continuously (equivalent of 16.4 feet water-head pressure).

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Install equipment with working space and dedicated space in strict accordance with 2008 NEC Article 110.26.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- G. Verify exact electrical service requirements for each piece of equipment receiving electrical connections. Provide proper service for each.
- H. Include any and all items required by the National Electrical Code and/or field conditions for the proper connection and installation of each piece of equipment.
- I. Right of Way: Give to piping systems installed at a required slope.
- J. Coordinate electrical work with architectural items and equipment by others.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Size pipe sleeves to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements of Division 26 Section "Electrical Firestopping".
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Cut sleeves to length for mounting flush with both surfaces of walls.

3.3 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 26 Section, "Electrical Firestopping".

3.4 SUPPORTS, HANGERS AND FOUNDATIONS

- A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.
- B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

3.5 PAINTING AND FINISHES

- A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.
- B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.
- C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.
- D. Protect all finishes and restore any finishes damaged as a result of work under Division 26 to their original condition.
- E. The preceding requirements apply to all work, whether exposed or concealed, as defined herein.
- F. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces. Do not paint manufacturer's labels or tags.
- G. All exterior equipment and conduits shall be painted to match adjacent surface in color as selected by Owner, unless otherwise indicated by the Architect and Owner.
- H. All exposed conduit, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Owner and conform to ANSI Standards.

3.6 COLOR SELECTION

- A. Color of finishes shall be as selected by the Owner.

3.7 PROTECTION OF WORK

- A. Protect work, material and equipment from weather and construction operations before and after installation. Properly store and handle all materials and equipment.
- B. Cover temporary openings in conduits and equipment to prevent the entrance of water, dirt, debris, or other foreign matter. Deliver conduits with factory applied end caps.
- C. Cover or otherwise protect all finishes.
- D. Replace damaged materials, devices, finishes and equipment.
- E. Protect stored conduits from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, where stored inside.

3.8 OPERATION OF EQUIPMENT

- A. Clean all systems and equipment prior to initial operation for testing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.
- B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.
- C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing.
- D. Do not use electrical systems for temporary services or during construction, unless approved by Owner in writing. Refer to Division 01 Section "Temporary Facilities and Controls".
- E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items.

3.9 TESTING AND ADJUSTMENT

- A. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices and perform all necessary preliminary tests to assure that the work is complete and ready for final test.
- B. Adjust all systems, equipment and controls to operate in a safe, efficient and stable manner.
- C. On all circuits, 600 volts or less, provide circuits that are free from ground faults, short circuits and open circuits.
- D. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.
- E. Submit all test results to the Architect/Engineer for approval.

3.10 WALL AND FLOOR PENETRATIONS

- A. All penetrations of partitions, ceilings, roofs and floors by or conduit under Division 26 shall be sleeved, sealed, and caulked airtight for sound and air transfer control. Penetrations of mechanical room partitions, ceilings, and floors shall be as specified in Division 26.
- B. All penetrations of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 26 Section, "Electrical Firestopping".
- C. Provide conduit escutcheons for all exposed conduit penetrations in finished interior spaces and all exposed exterior penetrations. Escutcheons shall match those provided under Division 23.

3.11 EQUIPMENT BY OTHERS

- A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.
- B. It shall be the responsibility of the supplier of the equipment to furnish complete instructions for connections. Failure to do so will not relieve the Contractor of any responsibility for improper equipment operation.

3.12 PHASING

- A. Refer to Architectural Specifications and Contract Drawings for any required phasing.
- B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities Having Jurisdiction (AHJ).
- C. Provide dust barriers/partitions, penetration closures, etc, to ensure safety of building occupants and protection of existing surroundings.
- D. The Building shall remain watertight at all times.
- E. Refer to phasing plans for additional requirements.
- F. While work is in progress, except for designated short intervals during which connections are made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The Contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

3.13 OUTAGES

- A. Provide a minimum of fourteen (14) days notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.
- B. Submit *Outage Request Form*, attached at the end of this Section, to Owner for approval.

3.14 CUTTING AND PATCHING

- A. Accomplish all cutting and patching necessary for the installation of work under Division 26. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore

disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.

- B. Do not cut structural members without approval from the Architect or Engineer.

3.15 CONNECTIONS AND ALTERATIONS TO EXISTING WORK

- A. Unless otherwise noted on the Drawings, where existing electrical work is removed, including hangers, to a point below finished floors or behind finished walls and capped, such point shall be far enough behind finished surfaces to allow for installation of normal thickness of required finish material.
- B. Where work specified in Division 26 connects to existing equipment, conduits, etc., Contractor shall perform all necessary alterations, cuttings, fittings, etc., of existing work as may be necessary to make satisfactory connections between new and existing work, and to leave completed work in a finished and workmanlike condition.
- C. Where the work specified under Division 26, or under other Divisions, requires relocation of existing equipment, conduit etc., Contractor shall perform all work and make necessary changes to existing work as may be required to leave completed work in a finished and workmanlike condition.
- D. Where the relocation of existing equipment is required for access or the installation of new equipment, the Contractor shall temporarily remove and/or relocate and re-install as required to leave the existing and new work in a finished and workman like condition.

3.16 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
 - 5. To provide working space and dedicated space clearances per 2008 NEC Article 110.26.
- B. Coordinate installation of required supporting devices.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26 Section "Electrical Firestopping".

3.17 DEMOLITION

- A. Unless otherwise noted all existing equipment, conduit, wire, etc., shall remain.
- B. Where existing equipment is indicated to be removed, all associated conduit, power, controls, insulation, hangers, supports and housekeeping pads, etc..., shall also be removed. Patch, paint and repair walls/roof/floor to match existing and/or new finishes.

- C. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.
- D. The location of all existing equipment, conduits etc., indicated is approximate only and shall be checked and verified. Provide all new electrical work required to connect to or clear existing work as applicable.
- E. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the Authorities Having Jurisdiction (AHJ).
- F. Make provisions and include in bid all costs associated with confined entry/space requirements in crawl spaces and all other applicable OSHA regulations.
- G. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing conduit systems to new conduit systems.
- H. At completion of project all temporary conduit, wires, etc., shall be removed in their entirety.
- I. Existing conduit, equipment, wiring, etc., not required for re-use or re-installation in this project, shall be removed from the project site.
- J. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.
- K. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing PCB's.
- L. Where conduit and wiring are removed, remove all conduit hangers which were supporting the removed conduit. Patch the remaining penetration voids with like materials and paint to match existing construction.
- M. Before demolition begins, and in the presence of the Owners representative, test and note all deficiencies in all existing systems affected by demolition but not completely removed by demolition. Provide a copy of the list of system deficiencies to the Owner and the Engineer. Videotape existing conditions in each space prior to beginning demolition work.
- N. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.
- O. All devices and equipment designated by the Owner to remain the property of the Owner shall be moved and stored by the Contractor at a location on site as designated by the Owner. It shall be the Contractor's responsibility to store all devices and equipment in a safe manner to prevent damage while stored.
- P. All existing equipment refused by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor in a timely manner and disposed of in a legal manner.

- Q. Work Abandoned in Place: Cut and remove conduit a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.
- R. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.
- S. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

END OF SECTION

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE: _____

END OUTAGE - TIME: _____ DATE: _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____
(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ___ NO ___ BY: _____ DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER : _____

OWNER'S PRESENCE REQUIRED: _____

YES: ___ NO: ___ NAME: _____

POINT OF CONTACT: _____ PHONE: _____

CANNOT BE USED FOR BIDDING

DIVISION 26
SECTION 260519
CONDUCTORS AND CABLES
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SECTION 260519 - CONDUCTORS AND CABLES

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 building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 SUBMITTALS

- A. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Indicate procedures and values obtained.
- B. Product Data: Provide for each cable assembly type, wire, cables, conductors, and connectors.
- C. Project Record Documents: Record actual locations of components and circuits.

1.4 QUALITY ASSURANCE

- A. Listing and Labeling: Provide wires and cables specified in this Section that are listed and labeled.
 - 1. The Terms *Listed and Labeled*: As defined in NFPA 70, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* as defined in OSHA Regulation 1910.7.
- B. Comply with NEMA/Insulated Cable Engineers Association (ICEA) Standards.
- C. Comply with NECA Standard of Installation.
- D. American Society for Testing and Materials (ASTM): Comply with requirements of the following:
 - 1. B3: Standard Specification for Soft or Annealed Copper Wire
 - 2. B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. D753: Standard Specification for General Purpose Polychloroprene Jacket for Wire and Cable
- E. Electrical Testing Laboratories (ETL): Provide wiring, cabling and connector products which are ETL listed and labeled.
- F. Institute of Electrical and Electronics Engineers (IEEE): Comply with the following standards which apply to wiring systems:
 - 1. 82: Test procedure for Impulse Voltage Tests on Insulated Conductors

2. 241: Recommended Practice for Electric Power Systems in Commercial Buildings
 - G. NFPA: Comply with NFPA 70 requirements for construction, installation and color coding of electrical wire, cable and connections.
 - H. National Electrical Manufacturer's Association (NEMA): Comply with requirements of the following:
 1. WC5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - I. UL: Provide material conforming to the following standards:
 1. UL 83 - Thermoplastic-Insulated Wires and Cables.
 2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - J. UL Labels: Provide wiring, cabling and connector products which are UL listed and labeled.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver wires and cables according to NEMA WC 26, *Wire and Cable Packaging*.
 - B. Storage: Store wire and cable in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.
 - C. Handling: Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.
- 1.6 COORDINATION
- A. Coordinate layout and installation of cables with other installations.
 - B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by Architect.
 - C. Determine required separation between cables and other work.
 - D. Determine cable routing to avoid interference with other work.
- 1.7 PROJECT CONDITIONS
- A. Verify that field measurements are as shown on the Drawings.
 - B. Conductor sizes are based on copper.
 - C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
 - D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

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. Wires and Cables:

- a. American Insulated Wire Corp.; Leviton Manufacturing Co.
- b. BICC Brand-Rex Company.
- c. Carol Cable Co., Inc.
- d. Senator Wire & Cable Company.
- e. Southwire Company.
- f. Colonial Wire Company

2. Connectors and Accessories for Wires and Cables:

- a. AMP Incorporated.
- b. Buchanan.
- c. General Signal; O-Z/Gedney Unit.
- d. Monogram Company; AFC.
- e. NSI Industries, Inc.
- f. Square D Company; Anderson.
- g. 3M Company; Electrical Products Division.

3. Metal Clad (MC) Cable

- a. Alcan Cable
- b. Atkore AFC Cable Systems
- c. Encore Wire Corporation
- d. General Cable
- e. Nexans
- f. Prysmian Cables and Systems
- g. Service Wire Company
- h. Southwire Company
- i. United Copper Industries

2.2 BUILDING WIRES AND CABLES

- A. UL-listed building wires and cables with conductor material, insulation type, cable construction and rating as specified herein.
- B. Building wires and cables shall be annealed (soft) copper, 600 volt, Type THHN/THWN (dual-rated) single conductors rated 90°C dry / 75°C wet, with a minimum conductivity of 98 percent at 20°C (68°F), or a maximum resistivity of 1.7 micro-ohms per centimeter.
- C. Conductors shall meet or exceed requirements of all applicable ASTM specifications, UL Standard 83, UL Standard 1581, NEMA WC 70, Federal Specification A-A-59544 and shall be RoHS/REACH Compliant.
- D. Conductors shall be solid for No. 10 AWG and smaller, and stranded for No. 8 AWG and larger.
- E. Building wire and cables shall be color-coded using colors factory impregnated throughout the insulation and jacket. The following color code convention(s) shall be used except where existing systems have established another color code convention:
 - 1. 120/208-Volt, 3-Phase, 4-Wire System:
 - a. Phase A: Black
 - b. Phase B: Red
 - c. Phase C: Blue
 - d. Neutral: White
 - e. Ground: Green
 - 2. 277/480-Volt, 3-Phase, 4-Wire System:
 - a. Phase A: Brown
 - b. Phase B: Orange
 - c. Phase C: Yellow
 - d. Neutral: Gray
 - e. Ground: Green
- F. Thermoplastic insulation material shall comply with NEMA WC 5.

2.3 CONNECTORS AND SPLICES

- A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 Article, "*Wire and Insulation Applications*".
- B. Split Bolt Connectors: Not acceptable.
- C. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.
- D. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- E. All wire connectors used in underground or exterior pull boxes shall be gel-filled twist connectors or a connector designed for damp and wet locations.

- F. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.
- G. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic high conductivity copper tubing, internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.
- H. Heat shrinkable tubing shall meet the requirements of ANSI C119.1-1986 for buried connections to 90 degrees C and shall be material flame-retarded per IEEE 383 *Vertical Tray Flame Test*.
- I. Wire Nut Connectors:
 - 1. Wire nuts installed in wet locations, exterior, etc., shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air.
 - 2. Connectors shall be UL listed and appropriately sized according to manufacturer's recommendation for the suitable wire sizes and voltage rating (600 volt minimum).
 - 3. Connector body shall have a color-coded outer shell.
 - 4. Connectors shall be as manufactured by King Technology or approved equal.

2.4 METAL CLAD (MC) CABLE AND CONNECTORS

- A. Cable shall meet or exceed the requirements of UL Standard 83, UL Standard 1063, and UL Standard 1569 for Type MC cable, Federal Specification A-A59544 Vertical Cable Tray Flame Test and the National Electrical Code. Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.
- B. Cable shall be constructed with soft drawn copper, 600 volt, type THHN/THWN conductors rated 90°C dry/75°C wet, with a green insulated grounding conductor. Only cables with conductor sizes 12 AWG and 10 AWG shall be permitted. Conductors shall be cabled together with a binder tape bearing a print legend that is wrapped around the assembly. An aluminum interlocked armor shall be applied over the assembly. Conductors shall be protected by an anti-short bushing at each termination.
- C. Straight connectors shall be one-piece spring-steel, set screw design with nylon insulator. Provide cable Lok XC-73 series, as manufactured by Steel City, or approved equal.
- D. 90°C connectors shall be die cast zinc, clamp type with insulated throat. Provide XC-89 series as manufactured by Steel City, or approved equal.

2.5 INSULATING TAPE, PUTTY, RESIN AND SUPPORTS

- A. Tape: Provide plastic electrical insulating tape which is flame-retardant, cold and weather-resistant. Tape for use in areas subject to temperatures 30 degrees C to 105 degrees C, or where the tape will be subjected to an oil splash, tape shall have a minimum thickness of 8.5 mils, and shall consist of an oil-resistant acrylic adhesive.
- B. Materials: Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases, or compositions of the type approved for the particular use, location, voltage and temperature and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

- C. Supports: Provide cable supports of the wedge type which firmly clamp each individual cable and tighten due to the cable weight.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. By beginning work, the Contractor has accepted conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRE AND INSULATION APPLICATIONS

- A. No branch circuit wires smaller than #12 AWG shall be used unless otherwise indicated. Conductors shall be continuous from outlet to outlet and from terminal board to point of final connection, and no splice shall be made except within outlet or junction boxes. All conductors shall be of the size indicated. All wires #8 AWG and larger shall be stranded.
- B. Control wiring shall not be less than #14 AWG and shall be color coded using colors impregnated into the insulation. All wiring, contacts, and terminal blocks shall be suitably tagged for ease in identification and tracing of circuits. Identification tags shall be engraved fiber or plastic type, subject to acceptance. Wires shall be numbered and coded, using Brady *Quicklabels*, or equal.
 - 1. Wiring shall be tagged at terminations, in pull boxes, junction boxes, outlet boxes, panelboards, handholes, etc...
- C. Switch leg wire shall be labeled with "S" tag.
- D. All control wiring shall be color coded with wires of colors different from those used to designate phase wires.
- E. Wiring for general 15 and 20 amp branch circuit work shall be as follows unless otherwise indicated:
- F. Joints of #10 AWG and smaller shall be made with properly insulated solderless type pressure connectors. Where stranded conductors or multiple solid conductors are connected to terminals, solderless lugs manufactured by Thomas and Betts Company or equivalent shall be used.
- G. Joints of #8 AWG and larger in power and lighting circuits shall be of the type indented into the conductor by means of a hand or hydraulic pressure tool. Connectors shall be Burndy *Hy-dent*, T&B *Sta-Kon*, or equivalent. Connectors for control wiring shall be Burndy *Hy-Lug*, or equivalent.
- H. Branch circuits for lighting and power concealed in ceilings and drywall partitions may be accomplished by utilizing type MC (metal clad) cable. Cables shall be supported with appropriate hangers. Tie wire will not be accepted.

- I. All exterior wiring shall be installed in conduit as specified above, unless otherwise noted on the Drawings.

3.4 INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's *Standard of Installation*.
- B. Remove existing wires from raceway before pulling in new wires and cables.
- C. Pull Conductors: Use a UL-listed and manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway. Completely and thoroughly swab conduit system before installing conductors.
- E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Division 26 Section, *Common Work Results for Electrical* and Division 26 Section, *Hangers and Supports*.
- G. Seal around cables penetrating fire-rated elements according to Division 26 Section *Electrical Firestopping*.
- H. Identify wires and cables according to Division 26 Section, *Electrical Identification*.
- I. Conductors installed in parallel shall be of equal lengths.
- J. Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet.
- K. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.
- L. The Contractor shall provide suitable installation equipment to prevent cutting and abrasion of conductor insulation. The Contractor shall use suitable cable guides, pulleys, and protective sleeving to prevent damage to cable during installation. Ropes used for pulling of wire and cable shall be made of polyethylene or other suitable non-metallic material. Pulling lines shall be attached to cable by means of either woven basket grips or pulling types attached directly to the conductors. Wire pulling lubricants, if used, shall conform to UL requirements applicable to the various insulations and raceway materials. The lubricants shall be certified by the manufacturer to be non-injurious to such insulation and materials.
- M. Each cable shall be labeled at terminals and at all accessible points in equipment and in pull boxes. Each control wire shall be labeled at both ends. Labels shall be self-sticking wire markers.
- N. Riser cables shall have cable supports as required by Code.

- O. For rubber and plastic-covered wire and cable, pulling compound Ideal Yellow 77 may be used.
- P. Terminal lugs for wires #8 AWG and larger shall be T&B 54,000 Series or Burndy *HY-Dent*, compression type, unless noted otherwise. One-hole lugs for #4/0 AWG and smaller. Two-hole lugs for all sizes #250 kcmil AWG and larger.
- Q. Install wires and cables using braided rope larger than the cable being pulled to keep twists to a minimum.
- R. Provide an insulated green ground equipment grounding conductor (EGC), sized per NEC, for all feeder and branch circuits, shown or not shown.
- S. Install electrical cables, wires, and connectors as indicated in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices.
- T. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- U. Conductors installed in runs within 6 inches of heating pipes or equipment shall be type AVA.
- V. No conductors shall be drawn into conduit until all work, which may cause cable damage, is completed.
- W. During installation, do not deform cable by improper bending, stretching, twisting, kinking, or pinching, nor do any other abusive handling. Any failure to observe these instructions will be detected and corrected during the demonstrations following completion of the installation. All cable runs shall contain S loops or other means to accommodate expansion or contraction as required. Cable bends will have a radius not less than the value recommended by the cable manufacturer. Cable connected to electronic equipment in the system shall be tagged to show its function and the location of its other end. All labels shall be of durable material and securely fastened to the cable.
- X. Wiring of different system voltages shall not be mixed at pull boxes enclosures, surface metal raceway, wiretrough, etc., unless a barrier (separator) is provided between the differing systems.

3.5 CONNECTIONS

- A. Conductor Splices: Keep to minimum.
- B. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
- C. Use splice and tap connectors compatible with conductor material.
- D. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Wire splices and taps shall be adequate to carry full current rating of wire.

- G. Splices and taps in wires up to #8 AWG shall be made with *Scotch-lok* or T&B PT Series or Ideal Wing Nut insulated electrical connectors. Wire nuts installed in wet location boxes shall be silicon gel-filled. For wires #8 AWG and larger, use copper solderless connectors covered with insulating molded body and then wrapped with electrical tape. Use twist-on wire connectors for connecting lighting fixtures and small motor leads up to #8 AWG wire.
- H. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes may be utilized where required. Wire connectors of insulating material or solderless pressure connections, properly taped, shall be utilized for all splices in wiring.
- I. Splices in branch circuits and feeders shall be made where indicated or as required for the installation. All splices shall be accessible and made in enclosure approved for that purpose.
- J. For splices in branch circuits and feeders, provide connectors as follows;
 - 1. Wire Sizes #14 AWG to #10 AWG: Provide Ideal Model 74B or 76B or equivalent by T&B.
 - 2. Wire Sizes #8 AWG and Larger: Provide Ideal Model Series AGP and GT or equivalent by Burndy, O-Z, or T&B. All splices shall be enclosed in insulating molded thermoplastic, rubber, or rubber-like covers or shall be wrapped with Bishop No. 111 or equivalent insulating tape in accordance with the Manufacturer's directions.
- K. Thoroughly clean wiring prior to installing lugs or connectors.

3.6 IDENTIFICATION

- A. Interface with Other Work:
 - 1. Identify wire and cable using Thomas and Betts Type WM vinyl markers.
 - 2. Identify each phase and neutral conductor with its circuit number or other designation indicated on the Drawings in all junction, pull, terminal boxes, and cabinets.
- B. Provide identification tags on each conductor entering panel, switch, junction box, and pull box to identify conductor.
- C. Comply with the requirements of Division 26 Section, *Electrical Identification*.
- D. Feeder Identification: Securely fasten nonferrous identifying tags or pressure-sensitive labels to all cables, feeders, and power circuits in pull boxes, handholes, panelboards, and at termination of cables.
 - 1. Tags or labels shall be stamped or printed to correspond with markings on Contract Drawings or marked so that feeder or cable may be readily identified.
 - 2. If suspended type tags are provided, they shall be attached by approximately 55-pound test monofilament line or slip-free plastic cable lacing units.

3.7 FIELD QUALITY CONTROL

- A. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.2. Certify compliance with test parameters.
- B. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
- C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.
- D. Verify continuity of each branch circuit conductor.
- E. Tests: All wire and cable branch circuit insulation shall be tested after installation, and before connection to fixtures and appliance.
 1. Tests shall be performed with a 1,000-volt megger, and conductors shall test free from short-circuits and grounds.
 2. Conductors shall be tested phase-to-phase and phase-to-ground.
 3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Owner's Representative.
 4. Actual test readings shall be recorded.
 5. Submit all test reports to the Architect for approval.
- F. Demonstration: Subsequent to wire and cable hook-ups, energize circuit and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

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SECTION 260526
GROUNDING AND BONDING
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CANNOT BE USED FOR BIDDING

SECTION 260526- GROUNDING AND BONDING

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 grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.
- B. Bond each separately-derived system neutral to nearest grounding system.
- C. Bond together system neutrals; service equipment enclosures; exposed non-current carrying metal parts of electrical equipment; metal raceway systems; grounding conductor in raceways; receptacle ground connectors; and plumbing systems.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 - National Electrical Code.
- B. Comply with UL 467 - UL Standard for Safety Grounding and Bonding Equipment.
- C. Comply with IEEE Standard 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms *Listed* and *Labeled*: As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* (NRTL) as defined in OSHA Regulation 1910.7.

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. Erico Inc.; Electrical Products Group.
 - 2. Ideal Industries, Inc.
 - 3. ILSCO.
 - 4. Raco, Inc.
 - 5. Thomas & Betts, Electrical.

2.2 GROUNDING AND BONDING PRODUCTS

- A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Comply with Division 26, Section "Conductors and Cables". Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductors: Size as indicated on the Drawings, or as required by 2008 National Electrical Code (NEC) Table 250-122, whichever is larger. Insulated with green color insulation.
- C. Grounding Electrode Conductors: Size as indicated on the Drawings, in the Specifications, or as required by 2008 National Electrical Code (NEC) Table 250-66, whichever is larger. Insulated with green color insulation, unless installed in direct contact with earth, in which case conductors shall be bare.
- D. Bare Copper Conductors: Conform to the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.4 CONNECTOR PRODUCTS

- A. Mechanical Connectors
 - 1. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper ally material. Bolts, nuts, washers and lockwashers shall be made of silicon bronze and supplied as a part of the connector body and shall be of the two-bolt type.
 - 2. Split bolt connector types are NOT allowed.
 - 3. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.
- B. Compression Connectors
 - 1. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99 percent by IACS Standards.
 - 2. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.
 - 3. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.
 - 4. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.
 - 5. Each connector shall be factory filled with an oxide-inhibiting compound.

PART 3 EXECUTION

3.1 APPLICATION

- A. Equipment Grounding Conductors: Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.
1. Install Equipment Grounding Conductor (EGC) with circuit conductors for the items below in addition to those required by Code:
 - a. Feeder circuits.
 - b. Receptacle branch circuits.
 - c. Single-phase motor or appliance branch circuits.
 - d. Three-phase motor or appliance branch circuits.
 - e. Flexible raceway runs.
 - f. Metal-clad cable (MC) runs.
 2. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
 3. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and above, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- B. Separately Derived Systems: Where NEC requires grounding, ground according to NEC Article 250-26.

3.2 INSTALLATION

- A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.
- B. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Grounding shall satisfy requirements of the applicable publications. All exposed noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in nonmetallic raceways, and grounded conductors of the wiring system shall be grounded.
- D. Equipment grounding conductors shall be extended from the ground bus in the distribution equipment to the receptacle, fixture or device lugs where they are provided. When not provided, they shall be connected to equipment enclosures. The connections shall be arranged such that removal of receptacle, the equipment grounding conductors, or ground jumpers from ground bus, shall not affect the system ground.
- E. Raceways shall not be considered as a grounding conductor. Each power, lighting, or control raceway shall have a separate equipment grounding conductor installed. Receptacles shall

have a separate grounding pole. All switchgear and bus duct shall be equipped with a grounding bus separate from the neutral bus.

3.3 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure 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.
- B. Equipment Grounding Conductor (EGC) Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- C. Non-Contact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.
- D. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.
- E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- F. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

END OF SECTION

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SECTION 260528
ELECTRICAL FIRESTOPPING
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SECTION 260528 - ELECTRICAL 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. Through-penetration firestopping in fire rated construction.
 - 2. Through-penetration smoke-stopping in smoke partitions.
- B. Related items: Raceway seals and manufactured electrical devices: Refer to Division 26 Section, "Raceways and Boxes".

1.3 REFERENCES

- A. Underwriters Laboratories
 - 1. UL Fire Resistance Directory
 - a. Through-penetration firestop devices (XHCR)
 - b. Fire resistance rating (BXUV)
 - c. Through-penetration firestop systems (XHEZ)
 - d. Fill, void, or cavity material (XHHW)
- B. American Society for Testing and Materials Standards: ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.4 DEFINITIONS

- A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.
- B. Barriers: Time-rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.
- C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.
- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
- E. System: Specific products and applications classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

- F. Sleeve: Metal fabrication or pipe section extended through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other Sections and may or may not be required.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

- 1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption.
- 2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption.

1.6 SUBMITTALS

- A. Submit in accordance with Division 01, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including the following:
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions.

1.7 QUALITY ASSURANCE

- A. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.
- B. Materials shall have been tested to provide fire rating at least equal to that of the construction.
- C. Manufacturer shall be a member of the International Firestop Council (IFC).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping:
 - 1. Deliver products in original unopened packaging with legible manufacturer's identification.
 - 2. Coordinate delivery with scheduled installation date, allow minimum storage at site.
- B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.9 PROJECT CONDITIONS

- A. Existing conditions:
 - 1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.
- B. Environmental requirements:
 1. Furnish adequate ventilation if using solvent.
 2. Furnish forced air ventilation during installation if required by manufacturer.
 3. Keep flammable materials away from sparks or flame.
 4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

1.10 GUARANTEE

- A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fall in joint adhesion, extrusion resistance, migration resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be two years from date of substantial completion unless otherwise noted.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 1. Hilti.
 2. 3M
 3. Nelson.

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

- A. Systems of devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrate type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.
 1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.
 2. Acceptable manufacturers and products.
 - a. Those listed in the UL Fire Resistance directory for the UL System involved and as further defined in the "System and Applications Schedule" in Part 3 of this Section.
 - b. All firestopping products must be from a single manufacturer.

2.3 ACCESSORIES

- A. Fill, void or cavity materials: As classified under category XHHW in the UL Fire Resistance Directory.
- B. Forming materials: As classified under category XHKU in the UL Fire Resistance Directory.
- C. Sleeves: Minimum 24 MSG galvanized steel, 12-inch diameter or smaller steel pipe. Sleeve shall project ½-inch from each surface of the floor/wall. Size as recommended by firestop manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

- A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.
- B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.
- C. Protect materials from damage on surfaces subject to traffic.
- D. When large openings are created in walls or floors to permit installation of conduits, cable tray, or other items, close unused portions of opening with firestopping materials tested for the application.
- E. Install smoke stopping as specified for firestopping.
- F. Provide sleeves the full thickness of the assembly being penetrated and cut sleeves to a length of 1-inch more than the over-all thickness of the penetration, or as recommended by the firestop manufacturer.

3.4 FIELD QUALITY CONTROL

- A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

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AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

3.5 ADJUSTING AND CLEANING

- A. Clean up spills of liquid components.
- B. Neatly cut and trim materials as required.
- C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.6 SYSTEMS AND APPLICATION SCHEDULES*

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
Metal Pipe	CAJ1001 CP25S/L, CP25N/S CAJ1006 CS-195+, FS-195+ CAJ1007 FS-195+, 1-inch& 2-inch Wide CAJ1009 2000, 2000+, 2003 CAJ1010 2000, 2000+, 2003 CAJ1012 2000, 2000+, 2003 CAJ1013 2000, 2000+, 2003 CAJ1014 2000, 2000+, 2003 CAJ1015 2000, 2000+, 2003 CAJ1017 FD 150 CAJ1021 FD 150 CAJ1027 MPS-2+ CAJ1044 CP 25WB+ CAJ1052 CP 25S/L, CP 25N/S CAJ1058 2000, 2000+, 2003 CAJ1060 2000, 2000+, 2003 CAJ1063 2000, 2000+, 2003 CAJ1066 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1091 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1092 CP 25WB+ CAJ1112 FS-195+ CAJ1160 CP 25S/L, CP 25N/S CAJ1175 CP 25WB+ CAJ1176 CP 25WB+ CAJ1188 2000+ CBJ1020 CS-195+, FS-195+ CBJ1021 CS-195+, MPS-2+ CBJ1031 2001 CBJ1032 2001 FA1002 CP 25WB+ WJ1010 CP 25WB+ WJ1023 2001	WL1001 CP 25 WL1002 FS-195+ WL1003 CP 25WB+,CP 25N/S WL1008 2000+ WL1009 2000+ WL1010 2000+ WL1016 CP 25WB+ WL1017 CP 25WB+,CP 25N/S WL1032 CP 25WB+,CP 25N/S WL1036 FD 150 WL1037 CS-195+,FS-195+ WL1067 CP 25N/S WL1073 CP 25WB+ WL1080 MPS-2+ WL1082 2000+	FC1002 CP 25 FC1003 2000,2000+,20003 FC1006 CP 25WB+

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PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
Non-Metallic	CAJ2001 FS-195+, 1-inch & 2-inch WIDE, PPD'S CAJ2002 FS-195+ CAJ2003 CS-195+, FS-195+ CAJ2005 FS-195+ CAJ2006 FS-195+ CAJ2013 FS-195+ CAJ2019 2000, 2000+, 2003 CAJ2027 FS-195+, CP 25N/S, CP 25S/L, CP 25WB+ CAJ2028 FS-195, MPS-2+ CAJ2029 FS-195+, PPD'S CAJ2030 CS-195+, FS-195+ CAJ2040 FS-195+, CP 25WB+ CAJ2044 FS-195+, CP 25N/S, CP 25S/L, CP 25 WB+ CAJ2090 FS-195+ CAJ2177 FS-195+, PPD'S FA2001 FS-195+, PPD'S FS2002 CS-195+, FS-195+, MPS-2+, PPD'S FA2011 FS-195+ WJ2012 FS-195+ 1-inch WIDE	WL2002 FS-195+, PPD'S WL2003 FS-195+ WL2004 FS-195+ WL2005 FS-195+ 4' WIDE WL2006 FS-195+ WL2013 FS-195+ WL2031 CS-195+, FS-195+ WL2032 CS-195+, FS-195+ WL2033 FS-195+ WL2073 FS-195+ 1-inch WIDE	FC2002 FS-195+, PPD'S FC2007 FS-195+, PPD'S FC2008 FS-195+ FC2009 FS-195+, PPD'S FC2024 FS-195+ FC2026 FS-195+ FC2028 FS-195+, 1' & 2-inch WIDE, PPD'S
Insulated Cable	CAJ3001 CP 25N/S, CP 25S/L CAJ3005 CS 195+, FS-195+ CAJ3007 2001 CAJ3009 2000, 2000+, 2003 CAJ3010 2000, 2000+, 2003 CAJ3011 2001 CAJ3014 FD 150 CAJ3015 FD 150 CAJ3021 MPS-2+ CAJ3029 2000, 2000+, 2003 CAJ3030 CP 25WB+ CAJ3031 CP 25N/S, CP 25S/L CAJ3041 2000, 2000+, 2003 CAJ3044 CS-195+, FS-195+ CAJ3058 FS-195+, MPS-2+ CAJ3071 CP 25N/S, CP 25S/L	WL3001 CP 25, MPS-2+ WL3008 2000+ WL3009 2000+ WL3015 CP 25WB+, CP 25N/S WL3022 2000+ WL3030 FS-195+ WL3031 MPS-2+ WL3032 CP 25WB+ WL3041 2000+ WL3051 CP 25N/S WL3056 CP25N/S WL3062 CP 25WB+	FC3001 CP 25S/L, CP 25N/S FC3002 2000+ FC3003 2000, 2000+, 2003 FC3007 CP 25WB+, MPS-2+ FC3008 FS-195+

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PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
	CAJ3074 CP 25N/S, CP 25S/L CAJ3075 2001 CAJ3080 CP 25WB+ CBJ3016 CS-195+, FS-195+ CBJ3017 CS-195+, MPS-2+ FA3001 CP 25WB+ FB3004 CS-195+, MP WJ3015 2001 WJ3016 2001		
Mixed Penetrating Items Combos	CAJ8001 CS-195+ FS-195+ CAJ8003 2000, 2000+, 20003 CAJ8004 2000, 2000+, 20003 CAJ8006 2001 CAJ8013 FS-195+, CP 25 CBJ8004 CS-195, FS-195+ CBJ8005 CS-195+, MPS-2+ CBJ8008 2001 FA8001 FS-195+, CP 25WB+	WL8002 CS-195+, FS-195+	

* Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF SECTION

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SECTION 260529
HANGERS AND SUPPORTS
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CANNOT BE USED FOR BIDDING

SECTION 260529 – HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Requirements of the following Division 26 Sections apply to this Section:
 - 1. “Common Work Results for Electrical” for general installation requirements.
 - 2. “Electrical Firestopping” for requirements for firestopping at sleeves through walls and floors that are fire barriers.

1.2 SUMMARY

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.
- B. Provide equipment supports consisting of cradles, structural members, hangers, rods, racks, and incidental materials.
- C. Provide all labor, supervision, and fabrication. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to properly distribute the load and impact over building areas. Provide all engineering and fabrication as required for installation of support system.
- D. Provide hangers, clamps, anchors, inserts, supports, supplementary steel framing, and hardware of the proper size and load capacity to support electrical equipment and raceways, whether indicated on the drawings or not.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with conditions of Contract and Division 01 Specification Sections.
- B. Product data for each type of product specified.

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 *National Electrical Code*.
- B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party Certification follow-up services.
- C. Installation Standard: Installation shall meet or exceed the National Electrical Contractors Association (NECA) Standard of Installation.
- D. Manufacturer's Qualifications:
 - 1. The Manufacturer shall not have had less than ten years' experience in manufacturing Strut Support Systems.

2. The Manufacturer must certify in writing all components supplied have been produced in accordance with an established quality assurance program.
- E. All Strut Support System components must be supplied by a single manufacturer.
- F. Standards:
 1. Work shall meet the requirements of the following standards:
 - a. Federal, State and Local Codes.
 - b. American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members - August 19, 1986 Edition, December 11, 1989 Addendum.
 - c. American Society for Testing and Materials (ASTM).
 - d. Underwriters Laboratories (UL).
 - e. National Electrical Code (NEC).

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All material is to be delivered to the work site in original factory packaging to avoid damage to the finish.
- B. Upon delivery to the work site, all components shall be protected from the elements by a shelter or other covering.

1.6 GUARANTEE

- A. Separate guarantees shall be issued from the erector and manufacturer, valid for a period of one year against any defects that may arise from the installation or manufacture of the Strut Support System components.

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. Slotted Metal Angle and U-Channel Systems:
 - a. American Electric, Kindorf
 - b. Alstrut
 - c. Unistrut Diversified Products
 - d. Power-Strut
 - e. Thomas & Betts

2.2 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion-resistance using approved alternative treatment, finish, or inherent material characteristic. All products shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. Fasteners: Types, materials, and construction features, as follows:
 - 1. Expansion Anchors - Carbon steel wedge or sleeve type.
 - 2. Toggle Bolts - All steel springhead type.
 - 3. Power-Driven Threaded Studs - Heat-treated steel, designed specifically for the intended application.

2.4 ANCHOR METHODS

- A. Hollow Masonry: Toggle bolts or plastic conical type expansion anchors.
- B. Solid Masonry: Lead expansion anchors or preset inserts.
- C. Metal Surfaces: Machine screws, bolts, or welded studs.
- D. Wood Surfaces: Wood screws.
- E. Concrete Surfaces: Female-wedge, stud-wedge, or undercut drill-in bolt anchors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The installer shall inspect the work area prior to installation. If work area conditions are unsatisfactory, installation shall not proceed until satisfactory corrections are completed.

3.2 INSTALLATION

- A. Set Strut System components into final position true to line, level and plumb, in accordance with approved Shop Drawings.
- B. Anchor material firmly in place. Tighten all connections to their recommended torques.
- C. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.
- D. Coordinate with the building structural system and with other electrical installation.
- E. Raceway Supports: Comply with the NEC and the following requirements:
 - 1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.
 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
 5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
 6. Space supports for raceways in accordance with Table I of this Section. Space supports for raceway types not covered by the above in accordance with NEC.
 7. Support exposed and concealed raceway within one foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminations are not made with chase nipples or threadless box connectors.
 8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminations.
- F. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting disconnects, light fixtures, and other devices.
- G. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to the raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
- H. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including, but not limited to conduits, raceways, boxes, disconnect switches, and control components in accordance with the following:
1. Fasten by means of toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.
 2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.
 4. Concrete (Existing): Double-plated expander type anchors. Phillips, Hilti, or approved equivalent. Loads shall not exceed 1/4 of tested pullout (or shear) strength.
- I. General Supporting Installations:
1. Provide appropriate concrete anchors for hanger rods. Rods shall be screwed into or extended through frame construction (with washer and nut). Supports shall secure conduit in place, and shall prevent vibration, provide for expansion and contraction and shall make neat appearance. Strap hangers or chains are not permitted.
 2. Electrical raceways (conduit and EMT) 1-1/2-inches and smaller shall be secured with 1-hole malleable iron straps or brackets to walls. Trapeze supports shall be used for groups or parallel raceways with raceways secured to trapeze with approved clamps. Individual runs of raceways 2-inches and larger shall be supported by Clevis type hangers.
 3. Provide all steel supports including roof curbs for all equipment provided under this Section.
 4. Electrical raceway supports to be spaced on the following maximum centers, unless otherwise required by the NEC:
 - a. 3/4-inch to 1-inch conduit - 8 feet
 - b. 1-1/4-inch and larger conduit - 10 feet
 5. Provide additional hangers or steel members to distribute the load among two or more structural members when required or directed.
 6. Drilling of new concrete slabs will not be permitted. Anchors and inserts shall be cast in the concrete slabs.
- J. Locations:
1. Anchor bolts, sleeves, inserts, hangers, and supports required for the electrical work shall be furnished and installed under Division 26.
 2. Coordinate with other trades the location of anchors, sleeves, inserts, and supports and insure that they are properly installed.
 3. Openings and sleeves shall be set true to line, level, plumb, and position and shall be set true to line, level, plumb, and position and shall be so maintained during construction. Where sleeves and openings are provided in poured concrete, inspect same during and after concrete is poured to insure proper position and correct any deviation.
- K. Hangers and Supports:

1. Provide hangers, angles, channels, and other supports required by field conditions to install items of electrical equipment. Design of supports and methods of fastening to building structure shall be acceptable to the Owner.
2. Use of power-actuated fasteners and devices is permitted in the vertical surfaces of the building only with the following requirements.
 - a. For fastening conduits 1-1/2-inch and smaller and lighting fixtures 50 lbs or less.
 - b. Load capacity per manufacturers' recommendations.
 - c. Fasteners shall be located in the thickest part of the slab.
 - d. Devices shall comply with OSHA requirements.
3. Use of lead shield expansion anchors is not permitted.
4. No electrical items shall rest on, or depend for support on suspended ceiling media (tiles, lath, plaster, splines, etc.).
5. In suspended ceilings, support conduits directly from structural slabs, decks (or framing members). Do not support conduits on ceiling suspension members.
6. Support recessed lighting fixtures directly from structural slab, deck, or framing members. Refer to Division 26 Section "Interior Lighting" for additional installation requirements.
7. Provide weight-distribution facilities, where required so as not to exceed the load bearing capabilities of floor or walls that bear the weight of, or support, electrical items.
8. Hangers and supports shall be hot dipped galvanized, unless noted otherwise.
9. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.
10. Trapeze type hangers may be used where several conduits are to be installed at the same elevation. The spacing of such trapeze hangers shall be in accordance with the NEC for the smallest conduit in the run.
11. Vertical conduits shall be supported by heavy wrought iron clamps or collars anchored to construction at each floor.

L. TABLE I: SPACING FOR RACEWAY SUPPORTS

TABLE 1: SPACING FOR RACEWAY SUPPORTS			
Raceway Size (Inches)	No. of Conductors in Run	Location	EMT (Ft.)
		HORIZONTAL RUNS	
1/2, 3/4	1 or 2	Flat ceiling or wall.	5

TABLE 1: SPACING FOR RACEWAY SUPPORTS			
Raceway Size (Inches)	No. of Conductors in Run	Location	EMT (Ft.)
		HORIZONTAL RUNS	
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7
1/2, 3/4	3 or more	Any location.	7
1/2 - 1	3 or more	Any location.	
1 & larger	1 or 2	Flat ceiling or wall.	6
1 & larger	1 or more	Where it is difficult to provide supports except at intervals fixed by the building construction.	10
1 & larger	3 or more	Any location.	10
Any	---	Concealed.	10
		VERTICAL RUNS	
1/2, 3/4	---	Exposed.	7
1, 1-1/4	---	Exposed.	8
1-1/2 & larger	---	Exposed.	10
Up to 2	---	Shaftway.	10
2-1/2	---	Shaftway.	10
3 & larger	---	Shaftway.	10
Any	---	Concealed.	10
Abbreviations:	EMT	Electrical Metallic Tubing	

3.3 CLEANUP

- A. Upon completion of this Section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

3.4 PROTECTION

- A. During installation, protect this work from damage.
- B. Upon completion of this scope of work, it shall become the responsibility of the General Contractor to protect this work from damage during the remainder of construction on the project and until substantial completion.

END OF SECTION

CANNOT BE USED FOR BIDDING

DIVISION 26
SECTION 260533
RACEWAYS AND BOXES
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SECTION 260533 - RACEWAYS AND BOXES

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 raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1. Raceways include the following:

- a. EMT.
- b. FMC.
- c. LFMC.
- d. LFNC.
- e. PVC.
- f. RGS.
- g. Wireways.

2. Boxes, enclosures, and cabinets include the following:

- a. Device boxes.
- b. Outlet boxes.
- c. Pull and junction boxes.
- d. Cabinets and hinged-cover enclosures.

3. Miscellaneous Products include the following:

- a. Expansion/Deflection fittings.
- b. Bushings.

- B. Related Sections include the following:

- 1. Division 26 Section "Electrical Firestopping" for requirements for firestopping at penetrations through walls and floors that are fire barriers.
- 2. Division 26 Section "Hangers and Supports" for raceways and box supports.

1.3 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.

- B. FMC: Flexible Metal Conduit.
- C. LFMC: Liquidtight Flexible Metal Conduit.
- D. LFNC: Liquidtight Flexible Nonmetallic Conduit.
- E. PVC: Rigid Polyvinyl Chloride Conduit.
- F. RGS: Rigid Galvanized Steel Conduit.

1.4 SUBMITTALS

- A. Product Data: For raceways, wireways and fittings, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide raceways and boxes specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- B. Comply with NECA's "Standard of Installation" and NECA 101 "Recommended Practice for Installing Steel Conduits".
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access.
- B. Verify routing and termination locations of conduits and boxes prior to rough-in.
- C. Conduit routing shown on Drawings is only approximate and diagrammatic. Route conduits as required for a complete conduit and wiring system.
- D. Coordinate installation of outlet boxes, mounting heights, orientation, and locations of outlets.

1.7 PROJECT RECORD DOCUMENTS:

- A. Accurately record routing of all concealed conduits. Record actual routing of all exposed conduits/larger than 1 inch. Indicate actual locations and mounting heights of outlet boxes, pull and junction boxes, branch circuits, arrangements, etc.

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. Metal Conduit and Tubing:

**HEAT PUMP REPLACEMENT & DRY STORAGE HVAC
AT THE NEW CASTLE COUNTY DETENTION CENTER**

**DA LLC NO. 011-040/043
STATE NO. MC3701000022**

- a. Allied Tube & Conduit Corporation.
 - b. Anamet, Inc.; Anaconda Metal Hose.
 - c. AFC/Monogram Company.
 - d. Carol Cable Co., Inc.
 - e. Cole-Flex Corp.
 - f. Electri-Flex Co.
 - g. Flexcon, Inc.; Coleman Cable Systems, Inc.
 - h. Grinnell Co.; Allied Tube and Conduit Div.
 - i. Monogram Co.; AFC.
 - j. Spiraduct, Inc.
 - k. Triangle PWC, Inc.
 - l. Wheatland Tube Co.
2. Nonmetallic Conduit and Tubing:
- a. Anamet, Inc.; Anaconda Metal Hose.
 - b. Arco Corp.
 - c. Breeze-Illinois, Inc.
 - d. Cantex Industries; Harsco Corp.
 - e. Certainteed Corp.; Pipe & Plastics Group.
 - f. Cole-Flex Corp.
 - g. Condux International; Electrical Products.
 - h. Electri-Flex Co.
 - i. George-Ingraham Corp.
 - j. Hubbell, Inc.; Raco, Inc.
 - k. Lamson & Sessions; Carlon Electrical Products.
 - l. R&G Sloan Manufacturing Co., Inc.
 - m. Spiraduct, Inc.
 - n. Thomas & Betts Corp.
3. Conduit Bodies and Fittings:

- a. American Electric; Construction Materials Group.
 - b. Crouse-Hinds; Div. of Cooper Industries.
 - c. Emerson Electric Co.; Appleton Electric Co.
 - d. Hubbell, Inc.; Killark Electric Manufacturing Co.
 - e. Lamson & Sessions; Carlon Electrical Products.
 - f. O-Z/Gedney; Unit of General Signal.
 - g. Scott Fetzer Co.; Adalet-PLM.
 - h. Spring City Electrical Manufacturing Co.
 - i. Thomas & Betts Corporation.
4. Metal Wireways:
- a. Hoffman Engineering Co.
 - b. Keystone/Rees, Inc.
 - c. Square D Co.
5. Boxes, Enclosures, and Cabinets:
- a. American Electric; FL Industries.
 - b. Butler Manufacturing Co.; Walker Division.
 - c. Crouse-Hinds; Div. of Cooper Industries.
 - d. Electric Panelboard Co., Inc.
 - e. Erickson Electrical Equipment Co.
 - f. Hoffman Engineering Co.; Federal-Hoffman, Inc.
 - g. Hubbell Inc.; Killark Electric Manufacturing Co.
 - h. Hubbell Inc.; Raco, Inc.
 - i. Lamson & Sessions; Carlon Electrical Products.
 - j. O-Z/Gedney; Unit of General Signal.
 - k. Parker Electrical Manufacturing Co.
 - l. Robroy Industries, Inc.; Electrical Division.
 - m. Scott Fetzer Co.; Adalet-PLM.
 - n. Spring City Electrical Manufacturing Co.

- o. Thomas & Betts Corp.
- p. Woodhead Industries, Inc.; Daniel Woodhead Co.

2.2 METAL CONDUIT AND TUBING

- A. Rigid Galvanized Steel Conduit: ANSI C80.1 and UL 6.
- B. EMT and Fittings: ANSI C80.3, galvanized tubing.
 - 1. Fittings: Compression type, NEMA FB1.
- C. FMC: Zinc-coated steel.
- D. LFMC: Flexible steel conduit with PVC jacket.
- E. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

- A. PVC: NEMA TC 2, Schedule 40 or 80.
- B. PVC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.
- C. LFNC: UL 1660.

2.4 METAL WIREWAYS

- A. Material: Sheet metal sized and shaped as indicated.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- D. Wireway Covers: Screw-cover type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 OUTLET AND DEVICE BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized flat-rolled sheet steel.
- B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box, deep type, with gasketed cover, and threaded hubs.
- C. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including corrosion-resistant screws, mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.

2.6 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- B. Sheet metal boxes over 12" in any dimension shall comply with the requirements of Article "Enclosures and Cabinets" of this Section.
- C. Boxes for Outdoor and Wet Locations: Flat flanged, surface-mounted, UL listed as raintight, galvanized cast iron box and cover with neoprene gasket and stainless steel cover screws.

2.7 BOX EXTENSIONS

- A. Prohibited on new construction.
- B. Where more than one box is needed to flush out installation, provide a large (i.e., 6" x 6") box to flush out the existing box and nipple over to a new box.

2.8 ENCLOSURES AND CABINETS

- A. Hinged-Cover Enclosures: NEMA 250, Type 1 in dry locations, and Type 4 in wet or damp locations, with continuous hinge cover and flush latch.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

2.9 EXPANSION / DEFLECTION FITTINGS

- A. Provide an expansion/deflection fitting in each concealed or exposed electrical run crossing a building expansion joint. Fittings shall be complete with bronze end couplings, neoprene sleeves, tinned copper braid integral bonding jumper and stainless steel bands. Expansion/deflection fittings shall be suitable for the size and type of conduit run they connect. Bonding jumper shall comply with NEC and UL requirements.
- B. Expansion/deflection fitting shall accommodate the following movements without collapsing or fracturing the conduit and damaging the wires it contains:
 - 1. Axial expansion or contraction up to 3/4-inch.
 - 2. Angular misalignment of the axes of the conduits up to 30 degrees in all directions.
 - 3. Parallel misalignment of the axes of the conduits up to 3/4-inch in all directions.
- C. Expansion/Deflection fitting shall be OZ/Gedney Type "DX" or approved equal by Crouse Hinds (Type XD).

2.10 BUSHINGS

- A. Bushings for 1-inch conduit and smaller shall be self-extinguishing thermoplastic type - 150°C temperature rating.
- B. Bushings for 1-1/4" conduit and larger shall be malleable iron body with 150 degrees C insulating ring. Insulating material shall be locked in place and non-removable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 RACEWAY REQUIREMENTS

- A. Conduit Application Schedule:

Application	Conduit Type	Remarks
In or under concrete slab	RGS	
Exposed exterior locations.	RGS	Use threaded or rain-tight fittings.
Wet interior locations.	RGS	Use threaded or rain-tight fittings.
Exposed dry interior locations up to 7'-0" AFF.	RGS	
Exposed dry interior locations above 7'-0" AFF.	EMT	
Exterior Underground	RNC (Sched. 40 PVC)	RGS Elbows/Sweeps
Equipment connections in dry interior locations.	FMC (e.g. Greenfield)	Short lengths only (maximum 6 feet).
Equipment connections in wet interior locations.	LFMC (e.g. Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings.
Equipment connections in exterior locations.	LFMC (e.g. Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings.
Concealed in dry wall construction.	EMT, RGS, MC Cabling	
Concealed above suspended ceilings.	EMT, RGS, MC Cabling	
Concealed in masonry walls.	EMT	

1. Provide hot-dip Rigid Galvanized Steel Conduit (RGS) for embedded interior work in concrete.
2. Provide hot-dip Rigid Galvanized Steel Conduit (RGS), or galvanized Electrical Metallic Tubing (EMT) for concealed work above suspended ceilings and within interior partitions and for exposed interior work above 7'-0".
3. Provide Flexible Metal Conduit (FMC), e.g. Greenfield, in short lengths (maximum 6 feet) for the connection of lighting fixtures, dry type transformers and any vibrating equipment in dry interior locations. The flexible connections to recessed fixtures and equipment shall be sufficient slack to permit removal of fixture.
4. Provide Liquidtight Flexible Metal Conduit (LFMC), e.g. Sealtite, in short lengths (maximum 6 feet) for the connection of exterior equipment, motors and equipment in damp or wet locations as defined in Division 26 Section "Common Work Results for Electrical".

5. Aluminum conduit is prohibited.
6. Where indicated on the drawings, Rigid Non-metallic Conduit may be used as permitted in Article 352 of the NEC, with or without concrete encasement. Where rigid non-metallic conduit is exposed, it shall be Schedule 40 PVC, with all provisions for thermal expansion/contraction as recommended by the Manufacturer.

B. Fittings:

1. All fittings to match conduit material and to be suitable for the purpose intended. Join conduit with fittings designed and approved for the purpose and make joints tight.
2. Provide UL listed compound filled sealing fittings for NEC-required locations, for conduits passing from interior to exterior, and at the interface of widely different space temperatures such as refrigeration or cold storage rooms where conduits pass from warm locations to cool locations, such as the boundaries of air conditioned spaces and non-conditioned air spaces. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
3. Provide expansion fittings with bonding jumpers where conduits cross expansion joints or where otherwise required to compensate for thermal expansion and contraction. Provide expansion fittings in each straight uninterrupted run of surface-mounted conduit, both horizontal and vertical, in excess of 200 feet. Distance between fittings shall not exceed 200 linear feet. The Contractor shall refer to the Architectural Drawings for expansion joint locations.
4. Fasten rigid steel conduit with threaded galvanized steel fittings, double locknuts, and insulated bushings. Insulated bushings shall be OZ/Gedney type "B", or equal.
5. Fasten EMT conduit with "Concretight" or "Raintight" compression fittings made from galvanized steel or malleable iron. Fittings using set screw or indentations as a means of attachment or made from cast "white metal" are prohibited. All connectors shall have insulated throats.
6. Fasten liquid-tight conduit with fittings incorporating a threaded ferrule, nylon sealing ring, and steel or malleable iron compression nut and body. Furnish Crouse Hinds metallic liquid-tight fittings, or equal.
7. Fasten Flexible Metallic Conduit (FMC) with Thomas & Betts (T&B) "Tite-Bite" insulated connectors, or equal.
8. Watertight fittings shall use a copper base anti-corrosive conductive compound. Provide watertight fittings in conduits exposed to weather, in wet locations, in underground locations, and in slabs.

C. Box Locations:

1. Electrical boxes shall accommodate wire pulling, splices, taps, equipment connections and Code compliance.
2. Coordinate access doors as required to provide access to boxes in hard ceilings and similar inaccessible areas.

3. Provide cast box (with threaded hubs) in exterior enclosures, and high traffic areas (surface installations), as specified by Owner.

D. Outlet Boxes:

1. Outlet boxes for concealed work shall be zinc-coated or cadmium-plated sheet steel boxes suitable for the service and type outlet. Boxes and conduit fittings for outdoor and exposed work shall be NEMA 4 cast-aluminum, cast steel or cast iron type with threaded hubs for conduit entrance. Boxes and conduit fittings for outdoor work shall have gasketed cover plates. Extra large boxes shall be provided in accordance with the National Electrical Code where necessary to prevent crowding of wire in the box. Plastic boxes and cast "white metal" boxes classified as NEMA 4 will not be acceptable.
2. Outlet boxes in unplastered brick or block walls shall be provided with deep square-cut device covers. They shall be set so that the brick or block can be cut and fitted closely to the cover opening and so that the standard wall plate will cover the joint between the brick or block and the box.
3. All outlet boxes used for supporting fixtures shall be furnished with malleable iron fixture studs of "no-bolt" type secured by locknut. Provide support for boxes occurring in suspended ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction.
4. All boxes, whether outlet, junction, pull, or equipment, shall be furnished with appropriate covers.
5. No sectionalized boxes shall be used.
6. Back-to-back outlet boxes are not permitted. Separate boxes a minimum of 6" in standard walls and a minimum of 2 feet in acoustical walls.
7. Provide knockout closures for unused openings.
8. Provide blank coverplates for all unused boxes.
9. For multiple device installations, provide multi-gang boxes. Sectional boxes are not permitted. Provide barrier separation of different voltage conductors in the same box.
10. Thoroughly coordinate mounting heights of boxes with casework and backsplash heights.
11. Provide recessed outlet boxes in finished areas, supported from interior partition studs. Supports are to be stamped steel stud bridges for hollow stud walls and adjustable steel channel fasteners for flush ceiling outlet boxes.
12. Provide back supports for boxes in metal stud walls.

E. Junction and Pull Boxes:

1. Junction and pull boxes shall be furnished and installed as shown or where required to facilitate pulling of wires or cables. Such boxes shall be installed in accessible locations. All boxes for concealed work shall be constructed of 12 gauge USS galvanized sheet steel minimum, unless otherwise specified or indicated and

provided with mounting brackets and flat screw covers secured in position by round head brass or stainless steel 300 grade machine screws. Boxes for exterior work shall be cast aluminum or galvanized cast iron type with threaded hubs unless otherwise directed. Gasketed cover plates shall be furnished for outdoor installation.

2. Provide barrier (separators) where different system voltage share the same box.
3. Wherever possible, locate pull and junction boxes above accessible ceilings in finished areas.
4. Pull or junction boxes shall be supported independently of conduit.
5. In flush grade outdoor applications, unit shall be adequately supported against settling or tipping. Where heavy traffic or poor soil compaction exists, cast box in a concrete base which provides 6" of cover around and under the box.

3.3 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- B. Furnish and install a separate and independent raceway system as shown on the Drawings for each of the various wiring systems including, but not limited to, the following:

Power 120/208 volt
Power 277/480 volt

1. All raceway systems shall be completely wired as specified herein, shown on drawings and/or required for satisfactory operation of the various systems.
2. Raceways, generally, shall be concealed conduit as specified herein. Where wiring troughs are required or used to facilitate the wiring installation, they shall be equal to Square D Company's Square-Duct and fittings, with hinged cover arranged for total removal, all finished in baked enamel and all components U/L listed. The gutters shall be of ample size to accommodate conductors therein and as required by the NEC.
3. Underground conduits for services outside of building and entrance into building shall be as specified herein.
4. Support all conduit not embedded in concrete or masonry such that strain is not transmitted to outlet boxes and pull/junction boxes, etc. Supports to be sufficiently rigid to prevent distortion of conduits during wire pulling.

- C. Minimum Raceway Size: 3/4-inch trade size (DN21).
- D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- E. Electrical Metallic Tubing (EMT) shall be used for the following unless otherwise indicated:
 1. Branch circuits for lighting, receptacles, and power concealed in:
 - a. Dry wall construction.

- b. Suspended ceilings.
 - c. Masonry walls.
 - 2. Exposed in equipment room areas as needed to serve fixed equipment.
 - 3. Circuits for communication and signaling concealed in:
 - a. Dry wall construction.
 - b. Suspended ceilings.
- F. Rigid Galvanized Steel Conduit (RGS) shall be used for the following, unless otherwise indicated:
 - 1. Branch circuits and feeders for lighting, receptacle and power, installed exposed in areas subject to physical damage.
 - 2. Circuits for communication and signaling exposed in areas subject to physical damage.
- G. Wiring installed concealed above hard ceilings and exposed in areas with no ceilings shall be installed in conduit.
- H. Conduit shall be run concealed wherever possible, within walls, ceilings, or floors, unless otherwise indicated or specified. Where exposed conduits runs are shown or required, they shall be run parallel to building construction and shall be suitably supported at required intervals.
- I. Conduit may be run exposed in Mechanical Equipment rooms, Electrical rooms, and where necessary in Storage rooms and unfinished areas. Where conduit is run exposed, it shall be run as close as possible to walls and ceilings and shall not interfere with equipment, ductwork and piping.
- J. Keep raceways at least 12 inches (300 mm) away from parallel runs of flues, steam or hot-water pipes and other hot surfaces above 77 degrees F. Install horizontal raceway runs above water and steam piping.
- K. Install raceways level and square and at proper elevations. Provide adequate headroom.
- L. Complete raceway installation before starting conductor installation.
- M. Support raceways as specified in Division 26 Section "Hangers and Supports". Arrange supports to prevent misalignment during wiring installation.
- N. Use capped bushings or "push-penny" plugs to prevent foreign matter from entering the conduit system during construction. Clean and plug or cap all conduits left empty for future use.
- O. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab. Conduit stub-ups and stub-downs shall be arranged in a neat and orderly manner and shall emerge at right angles to floors or ceilings.
- P. Make bends and offsets so the inside diameter is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

- Q. Use raceway fittings compatible with raceways and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.
- R. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.
- S. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
- T. Run parallel or banked raceways together, on common supports where practical.
- U. Make bends in parallel or banked runs from same centerline to make bends parallel. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- V. Join raceways with fittings designed and approved for the purpose and make joints tight.
1. Make raceway terminations tight. Use bonding bushings or wedges at connections subject to vibration. Use bonding jumpers where joints cannot be made tight.
 2. Use insulating bushings to protect conductors.
- W. Tighten set screws of threadless fittings with suitable tools.
- X. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.
- Y. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches (150 mm) above the floor. Install screwdriver-operated, threaded flush plugs flush with floor for future equipment connections.
- Z. Lubricants for pulling wires shall be approved for use with the types of wire and conduit installed.
- AA. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- BB. Use conduit hubs or sealing lock nuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- CC. Install no more than equivalent of three 90° bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inches (50 mm) in size.
- DD. Avoid moisture traps; provide junction box with drain fittings at low points in conduit system.
- EE. Die-cast fittings of pot metal will not be accepted.
- FF. Conduits shall be free of any burrs, foreign objects, and water prior to conduit installation.
- GG. Conduit placed against concrete or masonry above ground shall be fastened to the concrete or masonry with pipe straps or one screw clamp attached to the concrete by means of expansion screw anchors and screws. "Caddy Clip" type hangers or straps will be permitted only in non-exposed areas and restricted to ½ " to 3/4" conduit.

- HH. Rigid conduit or Electrical Metallic Tubing (EMT) shall not be strapped or fastened to equipment subject to vibration or mounted on shock-absorbing bases.
- II. Conduit shall be installed in such manner as to insure against the collection of trapped condensation, and runs of conduit shall be without traps wherever possible. Drill 1/8" diameter weep holes where necessary.
- JJ. Conduits run to and from cabinets shall be run neatly, in accurate manner and shall emerge from the floors and ceilings at right angles thereto.
- KK. Provide wall flanges and gasketing on conduits entering fan housings to minimize air leakage at points of penetration of housing.
- LL. Conduit risers shall be rigidly supported on the building structure, using appropriate supports only.
- MM. In equipment spaces, such as fan rooms, plenums, etc., conduits and outlets may be exposed, but shall avoid interference with ventilating ducts, piping, etc.
- NN. Exposed conduit installed on or adjacent to ventilating ducts shall be installed after the ducts are in place, and shall be run from ceiling or wall junction boxes in such manner as to retain accessibility to junction box covers and to permit future removal or replacement of ducts.
- OO. Conduits and other electrical items shall not be fastened to, or supported from ventilating ducts but shall be separately supported. The method of supporting and details of the supporting members shall be reviewed by the Owner's Representative. In no case shall screws penetrate the sheet metal of the ducts.
- PP. Exposed conduit run on surface shall be supported according to Code and within three feet of each outlet, junction box, or cabinet, by galvanized malleable conduit clamps and clamp backs. Suspended conduits shall be supported every five feet by conduit hangers and round rods, or where two or more conduits are run parallel, by trapeze hangers suitably braced to prevent swaying.
- QQ. Screws for all exposed work shall be stainless steel, unless otherwise noted.
- RR. Zinc coated galvanized steel screws may be used for interior dry locations only.
- SS. No running threads shall be cut or used.

3.4 FLEXIBLE CONNECTIONS

- A. Use maximum of six (6) feet (1830 mm) of UL listed Flexible Metal Conduit (FMC) for recessed and semi-recessed fluorescent lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use Liquidtight Flexible Metal Conduit (LFMC) in wet or damp locations, as defined per NEC. Flexible conduits shall not be used for indoor HID lighting fixture connections.
- B. Grounding conductors with green colored insulation shall be extended through all flexible connections including fixture "whips", and fastened to terminals within the first junction boxes on either side of the flexible length.
- C. Flexible connections shall be sized per the Contract Drawings, or as required in accordance with Code; the more stringent requirement shall apply.

3.5 INSTALLATION OF TERMINATIONS

- A. Where raceways are terminated with lock nuts and bushings, align the raceway to enter squarely, and install the lock nuts with dished part against the box. Where terminations cannot be made secure with one lock nut, use two lock nuts, one inside and one outside of the box.
- B. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- C. Open ends shall be capped with approved manufactured conduit seals as soon as installed and kept capped until ready to pull in conductors.
- D. Where conductors No. 10 AWG or larger enter a raceway, cabinet, pull box, and junction box, the conductors shall be protected by an insulated bushing providing a smoothly rounded surface.
- E. Double lock nuts shall be used at termination of rigid conduit in knock-out openings.
- F. Ends of conduits shall be equipped with insulating bushings for 1" and smaller, and insulated metallic bushings for 1-1/4" and larger. Ends of conduit shall be temporarily capped prior to installation and during construction to exclude foreign material.

3.6 INSTALLATION OF BOXES

- A. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors.
- B. Provide junction boxes, pull boxes, cable support boxes, and wireways as required for proper installation of the electrical work. Covers shall be accessible. Small junction boxes shall be similar to outlet boxes. Provide barriers (separators) where different system voltage wires share the same box.
- C. Pull boxes, cable support boxes, and large junction boxes for indoor use shall be made of Code gauge steel or no less than 12 gauge. Covers shall be held in place with zinc-coated galvanized steel screws. Paint interior and exterior surfaces with rust-inhibitive paint. (Pull boxes and covers shall be hot-dipped galvanized.)
- D. Boxes located outdoors and in damp or wet locations shall be cast metal or alloy, fitted with screw-fastened covers and gaskets, and with threaded conduit connections. Fasteners shall be stainless steel.
- E. Pull boxes shall be installed at all necessary points to prevent injury to the insulation or other damage that might result from pulling resistance or for other reasons necessary for proper installation. Pull box locations shall be approved by the Owner's representative prior to installation.
- F. Where boxes are used in connection with exposed conduit, plain covers attached to the box with a suitable number of countersunk flat head machine screws shall be used.
- G. Pull boxes with barriers shall have a single cover plate and the barriers shall be of the same gauge as the pull box.
- H. Exposed pull boxes will not be permitted in finished spaces.

- I. Location of pull boxes shall be coordinated with piping, ductwork, and other equipment so as to permit sufficient clearance for maintenance and access.
- J. Pull boxes recessed in walls or partitions shall be provided with flanged type covers.
- K. Outlet boxes and covers shall be sheet steel knockout type, zinc-coated, or cadmium-plated and shall be of proper Code size for the number of wires of conduits passing through or terminating therein, but in no case shall any box be less than 4" square, or boxes at end of a run and containing a single device may be of the "handy box" type. Covers for flush outlets shall finish flush with plaster or other finished surface. Approved factory-made knockout seals shall be used in all boxes where knockouts are not intact. Boxes in concrete shall be a type which will allow the placing of conduit without displacing the reinforcing bars. Additional pull boxes shall be installed as required to facilitate pulling of wires.
- L. Outlet boxes for lighting fixtures shall be equipped with fixture supporting devices.
- M. Outlet boxes for switches shall be of the gang type.
- N. Each circuit in each pullbox shall be marked with a tag guide denoting panels to which they connect.
- O. Boxes shall be separated to prevent sound transmission. Back-to-back boxes shall not be used.
- P. Outlet boxes shall be provided with suitable plaster rings and covers or plates.
- Q. Unused knockout holes shall remain closed and those opened by error shall be closed with snap-in blanks.
- R. Outlet boxes shall not be smaller than required by Code for the number and size of wires to be installed.
- S. Outlet boxes installed in plenum ceilings shall be in accordance with applicable codes.
- T. Outlet boxes shall be installed true and plumb so that the covers or plates will be level and at uniform elevations for the types of outlets contained.
- U. Outlet boxes for toggle switches and pilot lights at doorways shall be located at the strike side of the door as finally hung.
- V. Outlet box locations as indicated shall be considered to be approximate only. Determine exact locations from architectural details or from field instructions and coordinate outlet box locations with the work of other trades.
- W. Install junction and pull boxes to be accessible.
- X. Locations of junction and pull boxes requiring access panels shall be reviewed by the Owner's Representative.

3.7 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

- B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- C. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
- D. Steel conduit: Conduit that shows corrosion within the guarantee period shall be replaced.

3.8 CLEANING

- A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.
- B. After conduits and accessories have been installed, and concreting operations completed, conduit runs shall be satisfactorily cleared of obstructions and foreign matter. Defects which might damage cable upon installation shall be corrected. Where new conduits installed are connected to new conduits installed by others and where new conduits installed are connected to existing conduits, the entire run to the nearest box or other termination point shall be cleaned.

END OF SECTION

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SECTION 260553
ELECTRICAL IDENTIFICATION
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CANNOT BE USED FOR BIDDING

SECTION 260553 - ELECTRICAL IDENTIFICATION

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 electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.
- B. This section includes labeling of all terminations and related subsystems; including, but not limited to, nameplates, stenciling, wire and cable markers, labeling and identification of cables, equipment and other products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels. Provide a schedule of nameplates.
- C. Samples: Prior to installation, submit samples for each type of label and sign to illustrate color, lettering style, and graphic features of identification products. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8-1/2-inch x 11-inch sheets annotated, explaining their proposed use.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1 and NFPA 70 for color-coding.
- D. Comply with applicable EIA/TIA Standards.
- E. Comply with OSHA Standards.

1.5 DEFINITIONS

- A. Emergency systems include, but are not limited to, generator circuits and systems, fire alarm systems, exit sign circuits, emergency lighting circuits, etc.

PART 2 PRODUCTS

2.1 NAMEPLATES AND SIGNS

- A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine 3-layer plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8

inch (3.2 mm) thick for larger sizes. Use colors prescribed by ANSI A13.1, NFPA 70 and these specifications.

1. Engraved legend with white letters on black background.
 2. Punched or drilled for mechanical fasteners. Backed with adhesive material formulated for the type of surface and intended use.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.
- E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Where mixed voltages are used in one building (e.g., 480 volts, 208 volts), each switch, panelboard, junction box, equipment, etc., on each system must be labeled for voltage in addition to other requirements listed herein.
2. All branch circuit panelboards must be identified with the same designation used in the circuit directory in the Main Distribution Panelboard, Main Switchboard, and in Distribution Panelboards.
3. Before attaching labels, clean all surfaces with the label manufacturer's recommended cleaning agent.
4. Install all labels firmly, as recommended by the label manufacturer.
5. Labels attached to receptacle and switch data or Communication patch panels and faceplates shall be installed plumb and neatly on all equipment.
6. Install nameplates parallel to equipment lines.
7. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to inside of recessed panelboards in finished locations.
8. Embossed tape will not be permitted for any application.
9. Labels: All labels shall be permanent and be machine-generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.
10. Label size shall be appropriate for the conductor cable size(s), and outlet faceplate layout. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the cable sheath. Flag type labels are not allowed. The labels shall

be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminated over the full extent of the printed area of the label.

- B. Panelboard Directories:
1. Panelboards shall be equipped with equipment nameplates as specified in paragraph "Equipment Identifications Labels" in Part 3 of this Section.
 2. Panelboards shall have an accurate typed index indicating exactly what each added branch serves.
 3. The Contractor shall provide up to date directories in existing panelboards, indicating all deletions and additions, and to note the date of all changes on the directory.
 4. The directory shall reflect the actual room numbers and exact circuit designations. Directories indicating the reference room numbers on the contract drawings or in the panelboard schedule shall not be acceptable.
 5. If at anytime after occupancy the directory is found to be incorrect due to negligence by the installer, then the Contractor shall trace out circuits, and correct the directory at no additional cost to the Owner.
- C. Miscellaneous Identification:
1. Individual circuit breakers, switches, and motor starters/motor switches in panelboards and switchboards: 1/4-inch (6 mm); identify circuit and load served, including location.
 2. Individual circuit breakers, enclosed switches, and motor starters: 1/4-inch (6 mm); identify load served.
 3. Junction boxes: 1/2-inch (13 mm); identify system source(s) and load(s) served.
- D. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- F. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- G. Self-Adhesive Identification Products: Clean surfaces before applying.
- H. Circuit Identification Labels on Boxes: Install labels externally.
1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 2. Concealed Boxes: Plasticized card-stock tags.
 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- I. Branch-Circuit Conductors: Color-code throughout the secondary electrical system. Refer to Division 26 Section "Conductors and Cables" for additional requirements.

- J. Power-Circuit and Control Wire Identification: Metal tags or aluminum, wraparound marker bands for each conductor, cables, feeders, and power circuits in vaults, panelboard gutters, outlet boxes, junction boxes, pullboxes, junction boxes, manholes, switchboard rooms, and at load connections. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
1. Legend: 1/4-inch- (6.4-mm-) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 2. Tag Fasteners: Nylon cable ties.
 3. Band Fasteners: Integral ears.
- K. Apply identification to conductors as follows:
1. Conductors to be Extended in the Future: Indicate source and circuit numbers.
 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- L. Apply warning, caution, and instruction signs as follows:
1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- (9-mm-) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- M. Equipment Identification Labels: Engraved plastic laminate with white lettering on black background. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise noted, labels/nameplates shall identify equipment designation(s), voltage rating, and source (including source locations). Labels for disconnect switches, motor starters, etc..., shall indicate the designation of the load served as the "equipment designation". In general, labels requiring one or two lines of text shall be 1-1/2 inches high. Labels requiring three lines of text shall be 2 inches high. The first line of text, which shall indicate equipment designation/load served, shall utilize 1/2 inch high lettering. Remaining lines of text, which shall indicate voltage ratings and source information shall utilize 1/4 inch high lettering. Refer to the Drawings for labeling examples. Apply labels to each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards.
 2. Switchboards.

3. Disconnect Switches.
 4. Enclosed Circuit Breakers.
 5. Motor Starters.
 6. Motor Switches
 7. Push-Button Stations.
 8. Contactors.
 9. Electrical Cabinets and Enclosures.
 10. Control Devices.
- N. Surfaces shall be cleaned and painted, if specified, before applying markings.
- O. Place markings so that they are visible from the floor.
- P. Protect finished identification to insure that markings are clear and legible when project is turned over to the Owner.

END OF SECTION

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SECTION 262726
WIRING DEVICES
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CANNOT BE USED FOR BIDDING

SECTION 262726 - WIRING DEVICES

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. GFCI receptacles.
 - 2. Weather-Resistant receptacles.
 - 3. Toggle switches.
 - 4. Cord and plug sets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic Interference.
- B. GFCI: Ground-Fault Circuit Interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-Frequency Interference.
- E. TR: Tamper-Resistant.
- F. WR: Weather-Resistant.

1.4 SUBMITTALS

- A. Product Data: For each product specified, indicating configurations, finishes, dimensions, and manufacturer's instructions.
- B. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- B. Comply with NFPA 70.
- C. Comply with NECA Standard of Installation.
- D. Codes: Provide wiring devices conforming to the following:
 - 1. American National Standards Institute (ANSI): Provide lugs and receptacle devices constructed in accordance with ANSI C73, *Attachment Plugs and Receptacles, Dimensions of*.

2. Institute of Electrical and Electronics Engineers (IEEE): Construct and install wiring devices in accordance with requirements of IEEE 241, *Recommended Practice for Electric Power Systems in Commercial Building*.
3. National Electrical Manufacturers Association (NEMA): Provide wiring devices constructed and configured in accordance with the requirements of
 - a. WD1: General Requirements for Wiring Devices
 - b. WD5: Special Purpose Wiring Devices
 - c. WD6: Wiring Devices - Dimensional Requirements.
4. National Fire protection Association (NFPA): Comply with NFPA 70, *National Electrical Code*, as applicable to construction and installation of electrical wiring devices.
5. Underwriters Laboratories, Inc. (UL): Provide wiring devices which are UL listed and comply with the requirements of:
 - a. 20: General-Use Snap Switches.
 - b. 498: Attachments, Plugs and Receptacles
 - c. 943: Ground-Fault Circuit Interrupters

1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 1. Cord and Plug Sets: Match equipment requirements.

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. Wiring Devices:
 - a. Hubbell, Inc.; Wiring Devices Div.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 GFCI RECEPTACLES

- A. General Requirements
 1. GFCI receptacles shall have the following basic features:
 - a. Solid-state ground-fault sensing and signaling.
 - b. Trip time of 0.025 seconds (nominal).
 - c. Trip threshold of +/- 5mA.
 - d. Indicator light that is lighted when device is tripped.
 - e. Auto-ground clip to assure positive ground.

- f. Impact-resistant nylon face and thermoplastic base housing.
- g. #10 large head brass terminal and ground screws.

B. Duplex GFCI Receptacles

- 1. Duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V.
- 2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
- 3. Hubbell GF20LA, Pass & Seymour 2095, or approved equal by acceptable manufacturer.

C. Weather-Resistant Duplex GFCI Receptacles

- 1. Weather-resistant duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V with the following features:
 - a. "WR" marking on face as required by UL Standard.
 - b. UV-resistant nylon face for longer life under adverse environmental conditions.
- 2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
- 3. Hubbell GFTR20 Pass & Seymour 2095TRWR, or approved equal by acceptable manufacturer.

2.3 SWITCHES

A. General Requirements

- 1. Switches shall have the following basic features:
 - a. Heavy-gauge one-piece copper alloy contact arm.
 - b. Fast "make" and positive "break" to minimize arcing.
 - c. Heavy-duty bumper pads for quiet operation.
 - d. High strength thermoplastic polycarbonate toggle.
 - e. Oversized silvery alloy contacts for long life and heat dissipation.
 - f. Nickel-plated steel strap with integral ground.
 - g. Auto-ground clip to assure positive ground.

B. Toggle Switches

- 1. Toggle switches shall be quiet-type, extra heavy-duty, horsepower-rated, industrial grade, 120/277V, 20A: Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.
- 2. Hubbell HBL1221 (single-pole), HBL1222 (two-pole), Pass & Seymour PS20AC1 (single-pole), PS20AC2 (two-pole).

2.4 FINISHES

- A. Wiring device catalog numbers in Section text do not designate device color. Device colors shall be as follows, unless otherwise indicated elsewhere in the Specifications and Drawings or as required by NFPA or device listing:

1. Wiring Devices connected to Normal Power System: Finish selected by Architect.

2.5 DEVICE PLATES

- A. Device plates shall be provided for all switches and receptacles. Device plates shall be as manufactured to fit each type of single device, to fit devices which are ganged together, and they shall be same manufacturer as wiring devices with finish as follows:
 1. Material for Finished Spaces: 0.04-inch-thick, Type 302, satin-finished stainless steel, except as otherwise indicated.
 2. Material for Unfinished Spaces: Galvanized steel.
 3. Color: To match existing device plates.
 4. Plate-Securing Screws: Metal with heads colored to match plate finish.
- B. Material for Wet Locations: Heavy-duty die-cast zinc/aluminum construction with gasketed, hinged lockable lid, designed to be weatherproof while the device is in use, and listed and labeled for use in "wet locations." All components shall have baked-on electrostatic, polyester, power paint finish for superior corrosion resistance. Covers for receptacles shall be self-closing per UL514C42.3, be equipped with stainless steel springs, and shall have a cam action latch for secure closure. Covers for toggle switches shall be equipped with actuating levers and shall mount directly over the switch. Covers for receptacles shall comply with 2011 NEC Article 406.9(B). Covers for switches shall comply with 2011 NEC Article 404.4.
 1. Duplex/GFCI Receptacle - Pass & Seymour Model No. WIUCAST1 or approved equal.
 2. Toggle switch – Pass & Seymour Model No. CA1GL, or approved equal.
 3. Toggle switch, lockable cover – Crouse-Hinds Model No. DS185, or approved equal.

2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
 1. Verify that outlet boxes are installed at proper height.
 2. Verify that wall openings are neatly cut and will be completely covered by wall plates.

3. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- C. By beginning Work, accepts conditions and assume responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 INSTALLATION

- A. Install devices and assemblies plumb, level, and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top or as required by the local Authority Having Jurisdiction. Exception: Mount exterior GFCI weatherproof duplex receptacles horizontally with grounding terminals on the left, or as required by the local Authority Having Jurisdiction. Group adjacent switches under single, multi-gang wall plates.
- D. Protect devices and assemblies during painting.
- E. Coordinate cord and plug connected equipment for type and ratings required.
- F. All 15 ampere and 20 ampere, 125 volt and 250 volt, non-locking type receptacles installed in damp or wet locations shall be listed weather-resistant type in accordance with 2011 NEC Article 406.9(A) and 406.9(B) and shall be installed within an enclosure that is weather proof when an attachment plug is inserted.
- G. All 15 ampere and 20 ampere, 125 volt, single-phase, non-locking type receptacles installed in the following locations shall have GFCI protection for personnel, in accordance with 2011 NEC Article 210.8(B).
 1. Bathrooms/Toilet Rooms
 2. Kitchens
 3. Rooftops
 4. Outdoors
 5. Within six (6) feet (1.8m) of sinks, plumbing fixtures and water piping.
- H. Switches shall be located as indicated on the drawings, arranged singular or in gangs within 18" of the door jam on the strike side of the door openings. Verify the door swings with the Architectural Drawings prior to rough-in.
- I. Install receptacles with ground pole in position top unless otherwise required by local authority having jurisdiction.

3.3 IDENTIFICATION

- A. Comply with Division 26 Section "Electrical Identification".
 1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate. Light switches shall be labeled as to lights controlled and with circuit number and panel identification.
 2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate

and durable wire markers or tags within outlet boxes. Protect label from damage during construction. Replace all damaged and unclear labels.

3. Mark all conductors with the panel and circuit number serving the device at the device.
4. Mark the panel and circuit number serving the device on the back side of the device plate with a permanent marking system, machine-generated, that does not show through the front of the plate.

3.4 CONNECTIONS

- A. Connect wiring device grounding terminal to outlet box with bonding jumper.
- B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.
- C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity, continuity, short circuits, and ground continuity. Operate each device at least six times.
- B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- C. Replace damaged or defective components.

3.6 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

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SECTION 262813
FUSES
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SECTION 262813 - FUSES

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. Fuses.
 - 2. Spare Fuse Cabinet.
- B. The Electrical Contractor shall provide a complete set of fuses for all fusible equipment on the project as indicated on the Contract Documents. Final test and inspections shall be made prior to energizing the equipment.

1.3 PERFORMANCE REQUIREMENTS

- A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for components such as wire, cable, bus structures, and other equipment. Provide system to ensure that component damage is within acceptable levels during a fault.
- B. Select fuses to coordinate with time-current characteristics of other overcurrent protective elements, such as other fuses, circuit breakers, and protective relays. Provide system to ensure that device closest to fault operates.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data for each fuse type specified. Include the following:
 - 1. Descriptive data and time-current curves.
 - 2. Let-through current curves for fuses with current-limiting characteristics
 - 3. Coordination charts and tables and related data.
- C. Maintenance data for tripping devices to include in the Operation and Maintenance Manual.
- D. Record the equipment nameplate rating and actual fuse rating and location of fuses on the record drawings.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.

1. The terms *Listed* and *Labeled* as defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* (NRTL) as defined in OSHA Regulation 1910.7.
3. Comply with National Electrical Manufacturer's Association NEMA FU-1 *Low Voltage Cartridge Fuses*.
4. Comply with IEC269.
5. Comply with CANENA Standard 248.
6. Comply with UL 198.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 1. Spare Fuses: Furnish quantity equal to 20 percent of each 600 ampere and small fuse type and size installed, but not less than one (1) set of three (3) of each type and size. (Provide three (3) of each 601 Ampere and larger fuse type and size installed.)
 2. Fuse Pullers: Furnish two (2) fuse pullers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:
 1. Cooper Industries Inc. Bussmann Div.
 2. Ferraz Corp
 3. Gould Shawmut.
 4. Tracor, Inc; Littelfuse, Inc. Subsidiary
- B. All fuses shall be of the same manufacturer to assure coordination.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU-1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

2.3 SPARE FUSE CABINET

- A. Cabinet: Wall mounted, 0.05 inch (1.27 mm) thick steel unit with full length, recessed piano-hinged door with key coded cam lock and pull, and circuit voltage.
 1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.

2. Finish: Gray, baked enamel.
3. Identification: Provide engraved nameplate to read "SPARE FUSES" in 1/2-inch letters on door. Refer to Division 26 Section, "Electrical Identification" for nameplate requirements.
4. Fuse Pullers: For each size fuse.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits: Class RK1, time delay, 250 Volt Class J Time Delay 600 Volt, 0-600 Amp, and 300 kA interrupting rating. Time delay fuses shall hold 500% of rated current for a minimum of 10 seconds.
- B. Provide fuses of type and rating recommended by equipment manufacturer for packaged and/or specialized equipment.
- C. Motor, transformer, feeder, and main service protection - 250 Volts or less:
 1. Six hundred (600) ampere and less in interrupter switches, Class RK1, dual elements, time delay, 300 kA interrupting rating.
- D. Motor, transformer, feeder, and main service protection - 600 volts or less; 600 ampere and less - Class RK-1, dual element, time delay, 300 kA interrupting rating.
- E. Six hundred ampere or less, installed ahead of breaker: Class RK1, time delay.
- F. Six hundred ampere or less, for general power circuits: Class J, time-delay, dual element, 300 kA interrupting rating. Time-delay fuses shall hold 500 percent of rated current for a minimum of 10 seconds and shall be UL listed.
- G. Fuse sizes for motor protection shall be chosen from fuse manufacturers published data and recommendations.
- H. Motor Circuits: All individual motor circuits with full-load ampere ratings (FLA) of 480 amperes or less shall be protected by Dual-Element Time-Delay Fuses. The following guidelines apply for motors protected by properly sized overload relays: Fuses for motors with a marked service factor not less than 1.15 shall be installed in ratings of 125% of motor full-load current (or next size larger if 125 percent does not correspond to a fuse size), except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions, the fuses may be 150 percent to 175 percent of the motor full-load current. For all other motors, (such as 1.0 service factor motors) fuses shall be sized in ratings of 115 percent of the motor full load current (or next size larger if 115 percent does not correspond to a fuse size) except as noted above. The following guidelines apply where fuses are used as the only overload protection for the motor:

1. For motors with a 1.15 service factor or more, fuses should be sized at 125 percent of motor full-load current (or next size smaller if 125 percent does not correspond to a fuse size).
 2. For all other motors, fuses should be sized at 115 percent of motor full-load current (or next size smaller, if 115 percent does not correspond to a fuse size).
- I. Motor Controllers: NEMA and IEC Style motor controllers shall be protected from short-circuits by Dual-Element Time-Delay fuses in order to provide testing agency-witnessed Type 2 coordination for the controller. This provides *no damage* protection for the controller, under low and high level fault conditions, as required by IEC Publication 947-4. For IEC style controller, the fuses shall be installed in ratings to coordinate with the overload relays, such that the relay/fuse curves cross over at 7-10 times the IEC contactor current rating.
 - J. Panelboards: The manufacturer shall supply equipment utilizing fully-rated and listed components. This equipment shall be tested, listed, and labeled for the available short-circuit current.

3.3 INSTALLATION

- A. Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the job site, or from water that may contact the fuse before the equipment is installed. Final tests and inspections shall be made prior to energizing the equipment. This shall include a thorough cleaning, tightening, and review of all electrical connections and inspection of all grounding conductors. All fuses shall be furnished and installed by the electrical contractor. All fuses shall be of the same manufacturer.
- B. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.
- C. Install spare fuse cabinet as directed by Owner's representative.
- D. Provide fuse clips as required.

3.4 IDENTIFICATION

- A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION

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SECTION 262816
ENCLOSED SWITCHES
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CANNOT BE USED FOR BIDDING

SECTION 262816 – ENCLOSED SWITCHES

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 individually mounted switches used for the following:
 - 1. Feeder and equipment disconnect switches.
 - 2. Feeder branch-circuit protection.
 - 3. Motor disconnect switches.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 26 Section "Fuses" for fuses in fusible disconnect switches.
- C. Provide method of disconnection at all appliances, motors, equipment, etc., as required to comply with NEC (including Article 422-C, and Article 440-D).

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data for disconnect switches, and accessories specified in this Section.
- C. Submit a schedule of equipment to indicate ratings of disconnects, fuses, circuit breakers, and other electrical characteristics for each item of equipment.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.
- B. Comply with NFPA 70 for components and installation.
- C. Listing and Labeling: Provide disconnect switches and circuit breakers specified in this Section that are listed and labeled.
 - 1. The Terms *Listed* and *Labeled*: As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* (NRTL) as defined in OSHA Regulation 1910.7.
 - 3. Underwriters Laboratories (UL) listed equipment: UL 98 - Enclosed and Dead Front Switches, UL 50 - Cabinets and Boxes, UL489 - Molded Case Circuit Breakers and Circuit Breaker Enclosures, NEMA 250 - Enclosures for Electrical Equipment.

4. Comply with ANSI and NEMA Standards for materials ratings.
5. Replacement circuit breakers shall be obtained from the original manufacturer through an authorized factory distributor, complete with full factory warranty. Original manufacturer product data shall be submitted for review.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide equipment from one of the following manufacturers; no other manufacturers are acceptable.
 1. Disconnect/Safety Switches:
 - a. Square D Company. (Basis of Design)
 - b. Eaton Corp.; Cutler-Hammer.
 - c. Siemens Energy & Automation, Inc.
 2. Molded-Case Circuit Breakers:
 - a. Square D Company. (Basis of Design)
 - b. Eaton Corporation; Cutler-Hammer.
 - c. Siemens Energy & Automation, Inc.

2.2 DISCONNECT SWITCHES

- A. Enclosed, Nonfusible Switch: Heavy duty, NEMA KS 1, Type HD, with lockable handle in the *OFF* position. Switch shall be provided with an override screw to permit opening front cover with switch in *ON* position. Minimum fault current rating shall be 200,000 symmetrical rms amperes.
- B. Enclosed, Fusible Switch, 800 A and Smaller: Heavy duty, NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable in the *OFF* position, with 2 padlocks, and interlocked with cover in *CLOSED* position. Switch shall be provided with an override screw to permit opening front cover with switch in *ON* position. Minimum fault current rating shall be 200,000 symmetrical rms amperes.
- C. Characteristics: Size, number of poles and ratings as indicated and to match load being served.
- D. Enclosure: NEMA KS 1, Type 1, with gray baked enamel finish, unless otherwise specified or required to meet environmental conditions of installed location. Enclosure shall be rated for 200,000 rms symmetrical amperes short circuit current.
 1. Outdoor Locations: Type 4X, stainless steel, attached by molded hinges and Type 316 stainless steel hinge pins.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches in locations as indicated, according to manufacturer's written instructions.
- B. Install disconnect switches level and plumb. Provide mounting brackets, wall bracing, and accessories as required.
- C. Install wiring between disconnect switches, control, and indication devices.
- D. Connect disconnect switches and components to wiring system and to ground as indicated and instructed by manufacturer.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- E. Identify each disconnect switch according to requirements specified in Division 26 Section "Electrical Identification". All switches shall be provided with laminated plastic labels which clearly identify the equipment served.
 - 1. Each disconnect means shall be legibly marked as required by Code (including all disconnect units for motors, appliances, feeders, and branch(es)).
- F. Provide fuses for all fusible safety switches as indicated and required by the load being served. Coordinate fusing of disconnects with mechanical equipment electrical characteristics.
- G. Provide disconnect switches for all equipment as indicated and as required by the NEC. Where disconnect switches are specified and furnished with mechanical equipment, install one only. Coordinate devices furnished for mechanical equipment with Division 23 Drawings and Specifications.
- H. Weatherproof switches shall be provided for all locations exposed to the elements whether called for or not.
- I. Switches provided shall be suitable for:
 - 1. Circuit application voltage.
 - 2. Circuit application ampacity x 125 percent.
 - 3. One pole, two pole, three pole, solid neutral, ground connection, all as required by item served or as shown on the drawings.
- J. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's *Standard of Installation*, and in accordance with recognized industry practices.

3.2 FIELD QUALITY CONTROL

- A. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches.
- B. Certify compliance with test parameters.
- C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION

CANNOT BE USED FOR BIDDING

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SECTION 262913
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SECTION 262913 - MOTOR CONTROLLERS

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 AC motor-control devices rated 600 V and less that are supplied as enclosed units.
- B. Related Sections include the following:
 - 1. Division 26 Section "Common Work Results for Electrical" for Mechanical - Electrical coordination requirements.
 - 2. Division 26 Section "Common Work Results for Electrical" for general materials and installation methods.
 - 3. Division 26 Section "Electrical Identification" for labeling materials.
 - 4. Division 26 Section "Fuses".

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. N.C.: Normally closed.
- C. N.O.: Normally open.
- D. OCPD: Overcurrent protective device.

1.4 SUBMITTALS

- A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.
- B. Maintenance Data: For products to include in the maintenance manuals specified in Division 01.
- C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- D. Submit a schedule of equipment to indicate motor controller ratings, sizes, and other electrical characteristics for each item of equipment.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain, within 50 miles (80 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

- B. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.
- C. Comply with NFPA 70.
- D. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.
 - 1. The Terms *Listed* and *Labeled*: As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A *Nationally Recognized Testing Laboratory* as defined in OSHA Regulation 1910.7.
- E. UL Compliance: NEMA ICS 2, *Industrial Control Devices, Controllers and Assemblies*.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).
- B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or other unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical systems.
 - 2. Indicate method of providing temporary utilities.
 - 3. Do not proceed with interruption of electrical systems without Owner's written permission.
 - 4. Comply with NFPA 70E.

1.8 COORDINATION

- A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

- B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.
- C. The horsepower rating of all starters shall be checked against actual motor to be controlled, before installation and correct size overload elements shall be provided in all starters based on nameplate and manufacturer's recommendation.
- D. Provide all control devices and wiring, where not provided under Division 23, required for all equipment.
- E. Motors and controllers shall be provided for voltage and current characteristics as indicated. In the event that equipment provided is of different electrical characteristics than the ones specified, any increase in electrical feeders, conduits, circuit breakers, etc., including increase of labor cost shall be the responsibility of the Contractor.
- F. Provide branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with Liquid-Tight Flexible Metal Conduit (LFMC), Seal-tight "UA", or approved equal.
- G. All conduits and wiring required for control work from the holding coil circuit of the starter, including the furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays, pilot lights, selector switches, alternators, etc., shall be provided and installed by other trades unless otherwise indicated.
- H. Power Branch Circuits: Wire sizes for branch circuits not specifically called for on drawings or in Specifications shall be based on 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be used for motors in such calculations.

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. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers. No other manufacturers are acceptable.

1. Square D Company; Groupe Schneider. (Basis of Design).
 2. Eaton Corporation; Westinghouse & Cutler-Hammer Products.
 3. Siemens Energy and Automation, Inc.
- B. All motor controllers shall be NEMA type controllers. IEC type controllers shall NOT be acceptable.

2.2 MANUAL MOTOR CONTROLLERS

- A. Description: NEMA ICS 2, AC general-purpose Class A manually-operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit. Manual motor controllers shall be equipped with red pilot light, hand-off-automatic selector switch and toggle operator. Provide size and number of poles as required for a complete installation of the equipment being connected.
- B. Thermal Overload Units:
1. Thermal overload units shall be melting alloy type, properly sized for the equipment being protected, and shall be interchangeable. Controller shall be inoperable if thermal overload unit is removed.
- C. Enclosure: ANSI/NEMA ICS 6; Type 1 for interior use and Type 4X stainless steel or cast iron for damp or wet locations. Provide flush-mounted enclosures for units located in finished areas. Provide handle guard with locking provisions in the "off" position on all enclosures.
- D. Furnish Square D, Class 2510 Type F, or approved equal.

2.3 MANUAL MOTOR SWITCHES

- A. Description: NEMA ICS 2, AC general-purpose Class A manually-operated, full-voltage controller for integral horsepower induction motors, without thermal overload unit. Manual motor switches shall be equipped with red pilot light and toggle operator. Provide size and number of poles as required for a complete installation of the equipment being connected.
- B. Enclosure: ANSI/NEMA ICS 6; Type 1 for interior use and Type 4X stainless steel or cast iron for damp or wet locations. Provide flush-mounted enclosures for units located in finished areas. Provide handle guard with locking provisions in the "off" position on all enclosures.
- C. Furnish Square D, Class 2510 Type K, or approved equal.

2.4 ENCLOSURES

- A. Description: All motor controllers shall be mounted in enclosures. Flush or surface-mounted cabinets as indicated. NEMA 250, *Enclosures for Electrical Equipment*, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
1. Outdoor Locations: NEMA 250, Type 4X stainless steel.

PART 3 EXECUTION

3.1 APPLICATIONS

- A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.
- B. Select horsepower rating of controllers to suit motor controlled.
- C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.
- D. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.
- E. Provide heaters and fuses correlated with full load nameplate current of motors provided. Set overload devices to suit motor provided.

3.2 INSTALLATION

- A. Install independently mounted motor-control devices according to manufacturer's written instructions.
- B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pretesting and adjustment of solid-state controllers.
- C. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.
- D. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Division 26 Section "Common Work Results for Electrical".
- E. Install freestanding equipment on concrete housekeeping bases conforming to Division 03 Section "Cast-in-Place Concrete".

3.3 IDENTIFICATION

- A. Identify motor-control components and control wiring according to Division 26 Section "Electrical Identification".

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between motor-control devices according to Division 26 Section "Conductors and Cables".
- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic control devices where available.

3.5 CONNECTIONS

- A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

- A. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.
 - 2. Remove and replace malfunctioning units with new units, and retest.
- B. Reports: Prepare written reports of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.
- C. Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.
- D. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.
- E. Pretesting: On completing installation of the system, perform the following preparations for tests:
 - 1. Make insulation resistance test of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by the manufacturer.
 - 2. Make continuity tests of circuits.
 - 3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in the original Contract Documents.
 - 4. Provide manufacturer's instructions for installation and testing of motor control devices to test personnel.
- F. Visual and mechanical inspection: Include the following inspections and related work.
 - 1. Motor-Control Device Ratings and Settings: Verify that ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective-device ratings and settings where differences are found. Use accepted revised ratings or settings to make the final system adjustments. Prepare and submit the load current and overload relay heater list.
 - 2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current project drawings.
 - 3. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instructions.
 - 4. Check tightness of electrical connections of devices with calibrated torque wrench. Use Manufacturer's recommended torque values.

5. Clean devices using Manufacturer's approved methods and materials.
6. Verify proper fuse types and ratings in fusible devices.
- G. Electrical Tests: Perform the following in accordance with manufacturer's instructions:
 1. Insulation resistance test of motor control devices conducting parts to the extent permitted by the manufacturer's instructions. Insulation resistance less than 100 megohms is not acceptable.
 2. Test auxiliary protective features such as loss of phase, phase unbalance and undervoltage to verify operation.
 3. Check for improper voltages at terminals in controllers that have external control wiring when controller disconnect is opened. Any voltage over 30V is unacceptable.
- H. Correct deficiencies and retest motor control devices. Verify by the system tests that specified requirements are met.

3.7 CLEANING

- A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

3.8 DEMONSTRATION

- A. Training: Train Owner's maintenance personnel.
 1. Conduct a minimum of 1 hour of training in operation and maintenance as specified in Division 01 Section "Contract Closeout". Include training relating to equipment operation and maintenance procedures.
 2. Schedule training with at least 7 days' advance notice.

END OF SECTION