PROJECT MANUAL

FOR

SUSSEX TECHNICAL HIGH SCHOOL WEST PAVILION FIELD HOUSE & GREENHOUSE

Georgetown, Delaware

NOT FOR BIDDING

DRAFT BIDDING DOCUMENTS

BMG Project #2024150.02

SPECIFICATIONS

BECKER MORGAN GROUP
ARCHITECTURE ENGINEERING

June 16, 2026

BECKER MORGAN GROUP, INC.
312 WEST MAIN STREET, SUITE 300
SALISBURY, MARYLAND 21801

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ARCHITECT

BECKER MORGAN GROUP, INC.

STRUCTURAL ENGINEER

PILOTTOWN ENGINEERING

MECHANICAL/ELECTRICAL ENGINEERS

GIPE ASSOCIATES, INC.

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END OF SECTION

Title Page/Consultants Directory

By

Project Contacts

Owner's Representative
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Georgetown, Delaware 19947

Architects
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Public notice is hereby given that sealed bids for **Project No. 2024150.02**, will be received by the State of Delaware, Sussex County Vocational Technical School District, at the **Existing Sussex Tech High School located at 17137 County Seat Highway, Georgetown Delaware 19947 until 2:00pm local time on August 4, 2026** at which time they will be publicly opened and read aloud in the Library. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

Project involves the construction of a new West Pavilion Field House, Ag Building and Greenhouse. This is a construction management project. Bids are to be for the following contracts:

C-1: Concrete Work
C-2: Masonry Work
C-3: Steel Work
C-4: Carpentry & General Work
C-5: Roofing Work
C-6: Furnish Hollow Metal/Doors/Hardware
C-7: Aluminum Storefront/Glass & Glazing
C-8: Drywall/Metal Stud
C-9: Painting/Caulking
C-10: Mechanical
C-11: Electrical
C-12: Post Frame Construction
C-13: Greenhouse

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

A **NON-MANDATORY** Pre-Bid Meeting will be held on July 7, 2026, at 9:00amat the **Existing Sussex Tech High School located at 17137 County Seat Highway, Georgetown Delaware 19947** in the Library for the purpose of establishing the listing of subcontractors and to answer questions. **ATTENDANCE OF THIS MEETING IS NOT A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to Sussex County Vocational Technical School District, Attn: Superintendent Dr. Kevin Carson. The outer envelope should clearly indicate: **"Sussex Technical High School Project No. 2024150.02, Company Name, Contract you are bidding, SEALED BID - DO NOT OPEN."**
Construction documents will be available for review at the office of Richard Y Johnson & Son, Inc. Contract documents may be purchased at DiCarlo Printers, located at 2006 Northwood Drive, Salisbury MD, 21801 or RCI Printing and Graphics located at 298 Churchmans Road, New Castle DE, 19720. Electronic documents will be made available on the website of Richard Y. Johnson & Son, Inc.'s www.ryjson.com under plan room. It is the responsibility of each bidder to review and coordinate all project documents. This includes plans, specifications and addendums. All documents will be available on the day of the pre-bid meeting on the website on Richard Y. Johnson & Son, Inc. www.ryjson.com under plan room.

Questions should be directed to the Construction Manager, Richard Y. Johnson & Son, Inc. in writing only. Email questions too Attn: Jesse Dixon (jdixon@ryjson.com).

A bid security in the amount of 10% of the bid must accompany each bid. Bid Security shall specify the Owner as the obligee. Owner: Sussex County Vocational Technical School District, 17137 County Seat Highway, Georgetown, Delaware 19947

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.

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4. BIDDING PROCEDURES

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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.

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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.

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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.

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.

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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

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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 2 calendar 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.

NOT FOR BIDDING

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.

4.1.11 Each bidder shall include a signed Affidavit for the Bidder certifying compliance with OMB Regulation 4104 - "Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on "Large Public Works Projects." "Large Public Works" is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

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 In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, 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. The bidder must list **in each category** the full name and address (City & State) of the sub-contractor that the Bidder will be using to perform the work and provide material for that subcontractor category. Should the Bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the Bidder shall list that third-tier contractor's full name and address (City & State). **If the Bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the Bidder intends to perform the work themselves, the Bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address

NOT FOR BIDDING

(City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third-tier contractors, and submit it with your bid.

4.3.2 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 AFFIDAVIT OF CONTRACTOR QUALIFICATIONS

4.4.1 In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, each Bidder shall submit with their Bid the Affidavit of Contractor Qualifications certifying that the Bidder will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term. After a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

4.5 AFFIDAVIT OF CRAFT TRAINING COMPLIANCE

4.5.1 In accordance with Title 29, Chapter 69, Section 6962(c)(13) of the Delaware Code, contractors and subcontractors must provide craft training for journeyman and apprentice levels if **all** of the following apply:

A. A project meets the prevailing wage requirement under Title 29, Chapter 69, Section 6960 of the Delaware Code.
B. The contractor employs 10 or more total employees.
C. The project is not a federal highway project

Failure to provide required craft training on the project may subject the successful contractor and/or subcontractor(s) to penalties as outlined in Title 29, Chapter 69, Section 6962(c)(13) of the Delaware Code.

Bidders shall submit the Affidavit of Craft Training Compliance prior to contract execution.

4.6 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

4.6.1 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, sex, color, sexual orientation, gender identity 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, sex, color, sexual orientation, gender identity or national origin.

NOT FOR BIDDING

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, sex, color, sexual orientation, gender identity or national origin."

4.7 PREVAILING WAGE REQUIREMENT

4.7.1 Wage Provisions: For renovation and new construction projects whose costs exceed the thresholds contained in Delaware Code, Title 29, Section 6960, 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.

4.7.2 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.

4.7.3 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.

4.7.4 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.

4.8 SUBMISSION OF BIDS

4.8.1 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.

4.8.2 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.

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

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

NOT FOR BIDDING

4.8.5 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.

4.9 MODIFICATION OR WITHDRAW OF BIDS

4.9.1 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.

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

4.9.3 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).

NOT FOR BIDDING

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

NOT FOR BIDDING

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.

NOT FOR BIDDING

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. The successful Bidder shall provide, at least two business days prior to contract execution, copies of the Employee Drug Testing Program for the Bidder and all listed Subcontractors. 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, Bond and all required information, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.

5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and should the vendor be awarded a contract, such vendor shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

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 an 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.

6.3 Bidders to whom an award of a Contract has been made must produce their Delaware Business License before the Contract can be executed.

NOT FOR BIDDING

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

7.1.1 The cost of furnishing the required Bonds, that are stipulated in the Bidding Documents, shall be included in the Bid.

7.1.2 If the Bidder is required by the Agency to secure a bond from other than the Bidder's usual sources, changes in cost will be adjusted as provide in the Contract Documents.

7.1.3 The Performance and Payment Bond forms used shall be the standard OMB forms (attached).

7.2 TIME OF DELIVERY AND FORM OF BONDS

7.2.1 The bonds shall be dated on or after the date of the Contract.

7.2.2 The Bidder shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix a certified and current copy of the power of attorney.

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

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

END OF INSTRUCTIONS TO BIDDERS

NOT FOR BIDDING

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

For Bids Due: August 4, 2026 **To:** Sussex Technical School District
Attn: Superintendent
Dr. Kevin Carson

Contracts

Clearly Mark Contract you are bidding (Only 1 contract per bid form)

For Bid Package C: **GREENHOUSE**

___	**Contract #1**	**Concrete Work**
___	**Contract #2**	**Masonry Work**
___	**Contract #3**	**Steel Work**
___	**Contract #4**	**Carpentry & General Work**
___	**Contract #5**	**Roofing Work**
____	**Contract #6**	**Furnish Hollow Metal/Doors/Hardware**
___	**Contract #7**	**Aluminum Storefront/Windows/ Glass and Glazing**
___	**Contract #8**	**Drywall/Metal Stud**
___	**Contract #9**	**Painting/Caulking**
___	**Contract #10**	**Mechanical**
___	**Contract #11**	**Electrical**
___	**Contract #12**	**Post Frame Construction**
___	**Contract #13**	**Greenhouse**

NOT FOR BIDDING

Name of Bidder: _____

Delaware Business License No.: _____ **Taxpayer ID No.:** _____
(A copy of Bidder's Delaware Business License must be attached to this form.)

(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:

$_____
($)

BID FORM

ALTERNATES

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

NOT USED

ALLOWANCES

Contract No. 1 Concrete Work
1 – Include the lump sum of the following amount **$10,000** in the contract for cold weather protection of concrete work. See Section 012100 Allowances.

Contract No. 2 Masonry Work
2 – Include the lump sum of the following amount **$10,000** in the contract for cold weather protection of masonry work. See Section 012100 Allowances.

Contract No. 7 Carpentry & General Work
4 – Include the lump sum of the following amount **$50,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 25B HVAC
7 – Include the lump sum of the following amount **$20,000** in the contract for the temp heat fuel cost. Cost of work to be determined by fuel company receipts with the amount of fuel and cost per gallon. All equipment and labor for temp heat is part of the contract. This allowance is for fuel cost only. See Section 012100 Allowances.

Contract No. 28 Electrical
8 – Include the sum of **$20,000** for electrical gear revisions resulting from the short circuit analysis specified in Section 260573 "Power System Studies". This allowance includes material cost, receiving, handling, installation, and Contractor overhead and profit.

NOT FOR BIDDING

UNIT PRICES

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

NOT USED

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

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 90 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.

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

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

_____
(State of Corporation)

Business Address: _____
_____
_____
_____

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

(SEAL)

_____
(Title)

Date: _____

NOT FOR BIDDING

ATTACHMENTS

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

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, the following subcontractor listing must accompany any bid submittal. The bidder must list **in each category** the full name and address (City & State) of the sub-contractor that the bidder will be using to perform the work and provide material for that subcontractor category. Should the bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the bidder shall list that third-tier contractor's full name and address (City & State). **If the bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the bidder intends to perform the work themselves, the bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third-tier contractors, and submit it with your bid.

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax-payer ID # or Delaware Business license #
1.			
A.			
B.			
C.			
2.			
A.			
B.			
C.			

NOT FOR BIDDING

Sussex County Vocational Technical School District
Sussex Tech High School
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2022-16

BID FORM

3.			
A.			
B.			
C.			
4.			
A.			
B.			
C.			
5.			
A.			
B.			
C.			

NOT FOR BIDDING

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

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: _____

NOT FOR BIDDING

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.

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

AFFIDAVIT OF EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite that complies with this regulation.

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Authorized representative (typed or printed): _____

Authorized representative (signature): _____

TITLE: _____

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

My Commission expires _____. NOTARY PUBLIC _____.

NOT FOR BIDDING

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

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

AFFIDAVIT
OF
CONTRACTOR QUALIFICATIONS

We hereby certify that we will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term.

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, after a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

NOT FOR BIDDING

Contractor Name: _____

Contractor Address: _____

_____

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

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.

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

AFFIDAVIT OF CRAFT TRAINING COMPLIANCE

We, the contractor, hereby certify that we and all applicable subcontractors will abide by the contractor and subcontractor craft training requirements outlined below for the duration of the contract. Craft training must be provided by a contractor and/or subcontractor for each craft on a project for which there are Delaware Department of Labor approved and registered training programs. A list of crafts for which there are approved and registered training programs is maintained by the Delaware Department of Labor and can be found at https://laborfiles.delaware.gov/main/det/apprenticeship/DE%20Craft%20Training%20Occupation%20List%20Effective%20March%201%202022.pdf. If you have questions regarding craft training programs, please submit them in writing to the Delaware Department of Labor at: apprenticeship@delaware.gov. The Craft Training Compliance Affidavit must be submitted prior to contract execution.

In accordance with Title 29, Chapter 69, Section 6960A.(a)(1), a contract relating to a public works project under § 6962 of Title 29 must include a craft training program for each craft in the project if at the time the contractor executes a public works contract, all of the following apply:

a. A project meets the prevailing wage requirement under Section 6960 of Title 29.
b. The contractor employs 10 or more total employees.
c. The project is not a federal highway project, except for the project under Section 6962(c)(11) of Title 29.
d. There is an apprenticeship program for a craft in the project on the list of crafts under Section 204(b)(2) of Title 19.

Pursuant to Title 29, Chapter 69, Section 6960A.(a)(2), ***a contractor must commit that all subcontractors provide craft training*** if paragraph (a)(1) of this section applies to the subcontractor. Failure to provide required craft training or payment on the project may subject the successful contractor and/or subcontractor(s) to penalties as outlined in Title 29, Chapter 69, Section 6960A.(d)(1)-(3).

NOT FOR BIDDING

Craft(s) _____

Contractor Name: _____

Contractor Address: _____

_____

_____

Contractor Program Registration Number(s) _____
On this line also indicate whether DE, Other State (identify) or US Registration Number

Or

☐ **A payment has been made in the amount established under Section 204(b)(2)b.2. of Title 19, for the craft into the Delaware Department of Labor's Apprenticeship and Training Fund.**

Or

☐ **Craft Training requirements are not applicable because:**

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

State of Delaware

County of _____)

Before me, a notary public, in and for said county and state, personally appeared, _____, who acknowledged to me that she/he did execute the foregoing instrument on behalf of _____.
IN TESTIMONY WHEREOF, I have subscribed my name and affixed my official seal this ____ day of _____ 20___.

_____
Notary Public

Commission Expires _____

THIS PAGE MUST BE SIGNED AND NOTARIZED TO BE CONSIDERED.

NOT FOR BIDDING

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

For Bids Due: August 4, 2026 **To:** Sussex Technical School District
Attn: Superintendent
Dr. Kevin Carson

Contracts

Clearly Mark Contract you are bidding (Only 1 contract per bid form)

For Bid Package C: **WEST PAVILION FIELD HOUSE**

___	**Contract #1**	**Concrete Work**
___	**Contract #2**	**Masonry Work**
___	**Contract #3**	**Steel Work**
___	**Contract #4**	**Carpentry & General Work**
___	**Contract #5**	**Roofing Work**
____	**Contract #6**	**Furnish Hollow Metal/Doors/Hardware**
___	**Contract #7**	**Aluminum Storefront/Windows/ Glass and Glazing**
___	**Contract #8**	**Drywall/Metal Stud**
___	**Contract #9**	**Painting/Caulking**
___	**Contract #10**	**Mechanical**
___	**Contract #11**	**Electrical**
___	**Contract #12**	**Post Frame Construction**
___	**Contract #13**	**Greenhouse**

NOT FOR BIDDING

Name of Bidder: _____

Delaware Business License No.: _____ **Taxpayer ID No.:** _____
(A copy of Bidder's Delaware Business License must be attached to this form.)

(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:

$_____
($)

BID FORM

ALTERNATES

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

NOT USED

ALLOWANCES

Contract No. 1 Concrete Work
1 – Include the lump sum of the following amount **$10,000** in the contract for cold weather protection of concrete work. See Section 012100 Allowances.

Contract No. 2 Masonry Work
2 – Include the lump sum of the following amount **$10,000** in the contract for cold weather protection of masonry work. See Section 012100 Allowances.

Contract No. 7 Carpentry & General Work
4 – Include the lump sum of the following amount **$50,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 25B HVAC
7 – Include the lump sum of the following amount **$20,000** in the contract for the temp heat fuel cost. Cost of work to be determined by fuel company receipts with the amount of fuel and cost per gallon. All equipment and labor for temp heat is part of the contract. This allowance is for fuel cost only. See Section 012100 Allowances.

Contract No. 28 Electrical
8 – Include the sum of **$20,000** for electrical gear revisions resulting from the short circuit analysis specified in Section 260573 "Power System Studies". This allowance includes material cost, receiving, handling, installation, and Contractor overhead and profit.

NOT FOR BIDDING

UNIT PRICES

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

NOT USED

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

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 90 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.

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

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

_____
(State of Corporation)

Business Address: _____
_____
_____
_____

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

(SEAL)

_____
(Title)

Date: _____

NOT FOR BIDDING

ATTACHMENTS

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

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b of the Delaware Code, the following subcontractor listing must accompany any bid submittal. The bidder must list **in each category** the full name and address (City & State) of the sub-contractor that the bidder will be using to perform the work and provide material for that subcontractor category. Should the bidder's listed subcontractor intend to provide any of their subcontractor category of work through a third-tier contractor, the bidder shall list that third-tier contractor's full name and address (City & State). **If the bidder intends to perform any category of work itself, it must list its full name and address.** For clarification, if the bidder intends to perform the work themselves, the bidder **may not** insert "not applicable", "N/A", "self" or anything other than its own full name and address (City & State). To do so shall cause the bid to be rejected. In addition, the failure to produce a completed subcontractor list with the bid submittal shall cause the bid to be rejected. If you have more than three (3) third-tier contractors to report in any subcontractor category, print out additional page(s) containing the appropriate category, complete the rest of your list of third-tier contractors for that category, notate the addition in parentheses as (CONTINUATION) next to the subcontractor category and an asterisk (*) next to any additional third-tier contractors, and submit it with your bid.

Subcontractor Category	Subcontractor	Address (City & State)	Subcontractors tax-payer ID # or Delaware Business license #
1.			
A.			
B.			
C.			
2.			
A.			
B.			
C.			

NOT FOR BIDDING

Sussex County Vocational Technical School District
Sussex Tech High School
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2022-16

BID FORM

3.			
A.			
B.			
C.			
4.			
A.			
B.			
C.			
5.			
A.			
B.			
C.			

NOT FOR BIDDING

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

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: _____

NOT FOR BIDDING

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.

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

AFFIDAVIT OF EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite that complies with this regulation.

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Authorized representative (typed or printed): _____

Authorized representative (signature): _____

TITLE: _____

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

My Commission expires _____. NOTARY PUBLIC _____.

NOT FOR BIDDING

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

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

AFFIDAVIT
OF
CONTRACTOR QUALIFICATIONS

We hereby certify that we will abide by the contractor's qualifications outlined in the construction bid specifications for the duration of the contract term.

In accordance with Title 29, Chapter 69, Section 6962(d)(10)b.3 of the Delaware Code, after a contract has been awarded the successful bidder shall not substitute another subcontractor whose name was submitted on the Subcontractor Form except for the reasons in the statute and not without written consent from the awarding agency. Failure to utilize the subcontractors on the list will subject the successful bidder to penalties as outlined in the General Requirements Section 5.2 of the contract.

NOT FOR BIDDING

Contractor Name: _____

Contractor Address: _____

_____

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

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.

Sussex County Vocational Technical School District
STHS West Pavilion & Greenhouse
17137 County Seat Highway, Georgetown Delaware 19947
Project No. 2024150.02

BID FORM

AFFIDAVIT OF CRAFT TRAINING COMPLIANCE

We, the contractor, hereby certify that we and all applicable subcontractors will abide by the contractor and subcontractor craft training requirements outlined below for the duration of the contract. Craft training must be provided by a contractor and/or subcontractor for each craft on a project for which there are Delaware Department of Labor approved and registered training programs. A list of crafts for which there are approved and registered training programs is maintained by the Delaware Department of Labor and can be found at https://laborfiles.delaware.gov/main/det/apprenticeship/DE%20Craft%20Training%20Occupation%20List%20Effective%20March%201%202022.pdf. If you have questions regarding craft training programs, please submit them in writing to the Delaware Department of Labor at: apprenticeship@delaware.gov. The Craft Training Compliance Affidavit must be submitted prior to contract execution.

In accordance with Title 29, Chapter 69, Section 6960A.(a)(1), a contract relating to a public works project under § 6962 of Title 29 must include a craft training program for each craft in the project if at the time the contractor executes a public works contract, all of the following apply:

a. A project meets the prevailing wage requirement under Section 6960 of Title 29.
b. The contractor employs 10 or more total employees.
c. The project is not a federal highway project, except for the project under Section 6962(c)(11) of Title 29.
d. There is an apprenticeship program for a craft in the project on the list of crafts under Section 204(b)(2) of Title 19.

Pursuant to Title 29, Chapter 69, Section 6960A.(a)(2), ***a contractor must commit that all subcontractors provide craft training*** if paragraph (a)(1) of this section applies to the subcontractor. Failure to provide required craft training or payment on the project may subject the successful contractor and/or subcontractor(s) to penalties as outlined in Title 29, Chapter 69, Section 6960A.(d)(1)-(3).

NOT FOR BIDDING

Craft(s) _____

Contractor Name: _____

Contractor Address: _____

_____

_____

Contractor Program Registration Number(s) _____
On this line also indicate whether DE, Other State (identify) or US Registration Number

Or

☐ **A payment has been made in the amount established under Section 204(b)(2)b.2. of Title 19, for the craft into the Delaware Department of Labor's Apprenticeship and Training Fund.**

Or

☐ **Craft Training requirements are not applicable because:**

_____

Authorized Representative (typed or printed): _____

Authorized Representative (signature): _____

Title: _____

State of Delaware

County of _____)

Before me, a notary public, in and for said county and state, personally appeared, _____, who acknowledged to me that she/he did execute the foregoing instrument on behalf of _____.
IN TESTIMONY WHEREOF, I have subscribed my name and affixed my official seal this ____ day of _____ 20___.

_____
Notary Public

Commission Expires _____

THIS PAGE MUST BE SIGNED AND NOTARIZED TO BE CONSIDERED.

NOT FOR BIDDING

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

NOT FOR BIDDING

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness:_____ By: _____

_____
Title

AIA® Document A132™ – 2019

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

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

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

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

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

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

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

The Owner and Contractor agree as follows.

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

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

This document is intended to be used in conjunction with AIA Documents A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition; B132™–2019, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2019, Standard Form of Agreement Between Owner and Construction Manager as Adviser. AIA Document A232™–2019 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

3 DATE OF COMMENCEMENT AND DATES OF SUBSTANTIAL COMPLETION

4 CONTRACT SUM

5 PAYMENTS

6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS
EXHIBIT B DETERMINATION OF THE COST OF THE WORK

NOT FOR BIDDING

ARTICLE 1 THE CONTRACT DOCUMENTS

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

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND DATES OF SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:
(Check one of the following boxes.)

[ ] The date of this Agreement.

[ ] A date set forth in a notice to proceed issued by the Owner.

[ ] Established as follows:
(Insert a date or a means to determine the date of commencement of the Work.)

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

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

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User Notes:
(3B9ADA46)

§ 3.3 Substantial Completion of the Project or Portions Thereof

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the date of Substantial Completion of the Work of all of the Contractors for the Project will be:
(Insert the date of Substantial Completion of the Work of all Contractors for the Project.)

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work of all of the Contractors for the Project are to be completed prior to Substantial Completion of the entire Work of all of the Contractors for the Project, the Contractors shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date

§ 3.4 When the Work of this Contract, or any Portion Thereof, is Substantially Complete

§ 3.4.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall substantially complete the entire Work of this Contract:
(Check one of the following boxes and complete the necessary information.)

[ ] Not later than ( ) calendar days from the date of commencement of the Work.

[ ] By the following date:

§ 3.4.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work of this Contract are to be substantially complete prior to when the entire Work of this Contract shall be substantially complete, the Contractor shall substantially complete such portions by the following dates:

Portion of Work	Date to be substantially complete

§ 3.4.3 If the Contractor fails to substantially complete the Work of this Contract, or portions thereof, as provided in this Section 3.4, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be one of the following:
(Check the appropriate box.)

[ ] Stipulated Sum, in accordance with Section 4.2 below

[ ] Cost of the Work plus the Contractor's Fee, in accordance with Section 4.3 below

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

(Based on the selection above, complete Section 4.2, 4.3 or 4.4 below.)

§ 4.2 Stipulated Sum

§ 4.2.1 The Contract Sum shall be ($), subject to additions and deductions as provided in the Contract Documents.

§ 4.2.2 Alternates

§ 4.2.2.1 Alternates, if any, included in the Contract Sum:

Item	Price

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User Notes:
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§ 4.2.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.2.3 Allowances, if any, included in the Contract Sum:
(Identify each allowance.)

Item	Price

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

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.3 Cost of the Work Plus Contractor's Fee without a Guaranteed Maximum Price
§ 4.3.1 The Cost of the Work is as defined in Exhibit B, Determination of the Cost of the Work.

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

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

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

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

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

Item	Units and Limitations	Price per Unit ($0.00)

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

§ 4.4 Cost of the Work Plus Contractor's Fee with a Guaranteed Maximum Price
§ 4.4.1 The Cost of the Work is as defined in Exhibit B, Determination of the Cost of the Work.

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

NOT FOR BIDDING

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User Notes: (3B9ADA46)

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

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

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

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

Item	Units and Limitations	Price per Unit ($0.00)

§ 4.4.7 Guaranteed Maximum Price
§ 4.4.7.1 The Contract Sum is guaranteed by the Contractor not to exceed ($), subject to additions and deductions by Change Order as provided in the Contract Documents. This maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.

§ 4.4.7.2 Alternates
§ 4.4.7.2.1 Alternates, if any, included in the Guaranteed Maximum Price:

Item	Price

§ 4.4.7.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance

§ 4.4.7.3 Allowances, if any, included in the Guaranteed Maximum Price:
(Identify each allowance.)

Item	Price

§ 4.4.7.4 Assumptions, if any, upon which the Guaranteed Maximum Price is based:
(Identify each assumption.)

§ 4.4.8 To the extent that the Contract Documents are anticipated to require further development, the Guaranteed Maximum Price includes the costs attributable to such further development consistent with the Contract Documents and reasonably inferable therefrom. Such further development does not include changes in scope, systems, kinds and quality of materials, finishes, or equipment, all of which, if required, shall be incorporated by Change Order.

§ 4.4.9 The Owner shall authorize preparation of revisions to the Contract Documents that incorporate the agreed-upon assumptions contained in Section 4.4.7.4. The Owner shall promptly furnish such revised Contract Documents

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to the Contractor. The Contractor shall notify the Owner and Architect of any inconsistencies between the agreed-upon assumptions contained in Section 4.4.7.4 and the revised Contract Documents.

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any, to be assessed in accordance with Section 3.4.)

§ 4.6 Other:
(Insert provisions for bonus, cost savings or other incentives, if any, that might result in a change to the Contract Sum.)

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

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

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

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

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

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

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

§ 5.1.4.3 In accordance with AIA Document A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.4.3.1 The amount of each progress payment shall first include:

.1 That portion of the Contract Sum properly allocable to completed Work;

.2 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; and

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.4.3.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

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.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A232–2019;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A232–2019; and

.5 Retainage withheld pursuant to Section 5.1.7.

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

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

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

§ 5.1.5.3 In accordance with AIA Document A232-2019 and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.5.3.1 The amount of each progress payment shall first include:

.1 The Cost of the Work as described in Exhibit B, Determination of the Cost of the Work;

.2 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified; and

.3 The Contractor's Fee computed upon the Cost of the Work described in the preceding Section 5.1.5.3.1.1 at the rate stated in Section 4.3.2; or if the Contractor's Fee is stated as a fixed sum in Section 4.3.2 an amount which bears the same ratio to that fixed-sum Fee as the Cost of the Work included in Section 5.1.5.3.1.1 bears to a reasonable estimate of the probable Cost of the Work upon its completion.

§ 5.1.5.3.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A232–2019;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A232–2019;

.5 The shortfall, if any, indicated by the Contractor in the documentation required by Section 5.1.5.1 to substantiate prior Applications for Payment, or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and

.6 Retainage withheld pursuant to Section 5.1.7.

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

§ 5.1.5.5 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor, and such action shall not be deemed to be a representation that (1) the Construction Manager and Architect have made a detailed examination, audit or arithmetic verification of the documentation submitted in accordance with Article 5 or

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other supporting data; (2) that the Construction Manager and Architect have made exhaustive or continuous on-site inspections; or (3) that the Construction Manager and Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.

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

§ 5.1.5.7 If final completion of the Work is materially delayed through no fault of the Contractor, then the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A232-2019.

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

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

§ 5.1.6.2 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Guaranteed Maximum Price among: (1) the various portions of the Work; (2) any contingency for costs that are included in the Guaranteed Maximum Price but not otherwise allocated to another line item or included in a Change Order; and (3) the Contractor's Fee.

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

§ 5.1.6.2.2 The allocation of the Guaranteed Maximum Price under this Section 5.1.6.2 shall not constitute a separate guaranteed maximum price for the Cost of the Work of each individual line item in the schedule of values.

§ 5.1.6.2.3 When the Contractor allocates costs from a contingency to another line item in the schedule of values, the Contractor shall submit supporting documentation to the Architect and Construction Manager.

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

§ 5.1.6.4 In accordance with AIA Document A232-2019, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.4.1 The amount of each progress payment shall first include:

.1 That portion of the Guaranteed Maximum Price properly allocable to completed Work as determined by multiplying the percentage of completion of each portion of the Work by the share of the Guaranteed Maximum Price allocated to that portion of the Work in the most recent schedule of values;

.2 That portion of the Guaranteed Maximum Price properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction or, if approved in writing in advance by the Owner, suitably stored off the site at a location agreed upon in writing;

.3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified; and

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.4 The Contractor's Fee, computed upon the Cost of the Work described in the preceding Sections 5.1.6.4.1.1 and 5.1.6.4.1.2 at the rate stated in Section 4.4.2 or, if the Contractor's Fee is stated as a fixed sum in that Section, an amount that bears the same ratio to that fixed-sum fee as the Cost of the Work included in Sections 5.1.6.4.1.1 and 5.1.6.4.1.2 bears to a reasonable estimate of the probable Cost of the Work upon its completion.

§ 5.1.6.4.2 The amount of each progress payment shall then be reduced by:

.1 The aggregate of any amounts previously paid by the Owner;

.2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A232–2019;

.3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;

.4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A232–2019;

.5 The shortfall, if any, indicated by the Contractor in the documentation required by Section 5.1.6.1 to substantiate prior Applications for Payment, or resulting from errors subsequently discovered by the Owner's auditors in such documentation; and

.6 Retainage withheld pursuant to Section 5.1.7.

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

§ 5.1.6.6 In taking action on the Contractor's Applications for Payment, the Construction Manager and Architect shall be entitled to rely on the accuracy and completeness of the information furnished by the Contractor and such action shall not be deemed to be a representation that (1) the Construction Manager or Architect have made a detailed examination, audit, or arithmetic verification of the documentation submitted in accordance with Section 5.1.6.1 or other supporting data; (2) that the Construction Manager or Architect have made exhaustive or continuous on-site inspections; or (3) that the Construction Manager or Architect have made examinations to ascertain how or for what purposes the Contractor has used amounts previously paid on account of the Contract. Such examinations, audits, and verifications, if required by the Owner, will be performed by the Owner's auditors acting in the sole interest of the Owner.

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

§ 5.1.6.8 If final completion of the Work is materially delayed through no fault of the Contractor, then the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A232-2019.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to when the Work of this Contract is substantially complete, the Owner may withhold the following amount, as retainage, from the payment otherwise due:
(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to when the entire Work of this Contract is substantially complete, including modifications for completion of portions of the Work as provided in Section 3.4.2, insert provisions for such modifications.)

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§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, when the Work of this Contract is substantially complete, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted when the Work of this Contract is substantially complete shall not include retainage as follows:
(Insert any other conditions for release of retainage when the Work of this Contract is substantially complete, or upon Substantial Completion of the Work of all Contractors on the Project or portions thereof.)

§ 5.2 Final Payment
§ 5.2.1 Final Payment Where the Contract Sum is Based on a Stipulated Sum
§ 5.2.1.1 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 Article 12 of AIA Document A232–2019, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect.

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

§ 5.2.2 Final Payment Where the Contract Sum is Based on the Cost of the Work with or without a Guaranteed Maximum Price
§ 5.2.2.1 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 Article 12 of AIA Document A232–2019, and to satisfy other requirements, if any, which extend beyond final payment;

.2 the Contractor has submitted a final accounting for the Cost of the Work, pursuant to Exhibit B, Determination of the Cost of the Work and a final Application for Payment; and

.3 a final Certificate for Payment or Project Certificate for Payment has been issued by the Architect in accordance with Exhibit B, Determination of the Cost of the Work.

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

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§ 5.3 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.)

%

ARTICLE 6 DISPUTE RESOLUTION
§ 6.1 Initial Decision Maker
The Architect will serve as Initial Decision Maker pursuant to Article 15 of AIA Document A232–2019, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

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§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A232–2019, the method of binding dispute resolution shall be as follows:
(Check the appropriate box.)

[ ] Arbitration pursuant to Article 15 of AIA Document A232–2019.

[ ] Litigation in a court of competent jurisdiction.

[ ] Other: *(Specify)*

If the Owner and Contractor do not select a method of binding dispute resolution, 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.

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ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 Where the Contract Sum is a Stipulated Sum

§ 7.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2019.

§ 7.1.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A232–2019, then the Owner shall pay the Contractor a termination fee as follows:
(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

§ 7.1.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2019.

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

§ 7.2.1 Termination

§ 7.2.1.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A232–2019.

§ 7.2.1.2 Termination by the Owner for Cause

§ 7.2.1.2.1 If the Owner terminates the Contract for cause as provided in Article 14 of AIA Document A232–2019, the Owner shall then only pay the Contractor an amount as follows:

.1 Take the Cost of the Work incurred by the Contractor to the date of termination;

.2 Add the Contractor's Fee, computed upon the Cost of the Work to the date of termination at the rate stated in Section 4.3.2 or 4.4.2, as applicable, or, if the Contractor's Fee is stated as a fixed sum in that Section, an amount that bears the same ratio to that fixed-sum Fee as the Cost of the Work at the time of termination bears to a reasonable estimate of the probable Cost of the Work upon its completion;

.3 Subtract the aggregate of previous payments made by the Owner; and

.4 Subtract the costs and damages incurred, or to be incurred, by the Owner under Article 14 of AIA Document A232–2019.

§ 7.2.1.2.2 When the Contract Sum is based on the Cost of the Work with a Guaranteed Maximum Price, if the Owner terminates the Contract for cause as provided in Article 14 of AIA Document A232-2019, the amount, if any,

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to be paid to the Contractor under Article 14 of AIA Document A232-2019 shall not cause the Guaranteed Maximum Price to be exceeded, nor shall it exceed the amount calculated in Section 7.2.1.2.1.

§ 7.2.1.2.3 The Owner shall also pay the Contractor fair compensation, either by purchase or rental at the election of the Owner, for any equipment owned by the Contractor that the Owner elects to retain and that is not otherwise included in the Cost of the Work under Section 7.2.1.2.1.1. To the extent that the Owner elects to take legal assignment of subcontracts and purchase orders (including rental agreements), the Contractor shall, as a condition of receiving the payments referred to in this Article 7, execute and deliver all such papers and take all such steps, including the legal assignment of such subcontracts and other contractual rights of the Contractor, as the Owner may require for the purpose of fully vesting in the Owner the rights and benefits of the Contractor under such subcontracts or purchase orders. All Subcontracts, purchase orders and rental agreements entered into by the Contractor will contain provisions allowing for assignment to the Owner as described above.

§ 7.2.1.3 Termination by the Owner for Convenience

If the Owner terminates the Contract for convenience in accordance with Article 14 of AIA Document A232–2019, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of or method for determining the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

§ 7.3 Suspension

The Work may be suspended by the Owner as provided in Article 14 of AIA Document A232–2019; in such case, the Contract Sum and Contract Time shall be increased as provided in Article 14 of AIA Document A232–2019, except that the term "profit" shall be understood to mean the Contractor's Fee as described in Section 4.3.2 or 4.4.2, as applicable, of this Agreement.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A232–2019 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:

(Name, address, email address, and other information)

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§ 8.3 The Contractor's representative:

(Name, address, email address, and other information)

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

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§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A132™–2019, Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A232–2019, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Relationship of the Parties

Where the Contract is based on the Cost of the Work plus the Contractor's Fee, with or without a Guaranteed Maximum Price, the Contractor accepts the relationship of trust and confidence established by this Agreement and covenants with the Owner to cooperate with the Architect and exercise the Contractor's skill and judgment in furthering the interests of the Owner; to furnish efficient business administration and supervision; to furnish at all times an adequate supply of workers and materials; and to perform the Work in an expeditious and economical manner consistent with the Owner's interests. The Owner agrees to furnish and approve, in a timely manner, information required by the Contractor and to make payments to the Contractor in accordance with the requirements of the Contract Documents.

§ 8.8 Other provisions:

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ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition

.2 AIA Document A132™–2019, Exhibit A, Insurance and Bonds Exhibit

.3 AIA Document A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:

(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

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Number	Date	Pages

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

.8 Other Exhibits:
(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[ ] AIA Document A132™–2019, Exhibit B, Determination of the Cost of the Work

[ ] AIA Document E235™–2019, Sustainable Projects Exhibit, Construction Manager as Adviser Edition, dated as indicated below:
(Insert the date of the E235-2019 incorporated into this Agreement.)

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

.9 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A232–2019 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

NOT FOR BIDDING

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

OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
(Printed name and title)	*(Printed name and title)*

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Additions and Deletions Report for

AIA® Document A132™ – 2019

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Certification of Document's Authenticity

AIA® Document D401™ – 2003

I, , hereby certify, to the best of my knowledge, information and belief, that I created the attached final document simultaneously with its associated Additions and Deletions Report and this certification at 09:04:21 ET on 12/09/2021 under Order No. 6216521775 from AIA Contract Documents software and that in preparing the attached final document I made no changes to the original text of AIA® Document A132™ - 2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition, as published by the AIA in its software, other than those additions and deletions shown in the associated Additions and Deletions Report.

_____

(Signed)

_____

(Title)

_____

(Dated)

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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.

NOT FOR BIDDING

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

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

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

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

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

_____ By: _____ (SEAL)
Name: Name:
Title:

(Corporate Seal)

NOT FOR BIDDING

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.

NOT FOR BIDDING

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: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

_____ By: _____(SEAL)
Name: Name:
Title:

(Corporate Seal)

NOT FOR BIDDING

AIA® Document G732™ – 2019

Application and Certificate for Payment, Construction Manager as Adviser Edition

TO OWNER:

PROJECT: DT & CC

APPLICATION NO: 001

Distribution to:
OWNER: ☐
CONSTRUCTION MANAGER: ☐
ARCHITECT: ☐
CONTRACTOR: ☐
FIELD: ☐
OTHER : ☐

FROM CONTRACTOR:

VIA CONSTRUCTION MANAGER:

PERIOD TO:

CONTRACT DATE:

CONTRACT FOR: General Construction

VIA ARCHITECT:

PROJECT NOS: / /

NOT FOR BIDDING

CONTRACTOR'S APPLICATION FOR PAYMENT

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

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

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

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

CONTRACTOR:

By: _____ Date: _____

State of:

County of:

Subscribed and sworn to before me this day of

Notary Public:

My Commission expires:

CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on evaluations of the Work and the data comprising this application, the Construction Manager and Architect certify to the Owner that to the best of their knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED $0.00

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

CONSTRUCTION MANAGER:

By: _____ Date: _____

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

By: _____ Date: _____

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

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AIA® Document G703®CW – 2021

Continuation Sheet for Cost of the Work Projects

AIA Document G702®CW, Application and Certification for Payment without GMP, or G702®GMP, Application and Certificate for Payment with GMP, containing Contractor's signed certification is attached. Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:	001
APPLICATION DATE:	
PERIOD TO:	
ARCHITECT'S PROJECT NO:	

A	B	C1	C2	C3	C4	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE				WORK COMPLETED		MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D + E + F)	% (G÷C4)	BALANCE TO FINISH (C4 - G)	RETAINAGE (IF VARIABLE RATE)
		ORIGINAL	CHANGE FROM PREVIOUS APPLICATIONS	CHANGE THIS PERIOD	CURRENT (C1+C2+C3)	FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD					
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**0.00%**	**$0.00**	**$0.00**

NOT FOR BIDDING

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SECTION 006300 - STANDARD FORMS CERTIFICATES AND MODIFICATION FORMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Standard Forms.

1.2 RELATED SECTIONS

A. General and Supplementary Conditions.

1.3 STANDARD FORMS

A. Following is a list of the standard Documents published by the American Institute of Architects which will be used during the performance of Work covered by the Contract Documents.

B. The Contractor shall familiarize himself with the contents of the Documents, as he will not only be required to execute certain Documents, but will be required to prepare certain others in performing his work in accordance with the Contract Documents.

C. The Contractor will be required to obtain for his own use, those Documents marked with an asterisk (*). The Documents can be obtained, at nominal cost, from the Documents Division, The American Institute of Architects, 1735 New York Avenue, NW, Washington, DC 20006, as well as other local sources.

D. FORMS

A232*	General Conditions of the Contract for Construction Change Order (Architect Form)
G732/CM*	Application and Certificate for Payment
G703*	Continuation Sheet
G704	Certificate of Substantial Completion
G705*	Certificate of Insurance
G706*	Contractor's Affidavit of Payment of Debts and Claims
G706A*	Contractor's Affidavit of Release of Liens
G707*	Consent of Surety Company to Final Payment
G707A*	Consent of Surety to Reduction in or Partial Release of Retainage
G805*	List of Subcontractors

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 006300

NOT FOR BIDDING

AIA® Document A232™ – 2019

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

for the following PROJECT:
(Name, and location or address)

THE CONSTRUCTION MANAGER:
(Name, legal status, and address)

THE OWNER:
(Name, legal status, and address)

THE ARCHITECT:
(Name, legal status, and address)

TABLE OF ARTICLES

1 GENERAL PROVISIONS

2 OWNER

3 CONTRACTOR

4 ARCHITECT AND CONSTRUCTION MANAGER

5 SUBCONTRACTORS

6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

7 CHANGES IN THE WORK

8 TIME

9 PAYMENTS AND COMPLETION

10 PROTECTION OF PERSONS AND PROPERTY

11 INSURANCE AND BONDS

12 UNCOVERING AND CORRECTION OF WORK

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. A vertical line in the left margin of this document indicates where the author has added necessary information and where the author has added to or deleted from the original AIA text.

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

This document is intended to be used in conjunction with AIA Documents A132™–2019, Standard Form of Agreement Between Owner and Contractor, Construction Manager as Adviser Edition; B132™–2019, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2019, Standard Form of Agreement Between Owner and Construction Manager as Adviser.

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13 MISCELLANEOUS PROVISIONS

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

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

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

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

§ 1.1.4 The Project. The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by other Contractors, and by the Owner's own forces and Separate Contractors.

§ 1.1.5 Contractors. Contractors are persons or entities, other than the Contractor or Separate Contractors, who perform Work under contracts with the Owner that are administered by the Architect and Construction Manager.

§ 1.1.6 Separate Contractors. Separate Contractors are persons or entities who perform construction under separate contracts with the Owner not administered by the Architect and Construction Manager.

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

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

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

§ 1.1.10 Initial Decision Maker. The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

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§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building

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Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Construction Manager and the Architect do not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

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

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work, and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

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§ 2.3 Information and Services Required of the Owner

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

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 The Owner shall retain a construction manager adviser lawfully practicing construction management in the jurisdiction where the Project is located. That person or entity is identified as the Construction Manager in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.4 If the employment of the Construction Manager or Architect terminates, the Owner shall employ a successor construction manager or architect to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Construction Manager or Architect, respectively.

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

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

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

§ 2.3.8 The Owner shall forward all communications to the Contractor through the Construction Manager. Other communication shall be made as set forth in Section 4.2.6.

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to review by the Construction Manager and prior approval of the Architect, and the Construction Manager or Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Construction Manager's and Architect's and their respective consultants' additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

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ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.5, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Construction Manager and Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information submitted to the Construction Manager in such form as the Construction Manager and Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

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

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner, the Construction Manager, and the Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent

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for the completed construction. The Construction Manager shall review the proposed alternative for sequencing, constructability, and coordination impacts on the other Contractors. Unless the Architect or the Construction Manager objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

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

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

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect, in consultation with the Construction Manager, and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner, Construction Manager, and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Construction Manager or Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work or portions thereof provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices, and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Owner, assisted by the Construction Manager, shall secure and pay for the building permit. The Contractor shall secure and pay for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

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§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner, Construction Manager, and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect and Construction Manager will promptly investigate such conditions and, if the Architect, in consultation with the Construction Manager, determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect, in consultation with the Construction Manager, determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner, Construction Manager, and Contractor, stating the reasons. If the Owner or Contractor disputes the Architect's determination or recommendation, either party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner, Construction Manager, and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

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§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents:

.1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;

.2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and

.3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect, through the Construction Manager, of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Construction Manager may notify the Contractor, stating whether the Owner, the Construction Manager, or the Architect (1) has reasonable objection to the proposed superintendent or (2) require

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additional time for review. Failure of the Construction Manager to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner, Construction Manager, or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information, and the Construction Manager's use in developing the Project schedule, a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project. The Contractor shall cooperate with the Construction Manager in scheduling and performing the Contractor's Work to avoid conflict with, and as to cause no delay in, the work or activities of other Contractors, or the construction or operations of the Owner's own forces or Separate Contractors.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Construction Manager's and Architect's approval. The Architect and Construction Manager's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Construction Manager and Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall participate with other Contractors, the Construction Manager, and the Owner in reviewing and coordinating all schedules for incorporation into the Project schedule that is prepared by the Construction Manager. The Contractor shall make revisions to the construction schedule and submittal schedule as deemed necessary by the Construction Manager to conform to the Project schedule.

§ 3.10.4 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner, Construction Manager, and Architect, and incorporated into the approved Project schedule.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Construction Manager, Architect, and Owner, and delivered to the Construction Manager for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data, and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed

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in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect and Construction Manager is subject to the limitations of Sections 4.2.10 through 4.2.12. Informational submittals upon which the Construction Manager and Architect are not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Construction Manager or Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Construction Manager, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the Project submittal schedule approved by the Construction Manager and Architect or, in the absence of an approved Project submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of other Contractors, Separate Contractors, or the Owner's own forces. The Contractor shall cooperate with the Construction Manager in the coordination of the Contractor's Shop Drawings, Product Data, Samples, and similar submittals with related documents submitted by other Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner, Construction Manager, and Architect, that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been reviewed and approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Construction Manager and Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Construction Manager and Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner, the Architect, and the Construction Manager shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with

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information given and the design concept expressed in the Contract Documents. The Construction Manager shall review submittals for sequencing, constructability, and coordination impacts on other Contractors.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Construction Manager and Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

§ 3.13.1 The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.13.2 The Contractor shall coordinate the Contractor's operations with, and secure the approval of, the Construction Manager before using any portion of the site.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner, Separate Contractors, or of other Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner, Separate Contractors, or by other Contractors except with written consent of the Construction Manager, Owner, and such other Contractors or Separate Contractors. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Separate Contractors, other Contractors, or the Owner, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner, or Construction Manager with the Owner's approval, may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner, Construction Manager, and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner, Construction Manager, and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner, Architect, or Construction Manager. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect through the Construction Manager.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Construction Manager, Architect, Construction Manager's and Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is

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attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT AND CONSTRUCTION MANAGER

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 The Construction Manager is the person or entity retained by the Owner pursuant to Section 2.3.3 and identified as such in the Agreement.

§ 4.1.3 Duties, responsibilities, and limitations of authority of the Construction Manager and Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Construction Manager, Architect, and Contractor. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Construction Manager and Architect will provide administration of the Contract as described in the Contract Documents and will be the Owner's representatives during construction until the date the Architect issues the final Certificate for Payment. The Construction Manager and Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. On the basis of the site visits, the Architect will keep the Owner and the Construction Manager reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner and Construction Manager known deviations from the Contract Documents and defects and deficiencies observed in the Work.

§ 4.2.3 The Construction Manager shall provide one or more representatives who shall be in attendance at the Project site whenever the Work is being performed. The Construction Manager will determine in general if the Work observed is being performed in accordance with the Contract Documents, will keep the Owner and Architect reasonably informed of the progress of the Work, and will promptly report to the Owner and Architect known deviations from the Contract Documents and the most recent Project schedule, and defects and deficiencies observed in the Work.

§ 4.2.4 The Construction Manager will schedule and coordinate the activities of the Contractor and other Contractors in accordance with the latest approved Project schedule.

§ 4.2.5 The Construction Manager, except to the extent required by Section 4.2.4, and Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, and neither will be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. Neither the Construction Manager nor the Architect will have control over or charge of, or be responsible for acts or omissions of, the

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Contractor, Subcontractors, or their agents or employees, or of any other persons or entities performing portions of the Work.

§ 4.2.6 Communications. The Owner shall communicate with the Contractor and the Construction Manager's consultants through the Construction Manager about matters arising out of or relating to the Contract Documents. The Owner and Construction Manager shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Construction Manager otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with other Contractors shall be through the Construction Manager. Communications by and with the Owner's own forces and Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.7 The Construction Manager and Architect will review and certify all Applications for Payment by the Contractor, in accordance with the provisions of Article 9.

§ 4.2.8 The Architect and Construction Manager have authority to reject Work that does not conform to the Contract Documents, and will notify each other about the rejection. Whenever the Construction Manager considers it necessary or advisable, the Construction Manager will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, upon written authorization of the Owner, whether or not the Work is fabricated, installed or completed. The foregoing authority of the Construction Manager will be subject to the provisions of Sections 4.2.18 through 4.2.20 inclusive, with respect to interpretations and decisions of the Architect. However, neither the Architect's nor the Construction Manager's authority to act under this Section 4.2.8 nor a decision made by either of them in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect or the Construction Manager to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons performing any of the Work.

§ 4.2.9 Utilizing the submittal schedule provided by the Contractor, the Construction Manager shall prepare, and revise as necessary, a Project submittal schedule incorporating information from other Contractors, the Owner, Owner's consultants, Owner's Separate Contractors and vendors, governmental agencies, and participants in the Project under the management of the Construction Manager. The Project submittal schedule and any revisions shall be submitted to the Architect for approval.

§ 4.2.10 The Construction Manager will receive and promptly review for conformance with the submittal requirements of the Contract Documents, all submittals from the Contractor such as Shop Drawings, Product Data, and Samples. Where there are other Contractors, the Construction Manager will also check and coordinate the information contained within each submittal received from the Contractor and other Contractors, and transmit to the Architect those recommended for approval. By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Construction Manager represents to the Owner and Architect that the Construction Manager has reviewed and recommended them for approval. The Construction Manager's actions will be taken in accordance with the Project submittal schedule approved by the Architect or, in the absence of an approved Project submittal schedule, with reasonable promptness while allowing sufficient time to permit adequate review by the Architect.

§ 4.2.11 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Upon the Architect's completed review, the Architect shall transmit its submittal review to the Construction Manager.

§ 4.2.12 Review of the Contractor's submittals by the Construction Manager and Architect is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Construction Manager and Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Construction Manager and Architect's review shall not constitute approval of safety precautions or of any

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construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.13 The Construction Manager will prepare Change Orders and Construction Change Directives.

§ 4.2.14 The Construction Manager and the Architect will take appropriate action on Change Orders or Construction Change Directives in accordance with Article 7, and the Architect will have authority to order minor changes in the Work as provided in Section 7.4. The Architect, in consultation with the Construction Manager, will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.15 Utilizing the documents provided by the Contractor, the Construction Manager will maintain at the site for the Owner one copy of all Contract Documents, approved Shop Drawings, Product Data, Samples, and similar required submittals, in good order and marked currently to record all changes and selections made during construction. These will be available to the Architect and the Contractor, and will be delivered to the Owner upon completion of the Project.

§ 4.2.16 The Construction Manager will assist the Architect in conducting inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion in conjunction with the Architect pursuant to Section 9.8; and receive and forward to the Owner written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10. The Construction Manager will forward to the Architect a final Application and Certificate for Payment or final Project Application and Project Certificate for Payment upon the Contractor's compliance with the requirements of the Contract Documents.

§ 4.2.17 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Construction Manager of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.18 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of the Construction Manager, Owner, or Contractor through the Construction Manager. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.19 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions so rendered in good faith.

§ 4.2.20 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.21 The Construction Manager will receive and review requests for information from the Contractor, and forward each request for information to the Architect, with the Construction Manager's recommendation. The Architect will review and respond in writing, through the Construction Manager, to requests for information about the Contract Documents. The Construction Manager's recommendation and the Architect's response to each request will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include other Contractors or Separate Contractors or the subcontractors of other Contractors or Separate Contractors.

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§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Construction Manager, for review by the Owner, Construction Manager and Architect, of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Construction Manager may notify the Contractor whether the Owner, the Construction Manager or the Architect (1) has reasonable objection to any such proposed person or entity or, (2) requires additional time for review. Failure of the Construction Manager to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner, Construction Manager or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner, Construction Manager or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner, Construction Manager or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner, Construction Manager or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, that the Contractor, by these Contract Documents, assumes toward the Owner, Construction Manager and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner, Construction Manager and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

.1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and

.2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

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When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor Contractor or other entity. If the Owner assigns the subcontract to a successor Contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor Contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction with Own Forces and to Award Other Contracts

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When the Owner performs construction or operations with the Owner's own forces or Separate Contractors, the Owner shall provide for coordination of such forces and Separate Contractors with the Work of the Contractor, who shall cooperate with them.

§ 6.1.3 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner's own forces, Separate Contractors, Construction Manager and other Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner's own forces, Separate Contractors or other Contractors, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Construction Manager and Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor or other Contractors that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Construction Manager and the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's or other Contractors' completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractors or other Contractors that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs, including costs that are payable to a Separate Contractors or to other Contractors, because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of delays, improperly timed activities, damage to the Work or defective construction by the Owner's own forces, Separate Contractors, or other Contractors.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction, or to property of the Owner, Separate Contractors, or other Contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner, Separate Contractors, and other Contractors shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

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§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, other Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Construction Manager, with notice to the Architect, will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Construction Manager, Architect and Contractor. A Construction Change Directive requires agreement by the Owner, Construction Manager and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

A Change Order is a written instrument prepared by the Construction Manager and signed by the Owner, Construction Manager, Architect, and Contractor, stating their agreement upon all of the following:

.1 The change in the Work;
.2 The amount of the adjustment, if any, in the Contract Sum; and
.3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Construction Manager and signed by the Owner, Construction Manager and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Construction Manager shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Construction Manager may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

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.1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Construction Manager and Architect;

.2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;

.3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

.4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and

.5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Construction Manager of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Construction Manager and Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Construction Manager and Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Construction Manager and Architect determine to be reasonably justified. The interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Construction Manager and Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Construction Manager shall prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

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§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Construction Manager and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Construction Manager that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

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§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner, Architect, Construction Manager, or an employee of any of them, or of the Owner's own forces, Separate Contractors, or other Contractors; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts and the Architect, based on the recommendation of the Construction Manager, determines justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Construction Manager, before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Construction Manager and the Architect. This schedule, unless objected to by the Construction Manager or Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. The Construction Manager shall forward to the Architect the Contractor's schedule of values. Any changes to the schedule of values shall be submitted to the Construction Manager and supported by such data to substantiate its accuracy as the Construction Manager and the Architect may require, and unless objected to by the Construction Manager or the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least fifteen days before the date established for each progress payment, the Contractor shall submit to the Construction Manager an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner, Construction Manager or

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Architect require, such as copies of requisitions, and releases of waivers of lien from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Construction Manager and Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 Where there is only one Contractor, the Construction Manager will, within seven days after the Construction Manager's receipt of the Contractor's Application for Payment, review the Application, certify the amount the Construction Manager determines is due the Contractor, and forward the Contractor's Application and Certificate for Payment to the Architect. Within seven days after the Architect receives the Contractor's Application for Payment from the Construction Manager, the Architect will either (1) issue to the Owner a Certificate for Payment, in the full amount of the Application for Payment, with a copy to the Construction Manager; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Construction Manager and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Construction Manager and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1. The Construction Manager will promptly forward to the Contractor the Architect's notice of withholding certification.

§ 9.4.2 Where there is more than one Contractor performing portions of the Project, the Construction Manager will, within seven days after the Construction Manager receives all of the Contractors' Applications for Payment: (1) review the Applications and certify the amount the Construction Manager determines is due each of the Contractors; (2) prepare a Summary of Contractors' Applications for Payment by combining information from each Contractor's application with information from similar applications for progress payments from the other Contractors; (3) prepare a Project Application and Certificate for Payment; (4) certify the amount the Construction Manager determines is due all Contractors; and (5) forward the Summary of Contractors' Applications for Payment and Project Application and Certificate for Payment to the Architect.

§ 9.4.2.1 Within seven days after the Architect receives the Project Application and Project Certificate for Payment and the Summary of Contractors' Applications for Payment from the Construction Manager, the Architect will either (1) issue to the Owner a Project Certificate for Payment, with a copy to the Construction Manager; or (2) issue to the Owner a Project Certificate for Payment for such amount as the Architect determines is properly due, and notify the Construction Manager and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Project Application for Payment, and notify the Construction Manager and Owner of the Architect's reason for withholding certification in whole as provided in

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Section 9.5.1. The Construction Manager will promptly forward the Architect's notice of withholding certification to the Contractors.

§ 9.4.3 The Construction Manager's certification of an Application for Payment or, in the case of more than one Contractor, a Project Application and Certificate for Payment, shall be based upon the Construction Manager's evaluation of the Work and the data in the Application or Applications for Payment. The Construction Manager's certification will constitute a representation that, to the best of the Construction Manager's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is, or Contractors are, entitled to payment in the amount certified.

§ 9.4.4 The Architect's issuance of a Certificate for Payment or, in the case of more than one Contractor, Project Application and Certificate for Payment, shall be based upon the Architect's evaluation of the Work, the recommendation of the Construction Manager, and data in the Application for Payment or Project Application for Payment. The Architect's certification will constitute a representation that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is, or Contractors are, entitled to payment in the amount certified.

§ 9.4.5 The representations made pursuant to Sections 9.4.3 and 9.4.4 are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Construction Manager or Architect.

§ 9.4.6 The issuance of a Certificate for Payment or a Project Certificate for Payment will not be a representation that the Construction Manager or Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Construction Manager or Architect may withhold a Certificate for Payment or Project Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Construction Manager's or Architect's opinion the representations to the Owner required by Section 9.4.3 and 9.4.4 cannot be made. If the Construction Manager or Architect is unable to certify payment in the amount of the Application, the Construction Manager will notify the Contractor and Owner as provided in Section 9.4.1 and 9.4.2. If the Contractor, Construction Manager and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment or a Project Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Construction Manager or Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment or Project Certificate for Payment previously issued, to such extent as may be necessary in the Construction Manager's or Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from the acts and omissions described in Section 3.3.2 because of

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a Separate Contractor or other Contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- **.7** repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

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§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect or Construction Manager withholds certification for payment under Section 9.5.1, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Construction Manager, and both will reflect such payment on the next Certificate for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment or Project Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Construction Manager and Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Construction Manager will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Owner, Construction Manager and Architect on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner, Construction Manager nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Construction Manager and Architect do not issue a Certificate for Payment or a Project Certificate for Payment, through no fault of the Contractor, within fourteen days after the Construction Manager's receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Construction Manager and Architect or awarded

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by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner, Construction Manager and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Construction Manager, and the Contractor and Construction Manager shall jointly prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the list, the Architect, assisted by the Construction Manager, will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect, assisted by the Construction Manager, to determine Substantial Completion.

§ 9.8.4 When the Architect, assisted by the Construction Manager, determines that the Work of all of the Contractors, or designated portion thereof, is substantially complete, the Construction Manager will prepare, and the Construction Manager and Architect shall execute, a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor and Construction Manager shall jointly prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect after consultation with the Construction Manager.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Construction Manager, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

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§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon completion of the Work, the Contractor shall forward to the Construction Manager a notice that the Work is ready for final inspection and acceptance, and shall also forward to the Construction Manager a final Contractor's Application for Payment. Upon receipt, the Construction Manager shall perform an inspection to confirm the completion of Work of the Contractor. The Construction Manager shall make recommendations to the Architect when the Work of all of the Contractors is ready for final inspection, and shall then forward the Contractors' notices and Application for Payment or Project Application for Payment, to the Architect, who will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Construction Manager and Architect will promptly issue a final Certificate for Payment or Project Certificate for Payment stating that to the best of their knowledge, information and belief, and on the basis of their on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Construction Manager's and Architect's final Certificate for Payment or Project Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect through the Construction Manager (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Construction Manager and Architect so confirm, the Owner shall, upon application by the Contractor and certification by the Construction Manager and Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect through the Construction Manager prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

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ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall submit the Contractor's safety program to the Construction Manager for review and coordination with the safety programs of other Contractors. The Construction Manager's responsibilities for review and coordination of safety programs shall not extend to direct control over or charge of the acts or omissions of the Contractors, Subcontractors, agents or employees of the Contractors or Subcontractors, or any other persons performing portions of the Work and not directly employed by the Construction Manager.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

.1 employees on the Work and other persons who may be affected thereby;

.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor;

.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction; and

.4 construction or operations by the Owner, Separate Contractors, or other Contractors.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2, 10.2.1.3 and 10.2.1.4. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner, Construction Manager or Architect or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner, Construction Manager and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

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§ 10.3 Hazardous Materials

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner, Construction Manager and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor, Construction Manager and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor, the Construction Manager and the Architect will promptly reply to the Owner in writing stating whether or not any of them has reasonable objection to the persons or entities proposed by the Owner. If the Contractor, Construction Manager or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor, the Construction Manager and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Construction Manager, Architect, their consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or

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insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Construction Manager and Construction Manager's consultants, and the Architect and Architect's consultants, shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice directly to the Owner, and separately to the Construction Manager, of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform both the Contractor and the Construction Manager, separately and in writing, prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice directly to the Contractor, and separately to the Construction Manager, of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

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§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Construction Manager and Construction Manager's consultants; (3) the Architect and Architect's consultants; (4) other Contractors and any of their subcontractors, sub-subcontractors, agents, and employees; and (5) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Construction Manager, Construction Manager's consultants, Architect, Architect's consultants, other Contractors, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this Section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor, Architect, and Construction Manager for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Construction Manager, Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Construction Manager, Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Construction Manager's or Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by either, be uncovered for their examination and be replaced at the Contractor's expense without change in the Contract Time.

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§ 12.1.2 If a portion of the Work has been covered that the Construction Manager or Architect has not specifically requested to examine prior to its being covered, the Construction Manager or Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Construction Manager or Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion, and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Construction Manager's and Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner, Construction Manager or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner, Separate Contractors, or other Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

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ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Construction Manager, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Construction Manager and Architect timely notice of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Construction Manager, Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Construction Manager and Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Construction Manager and Architect of when and where tests and inspections are to be made so that the Construction Manager and Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Construction Manager's and Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Construction Manager for transmittal to the Architect.

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§ 13.4.5 If the Construction Manager or Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Construction Manager or Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

.1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;

.2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;

.3 Because the Construction Manager has not certified or the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or

.4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner, Construction Manager and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees, or any other persons performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner, Construction Manager and Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

.1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;

.2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;

.3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or

.4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, after consultation with the Construction Manager, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without

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prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

.1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 Accept assignment of subcontracts pursuant to Section 5.4; and

.3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Construction Manager's and Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall, upon application, be certified by the Initial Decision Maker after consultation with the Construction Manager, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and the Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent:

.1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or

.2 that an equitable adjustment is made or denied under another provision of this Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

.1 cease operations as directed by the Owner in the notice;

.2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition. A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

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§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Construction Manager and Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost. If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages. The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

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§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties, the Construction Manager, and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days of receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

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§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

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§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

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(Title)

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SECTION 007300 - SUPPLEMENTARY GENERAL CONDITIONS A232-2019

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A232-2019. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

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

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ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

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

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

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Paragraphs:

1.2.2 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.

1.2.3 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.

1.2.4 The word "PRODUCT" as used in the Contract Documents means all materials, systems and equipment.

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

Add the following paragraphs:

"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

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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 one (1) set 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.

3.2.5 The Contractor shall own all entities (products, materials, equipment and systems) identified in the Project Manual (Specifications) and drawings, regardless of whether said entities are only referenced in either the Project Manual or the drawings. Failure of the successful low bidder to identify all required quantities and locations of all project entities in the bidding period will not exempt the low bidder from the contractual responsibility for these items. In the event of a conflict between the Project Manual and the drawings, the Contractor shall own the more costly of the conflicting scenarios. The conflict, once identified and reported by the Contractor, will be resolved by the Architect."

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 Construction Manager 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 Construction Manager 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.

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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 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 two (2) years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of guarantee.

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

3.5.3 In addition to the General Guarantee there are other guarantees required for certain items for different periods of time than the two (2) years as above, and are particularly so stated in that part of the specifications referring to same. The said guarantees will commence at the same time as the General Guarantee.

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

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Paragraphs:

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

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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

Add the following Paragraph:

4.2.16.1 There will be no full-time project representative provided by the Owner or Architect on this project. The construction manager will be the owner's representative.

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 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:

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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.

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ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Paragraphs:

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

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

9.3 APPLICATIONS FOR PAYMENT

Add the following Paragraph:

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

Add the following Paragraphs:

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

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

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following to 9.5.1:

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

9.6 PROGRESS PAYMENTS

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

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

NOT FOR BIDDING

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, Construction Manager 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.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

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

11.2 OWNER'S LIABILITY INSURANCE

Delete Paragraph 11.2 in its entirety.

11.3 PROPERTY INSURANCE

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

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

11.4 PERFORMANCE BOND AND PAYMENT BOND

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

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Paragraph:

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

12.2.2.1 Strike "one" and insert "two".

12.2.2.2 Strike "one" and insert "two".

12.2.2.3 Strike "one" and insert "two".

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

ARTICLE 13: MISCELLANEOUS PROVISIONS

Add the following Paragraph:

NOT FOR BIDDING

13.1 GOVERNING LAW

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

13.6 INTEREST

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

13.8 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

NOT FOR BIDDING

SECTION 007300 - ATTACHMENT A - CONSTRUCTION MANAGER GENERAL CONDITIONS

COORDINATION OF THE CONTRACT

1. The Construction Manager will provide general coordination of all contracts between the Owner and Contractors, including the functions hereinafter described.

2. Coordinator, and in addition, home office executive, technical and clerical support for management, communications, documentation, inspection, planning, scheduling, estimating and accounting. He will furnish, maintain and operate a temporary field office and telephone.

3. The Construction Manager will provide support for the Contractors by providing the following General Condition Construction Items: ceremonies construction work; temporary toilets; first aid stations; bulletin board; job signs; temporary fire extinguishers.

   Temporary heat provided by Mechanical Contractor is space heat for certain finish trades unless otherwise specifically required by the trade specification. In no way should the contractor misconstrue this item to include weather protection for concrete or masonry.

4. The Construction Manager will establish a reference point and benchmark for layout and engineering. Further actual layout and engineering required on the site to accomplish this Bid Pac work shall be the responsibility of the Contractor.

5. The Construction Manager will:

   (a) Review all changes proposed by the Contractor, Architect or Owner and make recommendations to the Architect and Owner on the schedule and cost implications and may initiate requests for changes in its opinion required by field conditions or progress of the work.

   (b) Review the adequacy of each Contractor's personnel and equipment and the availability of necessary materials and supplies. If, in the opinion of the Construction Manager, a Contractor's personnel or equipment or the availability of necessary materials and supplies is inadequate, the Construction Manager shall give written notice to the Contractor specifying such inadequacy. If such inadequacy is not cured within five (5) working days after receipt of such notice, the Construction Manager shall have the right to order the Contractor and all of his subcontractors to stop work until the inadequacy is cured. Such a work stoppage shall not entitle the Contractor or any subcontractors to any extension of the schedule, and the Contractor shall remain responsible for completing its work on time.

   (c) Establish and maintain a complete onsite library of all Contract Documents, approved shop drawings and approved material samples. Maintain an onsite directory which includes contracts for all sources of materials, labor and services relating to the project, and maintain at the job site a current marked record set of the contract drawings and specifications.

NOT FOR BIDDING

(d) Conduct pre-construction conferences with successful bidders. Schedule and conduct job meetings to be attended by the Contractors and representatives of the Owner to discuss such matters as procedures, progress, problems and scheduling. Distribute minutes of such meetings to all parties.

6. Construction Manager's Daily Inspection Review:

(a) The Construction Manager will make daily review of work. In the event the interpretation of the meaning and intent of the plans and specifications becomes necessary during construction, he will consult with the Architect, request the Architect's interpretation in writing and transmit same to the appropriate Contractor. Pending receipt of such interpretation from the Architect, the Construction Manager shall have the right to stop the work of the Contractor. These reviews are intended to supplement but not replace those inspections that are the responsibility of the Architects and their consultants. These reviews do not relieve the Contractor from his responsibility to the Owner.

7. Construction Manager's Review of Safety Program:

(a) The Construction Manager will review the safety program as developed by each Contractor. (The Performance of such services by the Construction Manager shall not relieve the Contractor of his responsibilities for the safety of persons or property, and compliance with statutes, rules regulations and orders applicable to the conduct of the work.)

8. Construction Manager – Submittals Expediting Schedule:

(a) The Construction Manager will prepare and maintain a separate Submittals Expediting Schedule which schedules construction items requiring submission to Architect or Owner for review and approval prior to ordering, fabrication or delivery, such as: shop drawings preparation, submission of shop drawings samples – color schedules, templates, coordination drawings, equipment and fixture schedules, manufacturer literature, review and approval of submittal items, fabrication of equipment and products, shipping and delivery.

9. Construction Manager – Contractor's Progress Payments:

(a) The Construction Manager will review application for each Contractor's Progress Payments for compliance with the value of work accomplished and submit recommendations to the Architect.

10. Construction Manager – Change Orders:

(a) The Construction Manager will review all change order requests and submit recommendations to the Architect.

11. Construction Manager – Expansion of the Construction Schedule:

NOT FOR BIDDING

(a) The Construction Manager will meet with each Contractor who receives an award to expand the construction schedule to include: shop drawings preparation, samples, review and approvals, fabrication, equipment and product delivery and testing activities. He will monitor schedule periodically to identify slippage. He will recommend to each Contractor corrective action as required to maintain schedule compliance.

12. Construction Manager – Master Schedule Bar Chart:

(a) The Construction Manager will display a Master Schedule Bar Chart in the job office showing the duration and location of each activity and a summary bar chart depicting each major construction activity time scaled to a calendar. He will also furnish identical information to the Architect and Owner.

RECORD DRAWINGS

13. All Contractors shall report to the Construction Manager all changes, deviations, additions or deletions related to the contract documents along with dimensional locations of underground utilities and other items which will be hidden from view in the completed construction. The Construction Manager will maintain a complete set of sepia reproducible of the contract documents upon which these items shall be recorded. At the completion of the project their record drawings will be turned over to the Owner for his use in building maintenance.

COOPERATION OF PRIME CONTRACTORS

14. In as much as the completion of the building within the prescribed time is dependent very largely upon the close and active cooperation of all those engaged therein, it is, therefore, expressly understood and agreed that each Contractor will layout and install his work as such time or times and in such manner as consistent with the Master Schedule Bar Chart to permit the carrying forward of the work of other Contractors.

JOB MEETINGS

15. A meeting shall be conducted bi-weekly by the Construction Manager for the purpose of coordinating and expediting the work. It shall be mandatory that each Contractor and/or his Superintendent be in attendance. Also, from time to time, the Construction Manager will designate certain subcontractors to attend. Additional mandatory meetings may be called by the Construction Manager. Such as weekly progress meetings on Mondays with the onsite Superintendent or others needed to attend for all trades working on the site to discuss job problems.

CONTRACTOR'S PLANT AND PERSONNEL

16. Each Contractor shall provide for his own forces the following as necessary:

(a) Job Site Office with telephone.

(b) Personnel/Tool Locker.

(c) Equipment and Material Storage Facilities.

NOT FOR BIDDING

(d) Onsite supervision of personnel and plant acceptable to the Construction Manager. Supervisions shall not be changed during the project duration without approval of the Construction Manager. If required by the Construction Manager, the Contractor shall immediately remove any personnel from the project and replace same with approved personnel.

(e) The Contractor shall provide drinking water in accordance with Public Health requirements.

(f) Provide any additional temporary lighting as required and protection for new or existing finishes.

(g) Extension cords and light bulbs.

(h) The Contractor shall at the completion of his work remove all such temporary utilities.

(i) Pay for all power consumed.

SAFETY

17. The Construction Manager will have the right to correct any unsafe project conditions that exist due to the negligence of any Contractor and may reduce the Contractor's payments in the amount required to make necessary safe project conditions. In no way does this mean that the Construction Manager has the responsibility for any safety requirements that are specifically that of the Contractor.

17.1 Prime Contractor acknowledges that it is solely responsible for the health and safety of its employees, agents, subcontractors, and other persons on the adjacent to the Work Site. Prime contractor agrees that it shall be liable for any violation of any law, regulation, statue or ordinance applicable to Prime Contractor's work. The Prime Contractor shall be liable to the Owner and Construction Manager for all loss, cost and expense attributable to any act or omission by the Prime Contractor, or anyone acting on its behalf, including but not limited to any fines, penalties or assessments levied against the Owner and/or Construction Manager, and agrees that any such amounts may be deducted from any payment due to the Prime Contractor.

18. The Carpentry and General Work Contract will provide and install temporary safety rails for guarding any floor and wall openings during construction.

SCHEDULE

19. If the project progresses well and the project is ahead of schedule, the Contractor must take this point into consideration. At no time shall a Contractor use the Schedule Advancement as a reason for not completing work.

CONSTRUCTION MANAGER'S AUTHORITY REGARDING CLEANUP

20. The site and all portions of the work in progress shall be cleaned up daily.

NOT FOR BIDDING

21. In the event that any contractor fails to properly do his cleanup work during the construction period (as noted in subparagraph 4.15.1), the Construction Manager shall, after giving the contractor a 48 hour written notice, hire a clean up crew to do the necessary cleanup and then back-charge the contractor for doing this cleanup work. Note that when performing his required cleanup, the contractor shall deposit all debris at a place designated by the Construction Manager, or remove debris from the site. No burning will be permitted on this site.

22. The contractor shall furnish, at the construction manager's discretion, one (1) man for two (2) hours per week to police the construction site clean up of miscellaneous debris.

END CM GENERAL CONDITIONS

NOT FOR BIDDING

SECTION 007346 – WAGE DETERMINATION REQUIREMENTS (DELAWARE PREVAILING WAGE RATES)

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 318-2769

Mailing Address:
252 Chapman Road
Suite 210
Newark, DE 19702

Located at:
252 Chapman Road
Suite 210
Newark, DE 19702

PREVAILING WAGES FOR **BUILDING CONSTRUCTION** EFFECTIVE MARCH 13, 2026

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	30.70	37.76	55.01
BOILERMAKERS	91.87	46.51	68.52
BRICKLAYERS	68.29	68.29	68.29
CARPENTERS	64.06	64.06	52.30
CEMENT FINISHERS	96.91	68.92	53.44
ELECTRICAL LINE WORKERS	61.02	52.34	39.90
ELECTRICIANS	86.87	86.87	86.87
ELEVATOR CONSTRUCTORS	121.63	86.57	109.37
GLAZIERS	88.42	88.42	76.04
INSULATORS	71.54	71.54	71.54
IRON WORKERS	79.33	79.33	79.33
LABORERS	59.65	59.65	59.65
MILLWRIGHTS	91.00	91.00	73.10
PAINTERS	61.53	61.53	61.53
PILEDRIVERS	93.37	52.83	42.72
PLASTERERS	40.06	40.06	29.69
PLUMBERS/PIPEFITTERS/STEAMFITTERS	82.05	85.29	78.26
POWER EQUIPMENT OPERATORS	85.29	85.29	85.29
ROOFERS-COMPOSITION	36.41	31.28	33.64
ROOFERS-SHINGLE/SLATE/TILE	24.68	29.36	23.08
SHEET METAL WORKERS	87.84	87.84	87.84
SOFT FLOOR LAYERS	63.69	63.69	50.43
SPRINKLER FITTERS	77.63	77.63	77.63
TERRAZZO/MARBLE/TILE FNRS	73.75	73.75	84.10
TERRAZZO/MARBLE/TILE STRS	81.93	81.93	93.27
TRUCK DRIVERS	58.41	36.83	28.66

NOT FOR BIDDING

CERTIFIED: 3-24-2026 BY: Sabina Chowdhury for Francis Chudoba
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) 318-2769.

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

PROJECT: CN2340D STHS West Pavilion and Greenhouse, Sussex County

ACORD. CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

PRODUCER

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

INSURED

INSURERS AFFORDING COVERAGE	NAIC #
INSURER A:	
INSURER B:	
INSURER C:	
INSURER D:	
INSURER E:	

COVERAGES

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. AGGREGATE LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	ADD'L INSRD	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
		GENERAL LIABILITY				EACH OCCURRENCE	$
		COMMERCIAL GENERAL LIABILITY				DAMAGE TO RENTED PREMISES (Ea occurrence)	$
		CLAIMS MADE ☐ OCCUR				MED EXP (Any one person)	$
						PERSONAL & ADV INJURY	$
		GEN'L AGGREGATE LIMIT APPLIES PER:				GENERAL AGGREGATE	$
		POLICY ☐ PRO-JECT ☐ LOC				PRODUCTS - COMP/OP AGG	$
		AUTOMOBILE LIABILITY					
		ANY AUTO				COMBINED SINGLE LIMIT (Ea accident)	$
		ALL OWNED AUTOS				BODILY INJURY (Per person)	$
		SCHEDULED AUTOS				BODILY INJURY (Per accident)	$
		HIRED AUTOS				PROPERTY DAMAGE (Per accident)	$
		NON-OWNED AUTOS					
		GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
		ANY AUTO				OTHER THAN AUTO ONLY: EA ACC	$
						AGG	$
		EXCESS/UMBRELLA LIABILITY				EACH OCCURRENCE	$
		OCCUR ☐ CLAIMS MADE				AGGREGATE	$
		DEDUCTIBLE					$
		RETENTION $					$
		WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				WC STATU-TORY LIMITS ☐ OTH-ER	
		ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED?				E.L. EACH ACCIDENT	$
		If yes, describe under SPECIAL PROVISIONS below				E.L. DISEASE - EA EMPLOYEE	$
		OTHER				E.L. DISEASE - POLICY LIMIT	$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES / EXCLUSIONS ADDED BY ENDORSEMENT / SPECIAL PROVISIONS

SAMPLE
NOT FOR BIDDING
SAMPLE

CERTIFICATE HOLDER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL _____ DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER, ITS AGENTS OR REPRESENTATIVES.

AUTHORIZED REPRESENTATIVE

© ACORD CORPORATION 1988

SECTION 008000 - GENERAL REQUIREMENTS

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
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4. ADMINISTRATION OF THE CONTRACT
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7. CHANGES IN THE WORK
8. TIME
9. PAYMENTS AND COMPLETION
10. PROTECTION OF PERSONS AND PROPERTY
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12. UNCOVERING AND CORRECTION OF WORK
13. MISCELLANEOUS PROVISIONS
14. TERMINATION OR SUSPENSION OF THE CONTRACT

NOT FOR BIDDING

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. In the case of conflict, the most expensive combination of quality and quantity shall govern.

1.1.2 Work shall not begin until the Contractor is in receipt of a bonafide Contract.

1.2 EQUALITY OF EMPLOYMENT

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 Trade Contractor is to consult with the Construction Manager as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.

NOT FOR BIDDING

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 Construction Manager 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.

3.13 During the contract Work, the Contractor and each listed Subcontractor, shall implement an Employee Drug Testing Program in accordance with OMB Regulation 4104 ‘Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on “Large Public Works Projects”. “Large Public Works” is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

NOT FOR BIDDING

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 materiel or performing labor in the performance of the Contract, of all sums of money due the person for such labor and materiel. (The bond shall also contain the successful bidder's guarantee to indemnify and save harmless the Owner 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 owner may, when it considers that the interest of the Owner so require, cause judgement to be confessed upon the bond.

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

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

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the Owner that neglects or refuses to perform or fails to comply with the terms thereof, the Owner 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 pursing additional remedies as otherwise provided by law.

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

NOT FOR BIDDING

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 Owner, officer and/or employee of the Owner, 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 Owner, 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 Owner and all agencies, officers and employees thereof shall not be financially responsible for the consequences of work performed, pursuant to said contract.

4.4 RIGHT TO AUDIT RECORDS

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

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

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

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

1. A contract shall be awarded only to a Bidder whose Bid is accompanied by a statement containing, for each Subcontractor category, the name and address (city or town and State only – street number and P.O. Box addresses not required) of the subcontractor whose services the Bidder intends to use in performing the Work and providing the material for such Subcontractor category.

2. A Bid will not be accepted nor will an award of any Contract be made to any Bidder which, as the Prime Contractor, has listed itself as the Subcontractor for any Subcontractor unless:

   A. It has been established to the satisfaction of the awarding Agency that the Bidder has customarily performed the specialty work of such Subcontractor category by artisans regularly employed by the Bidder's firm;

   B. That the Bidder is duly licensed by the State to engage in such specialty work, if the State requires licenses; and

   C. That the Bidder is recognized in the industry as a bona fide Subcontractor or Contractor in such specialty work and Subcontractor category.

NOT FOR BIDDING

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.

5.1.5 Should a Bidder be awarded a contract, such successful Bidder shall provide to the agency the taxpayer identification license numbers of such subcontractors. Such numbers shall be provided on the later of the date on which such subcontractor is required to be identified or the time the contract is executed. The successful Bidder shall provide to the agency to which it is contracting, within 30 days of entering into such public works contract, copies of all Delaware Business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the Bidder entered the public works contract the Delaware Business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

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 Owner may determine to deduct payments of the penalty from the Contractor or have the amount paid directly to the Owner. 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 the State-funded projects shall be approved by the Office of Management and Budget, Division of Facilities Management pursuant to Chapter 78 of Title 16.

NOT FOR BIDDING

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 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.

NOT FOR BIDDING

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 Prime Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the Prime 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 Prime 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: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project."

8.4.2 "Upon such failure for any of the above stated reasons, the Agency that contracted for the public works project may petition the Director of the Office of Management and Budget for Suspension or Debarment of the Contractor. The Agency shall send a copy of the petition to the Contractor within three (3) working days of filing with the Director. If the Director concludes that the petition has merit, the Director shall schedule and hold a hearing to determine whether to suspend the Contractor, debar the Contractor or deny the petition. The Agency shall have the burden of proving, by a preponderance of the evidence, that the Contractor failed to perform or complete the public works project within the time schedule established by the Agency and failed to do so for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the project. Upon a finding in favor of the Agency, the Director may suspend a Contractor from Bidding on any project funded, in whole or in part, with public funds for up to 1 year for a first offense, up to 3 years for a second offense and permanently debar the Contractor for a third offense. The Director shall issue a written decision and shall send a copy to the Contractor and the Agency.

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Such decision may be appealed to the Superior Court within thirty (30) days for a review on the record."

8.5 RETAINAGE

8.5.1 Per Section 6962(d)(5) a.3, Title 29, Delaware Code: The Agency may at the beginning of each public works project establish a time schedule for the completion of the project. If the project is delayed beyond the completion date due to the Contractor's failure to meet their responsibilities, the Agency may forfeit, at its discretion, all or part of the Contractor's retainage.

8.5.2 This forfeiture of retainage also applies to the timely completion of the punchlist. A punchlist will only be prepared upon the mutual agreement of the Owner, Architect and Contractor. Once the punchlist is prepared, all three parties will by mutual agreement, establish a schedule for its completion. Should completion of the punchlist be delayed beyond the established date due to the Contractor's failure to meet their responsibilities, the Agency may hold permanently, at its discretion, all or part of the Contractor's retainage.

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

9.1.1 Applications for payment shall be made upon AIA Document G702. There will be a five percent (5%) retainage on all Contractor's monthly invoices until completion of the project. This retainage 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 Contract executed by the Owner 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 owner, 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 Owner, receipted bills from all Contractors, Subcontractors, and material, men, etc., for the previous payment must accompany each application for payment.

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Following such a request, no payment will be made until these receipted bills have been received by the Owner.

9.3 SUBSTANTIAL COMPLETION

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

9.3.2 If, after the Work has been substantially completed, full completion thereof is materially delayed through no fault of the Contractor, and without terminating the Contract, the Owner may make payment of the balance due for the portion of the Work fully completed and accepted. Such payment shall be made under the terms and conditions governing final payment that it shall not constitute a waiver of claims.

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

9.4 FINAL PAYMENT

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

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

9.4.1.2 An acceptable RELEASE OF LIENS;

9.4.1.3 Copies of all applicable warranties,

9.4.1.4 As-built drawings,

9.4.1.5 Operations and Maintenance Manuals,

9.4.1.6 Instruction Manuals,

9.4.1.7 Consent of Surety to final payment.

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

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

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

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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 (not yet installed and stored) and their

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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. A certificate of insurance with the job name specified in the description, Cape Henlopen School District is the certificate holder. Also state that Cape Henlopen School District and Richard Y. Johnson & Son, Inc. are additional insured.

NOT FOR BIDDING

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

NOT FOR BIDDING

such tests shall be submitted to the Owner. The cost of the testing shall be paid for by the Contractor.

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

13.4 ARCHAEOLOGICAL EVIDENCE

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

13.5 GLASS REPLACEMENT AND CLEANING

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

13.6 WARRANTY

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

ARTICLE 14: TERMINATION OF CONTRACT

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

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

NOT FOR BIDDING

ARTICLE 15: PERFERENCE FOR DELAWARE LABOR

15.1 In the construction of all public works for the State or any political subdivision thereof or by firms contracting with the State or any political subdivision thereof, preference in employment of laborers, workers or mechanics shall be given to bono fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State. Each public works contract for the construction of public works for the State or any political subdivision thereof shall contain a stipulation that any person, company or corporation who violates this section shall pay a penalty to the Secretary of Finance equal to the amount of compensation paid to any person in violation of this section.

END SECTION 008000 - GENERAL REQUIREMENTS

NOT FOR BIDDING

EMPLOYEE DRUG TESTING REPORT FORM
Period Ending:_____

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds submit Testing Report Forms to the Owner no less than quarterly.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____
_____
_____

Number of employees who worked on the jobsite during the report period:_____

Number of employees subject to random testing during the report period:_____

Number of Negative Results _____ Number of Positive Results _____

Action taken on employee(s) in response to a failed or positive random test:
_____
_____
_____

NOT FOR BIDDING

Authorized Representative of Contractor/Subcontractor: _____
(typed or printed)

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date: _____

EMPLOYEE DRUG TESTING
REPORT OF POSITIVE RESULTS

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors who work on Large Public Works Contracts funded all or in part with public funds to notify the Owner in writing of a positive random drug test.

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____
_____
_____

Name of employee with positive test result: _____

Last 4 digits of employee SSN: _____

Date test results received: _____

Action taken on employee in response to a positive test result:
_____
_____
_____

NOT FOR BIDDING

Authorized Representative of Contractor/Subcontractor: _____
(typed or printed)

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date: _____

This form shall be sent by mail to the Owner within 24 hours of receipt of test results.

Enclose this test results form in a sealed envelope with the notation "Drug Testing Form – DO NOT OPEN" on the face thereof and place in a separate mailing envelope.

SECTION 009300 - REFERENCE MATERIAL

The information described herein is believed to be accurate and representative, but no guarantee can be made that actual conditions encountered during construction will not vary or be changed.

1. GEOTECHNICAL REPORT (Boring Logs):

2. SURVEY:

These property surveys are included in the drawings as reference information.

Survey and their interpretation are to serve as the Contractor's basis in bidding excavation, grading requirements and other site related work. Contractors shall field verify all existing conditions and immediately report any discrepancies to the Owner's representative. Removal of unsuitable soils, if any, will be done under the direction of the Owner's Soils Engineer Consultant.

NOT FOR BIDDING

3. CADD FILES

Electronic Media (CADD files) drawings will be provided for contractors' reference subject to the terms and conditions outlined in Tetra Tech's " Release Form for Electronic Files" in Section 013301.

Upon request contractor shall sign a release form provided by the Architect and payment of $200 processing fee for each consultant drawings requested.

CADD files shall be provided for use as background plans only. Contractors shall be responsible verifications of all dimensions and revisions. Contractor shall not copy or reproduce details, elevations, sections, schedules or other similar data.

Electronic Media (CADD files) drawings will be provided for contractors' reference subject to the terms and conditions outlined in Tetra Tech's "Release Form for Electronic Files".

4. WAGE DETERMINATION

Wage Rates and Payroll Reporting: Contractors shall comply with all requirements of the State of Delaware regarding wage rates and payroll reporting. These requirements include, but are not limited to, the following:

a. **Wage Rates**: The wage rates that shall be used for this project are attached to this Section. This scale of wages shall be posted in a prominent and easily accessible location on the job site. All employees shall be paid directly upon the site of the work, not less often than once a week.

b. **Payroll Reporting**: Per Section 6912 of Title 29, payroll information shall be reported weekly to the Owner (refer to Section 01311 "Schedules and Reports"). Contractors shall retain copies Payroll Reports for inspection upon request by Delaware Department of Labor.

END OF SECTION

HYNES

SUPPLEMENT TO REPORT
OF
SUBSURFACE EXPLORATION
AND
GEOTECHNICAL CONSULTING SERVICES

SUSSEX TECH HIGH SCHOOL REPLACEMENT
GEORGETOWN, DELAWARE

NOT FOR BIDDING

PREPARED FOR
SUSSEX COUNTY VOCATIONAL TECHNICAL SCHOOL DISTRICT

DECEMBER 20, 2023
PROJECT NO.: JDH-10/22/148

32185 Beaver Run Drive • Salisbury, Maryland 21804 • 410-546-6462 • Fax 410-548-5346
Email: jdh@jdhynesinc.com

HYNES

JOHN D. HYNES & ASSOCIATES, INC.

Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

December 20, 2023

Hud Athey
Sussex County Vocational Technical School District
P.O. Box 351
Georgetown, Delaware 19947

Re: Supplement to Report of Subsurface Exploration
and Geotechnical Consulting Services
Sussex Tech High School Replacement
Georgetown, Delaware
Project No.: JDH-10/22/148

Dear Mr. Athey:

In accordance with a request from Davis, Bowen & Friedel, Inc. (DBF), John D. Hynes & Associates, Inc. provided supplemental subsurface soils data and consulting services for the project. We recommend appending this supplement to our original *Report of Subsurface Exploration and Geotechnical Consulting Services* dated June 12, 2023. Refer to the Geotechnical Report for our recommendations for the project, and for the original test boring and laboratory data.

NOT FOR BIDDING

As requested by Davis, Bowen & Friedel, Inc. 3 test borings designated as C-1, C-2, and C-3 were drilled at the site on December 12, 2023 to explore the subsurface conditions at a proposed stormwater management facility, designated as Pond "C", on the south side of U.S. Route 9. The approximate locations of the borings are shown on the Boring Location Plan that is included as an Attachment. The coordinates and existing surface elevations for the borings are noted on the boring location plan and on the boring logs. The borings were drilled to depths of 12 to 14 feet below existing grade using a track mounted 3230 Geoprobe DT drill rig.

Below the organic bearing soil horizon, the subsurface soils were visually classified in accordance with the USCS and USDA as interbedded layers of low Silt SAND (SP-SM, Sand), Silty SAND (SM, Loamy sand, Sandy loam), SAND and SILT (SM-ML, Loam), and Silty CLAY (CL, Silty clay loam). The granular soil layers were characterized by Standard Penetration Test (SPT) values (N-values) ranging from 4 to 18 blows per foot indicating in-place relative densities of very loose to medium dense. N-values in the cohesive soil layers ranged from 8 to 18 blows per foot, indicating in-place consistencies of medium stiff to very stiff. Refer to the attached test boring logs for the soil profiles at each boring location.

Groundwater was encountered at depths of 7 feet below existing grade at all 3 boring locations. We estimate that the seasonal high water table (SHWT) in the area of the 3 soil borings is 2 to 3 feet higher than conditions at the time the soil borings were drilled (approximately Elevation 42.1 to 44.0). We understand that the proposed basin bottom Elevation at SWM Pond "C" is El. 38.75. We note that this is well below the estimated SHWT.

This report has been prepared solely and exclusively for Sussex County Vocational Technical School District to provide guidance to design professionals in developing facilities plans for the proposed Sussex Tech High School Replacement project located in Georgetown, Delaware. It has not been developed to meet the needs of others, and application of this report for other than its intended purpose could result in substantial difficulties. The Consulting Engineer cannot be held accountable for any problems, which occur due to the application of this report to other than its intended purpose.

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

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted engineering principles and practices.

We appreciate the opportunity to be of service to you. If you have any questions regarding the contents of this report or if we may be of further assistance, please contact our office.

Respectfully,
JOHN D. HYNES & ASSOCIATES, INC.

Evan H. Cross
Geologist

Richard D. Rhoads, P.G.
Project Geologist

STATE OF DELAWARE
RICHARD D. RHOADS
No. S4-0001046
LICENSED PROFESSIONAL GEOLOGIST

JOHN D. HYNES
REGISTERED
No. 7591
DELAWARE
PROFESSIONAL ENGINEER

John D. Hynes, P.E.
President

EHC: RDR: JDH/kc

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APPENDIX

1. Investigative Procedures
2. Project Location Map
3. Boring Location Plan
4. Boring Logs
5. Unified Soil Classification Sheet
6. USDA Classification Sheet
7. Field Classification Sheet
8. Important Information Sheet

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INVESTIGATIVE PROCEDURES

SOIL TEST BORINGS

Soil drilling and sampling operations were conducted in accordance with ASTM Specification D-1586. The borings were advanced by mechanically turning continuous hollow stem auger flights into the ground. At regular intervals, samples were obtained with a standard 1.4 inch I.D., 2.0 inch O.D. split-spoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is the "Standard Penetration Resistance". The penetration resistance, when properly evaluated, is an index to the soil's strength, density and behavior under applied loads. The soil descriptions and penetration resistances for each boring are presented on the Test Boring Records in the Appendix.

SOIL CLASSIFICATION

Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigation, jar samples obtained during drilling operations are examined in our laboratory and visually classified by the geotechnical engineer in accordance with ASTM Specification D-2488. The soils are classified according to the AASHTO or Unified Classification System (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior.

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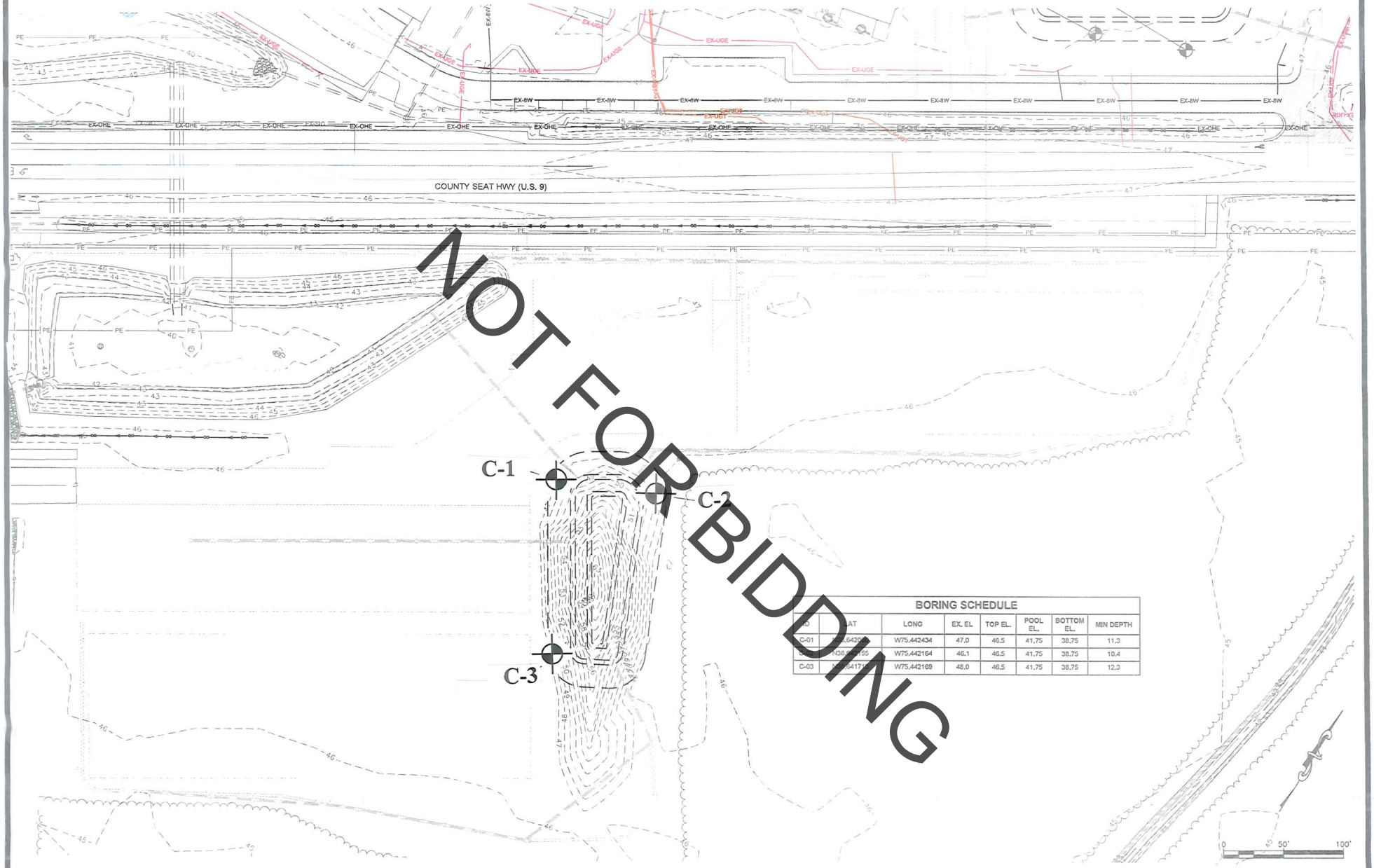
410-546-6462 / Fax: 410-548-5346

Date: December 18, 2023	
Scale = 1" = 2000 feet	
Drawn: ADC Maps	
Project Location Map Sussex Tech High School Replacement Georgetown, Delaware	DWG. No. JDH-10-22-148-A



BORING SCHEDULE							
ID	LAT	LONG	EX. EL	TOP EL.	POOL EL.	BOTTOM EL.	MIN DEPTH
C-01	N38.[illegible]5429	W75.442434	47.0	46.5	41.75	38.75	11.3
C-02	N38.[illegible]555	W75.442164	46.1	46.5	41.75	38.75	10.4
C-03	N38.[illegible]4171	W75.442169	48.0	46.5	41.75	38.75	12.3

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Boring Location Plan
Sussex Tech High School Replacement
Georgetown, Delaware

Date: December 18, 2023
Scale: As Shown
Drawn: DBF
DWG. No. JDH-10/22/148-B

HYNES & ASSOCIATES

LOG OF BORING C-1

Sussex Co. Vocational Technical School District
P.O. Box 351
Georgetown, Delaware 19947

Sussex Tech High School Replacement

Project No.: JDH-10/22/148

Date Completed: : December 14, 2023
Logged By: : E. Cross
Drilled By: : B. Walters
Drilling Method: : HSA (Geoprobe 3230)
Total Depth: : 12 feet

Depth in Feet	Surf. Elev. 47.0	DESCRIPTION	GRAPHIC	USCS	Sample No.	Blow Count	REMARKS
0	47	Grayish brown, wet, medium dense, fine to coarse SAND, with little silt, trace to little clay (10YR 6/1, Sandy loam)		SM	1	3-9-9-9	Scale 1" ~ 6.2 feet Approximately 10 inches of organic bearing soil was encountered at the ground surface.
2	45	Gray, wet, medium stiff, silty CLAY and SAND, (10YR 6/1, Silty clay loam)		CL	2	4-4-4-4	
4	43	Brown, wet, loose, fine to medium SAND, with trace to little silt (10YR 5/3, Sand)		SP-SM	3	2-3-4-5	Groundwater was encountered at 7 feet during drilling operations.
6	41	Brown, saturated, very loose, fine to medium SAND, with trace to little silt (10YR 5/3, Sand, mottled)		SP-SM	4	1-2-2-2	
8	39				5	1-1-2-3	Boring caved in at 3 feet. Latitude: 38.64206 Longitude: -75.44243
10	37	Brown, saturated, loose, fine to medium SAND, with little silt (10YR 5/3, Loamy sand)		SM	6	1-1-3-5	
12	35	Boring terminated at 12 feet.					
14	33						
16	31						
18	29						
20	27						
22	25						
24	23						
26	21						
28	19						
30	17						
32	15						
34	13						
36	11						
38	9						
40	7						
42							

NOT FOR BIDDING

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LOG OF BORING C-2

Sussex Co. Vocational Technical School District
P.O. Box 351
Georgetown, Delaware 19947

Sussex Tech High School Replacement

Project No.: JDH-10/22/148

Date Completed: : December 14, 2023
Logged By: : E. Cross
Drilled By: : B. Walters
Drilling Method: : HSA (Geoprobe 3230)
Total Depth: : 12 feet

Depth in Feet	Surf. Elev. 46.1	DESCRIPTION	GRAPHIC	USCS	Sample No.	Blow Count	REMARKS
0	46.1	Gray, wet, very loose to loose, fine to medium SAND and clayey SILT (10YR 6/1, Loam, mottled)		SM-ML	1	3-2-3-5	Scale 1" ~ 6.2 feet
2	44.1				2	1-2-2-3	Approximately 10 inches of organic bearing soil was encountered at the ground surface.
4	42.1				3	2-2-3-4	
6	40.1	Brown, saturated, very loose, fine to medium SAND, with little silt (10YR 5/3, Loamy sand)		SM	4	1-2-2-3	Groundwater was encountered at 7 feet during drilling operations.
8	38.1	Gray, saturated, medium dense, fine to medium SAND, with little silt, little clay (10YR 6/1, Sandy loam)		SM	5	4-6-7-10	Boring caved in at 4 feet.
10	36.1	Gray, saturated, loose, fine to coarse SAND, with trace to little silt, trace gravel (10YR 6/1, Sand)		SP-SM	6	2-2-3-5	Latitude: 38.64216 Longitude: -75.44216
12	34.1	Boring terminated at 12 feet.					
14	32.1						
16	30.1						
18	28.1						
20	26.1						
22	24.1						
24	22.1						
26	20.1						
28	18.1						
30	16.1						
32	14.1						
34	12.1						
36	10.1						
38	8.1						
40	6.1						
42							

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LOG OF BORING C-3

Sussex Co. Vocational Technical School District
P.O. Box 351
Georgetown, Delaware 19947

Sussex Tech High School Replacement

Project No.: JDH-10/22/148

Date Completed: : December 14, 2023
Logged By: : E. Cross
Drilled By: : B. Walters
Drilling Method: : HSA (Geoprobe 3230)
Total Depth: : 14 feet

Depth in Feet	Surf. Elev. 48.0	DESCRIPTION	GRAPHIC	USCS	Sample No.	Blow Count	REMARKS
0	48	Gray, wet, loose, fine to medium SAND, with little silt, little clay (10YR 6/1, Sandy loam)		SM	1	3-3-3-4	Scale 1" ~ 6.2 feet Approximately 12 inches of organic bearing soil was encountered at the ground surface. Groundwater was encountered at 7 feet during drilling operations. Boring caved in at 4.5 feet. Latitude: 38.64171 Longitude: -75.44217
2	46	Brown, wet, medium dense, fine to medium SAND, with trace to little silt (10YR 5/3, Sand)		SP-SM	2	1-3-5-6	
4	44	Gray, wet, stiff, silty CLAY and SAND (10YR 6/1, Silty clay loam)		CL	3	2-3-4-11	
6	42	Grayish brown, saturated, loose to medium dense, fine to coarse SAND, with trace to little silt, trace gravel (10YR 6/1-5/3, Sand)		SP-SM	4	3-5-5-7	
8	40				5	5-4-4-5	
10	38	Brown, saturated, very loose, fine to medium SAND, with little silt, trace clay (10YR 5/3, Loamy sand)		SM	6	1-1-2-2	
12	36	Brown, saturated, medium dense, fine to coarse SAND, with little silt, little clay (10YR 5/3, Sandy loam)		SM	7	1-3-5-8	
14	34	Boring terminated at 14 feet.					
16	32						
18	30						
20	28						
22	26						
24	24						
26	22						
28	20						
30	18						
32	16						
34	14						
36	12						
38	10						
40	8						
42							

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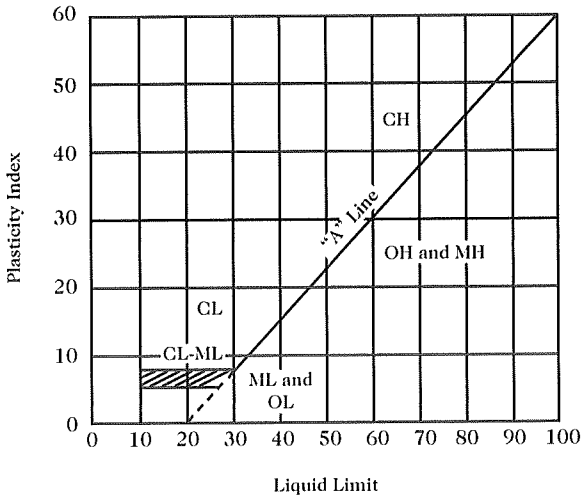
Geotechnical and Environmental Consultants
Monitoring Well Installation
Construction Inspection and Materials Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			*Group Symbols*	*Typical Names*	*Laboratory Classification Criteria*	
Coarse-grained soils (More than half of material is larger than No 200 sieve size)	Gravels (More than half of coarse fraction is larger than No 4 sieve size)	Clean gravels (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel sand mixtures, little or no fines	Not meeting all graduation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a] d / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
	Sands (More than half of coarse fraction is smaller than No 4 sieve size)	Clean sands (Little or no fines)	SW	Well-graded sands, gravelly sands,	$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all graduation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a] d / u	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are *borderline* cases requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No 200 sieve)	Silts and clays (Liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and clays (Liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		Pt	Peat and other highly organic soils		

Determine percentages of sand and gravel from grain-size curve.
Depending on percentage of fines (fraction smaller than No 200 sieve size), coarse grained soils are classified as follows:
Less than 5 percent — GW, GP, SW, SP
More than 12 percent — GM, GC, SM, SC
5 to 12 percent — *Borderline cases requiring dual symbols*[a]



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FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

DENSITY

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

RELATIVE PROPORTIONS

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

PARTICLE SIZE IDENTIFICATION

Boulders	- 8 inch diameter or more
Cobbles	- 3 to 8 inch diameter
Gravel	- Coarse - 1 to 3 inch
	- Medium - 1/2 to 1 inch
	- Fine - 4.75 mm to 1/2 inch
Sand	- Coarse - 2.0 mm to 4.75 mm
	- Medium - 0.425 mm to 2.0 mm
	- Fine - 0.075 mm to 0.425 mm
Silt	- 0.075 mm to 0.002 mm

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COHESIVE SOILS
(Clay, Silt and Combinations)

CONSISTENCY

Very Soft	- 3 blows/ft. or less
Soft	- 4 to 5 blows/ft.
Medium Stiff	- 6 to 10 blows/ft.
Stiff	- 11 to 15 blows/ft.
Very Stiff	- 16 to 30 blows/ft.
Hard	- 31 blows/ft. or more

PLASTICITY

Degree of Plasticity	Plasticity Index
None to Slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Classification on logs are made by visual inspection of samples unless a sample has been subjected to laboratory classification testing.

Standard Penetration Test - Driving a 2.0" O.D., 1-3/8" I.D., splitspoon sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6 inches of penetration on the drill log (Example - 6/8/9). The standard penetration test value (N - value) can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.). (ASTM D-1586)

Strata Changes - In the column "Soil Descriptions," on the drill log, the horizontal lines represent strata changes. A solid line (—) represents an actually observed change, a dashed line (----) represents an estimated change.

Groundwater - Observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc. may cause changes in the water levels indicated on the logs.

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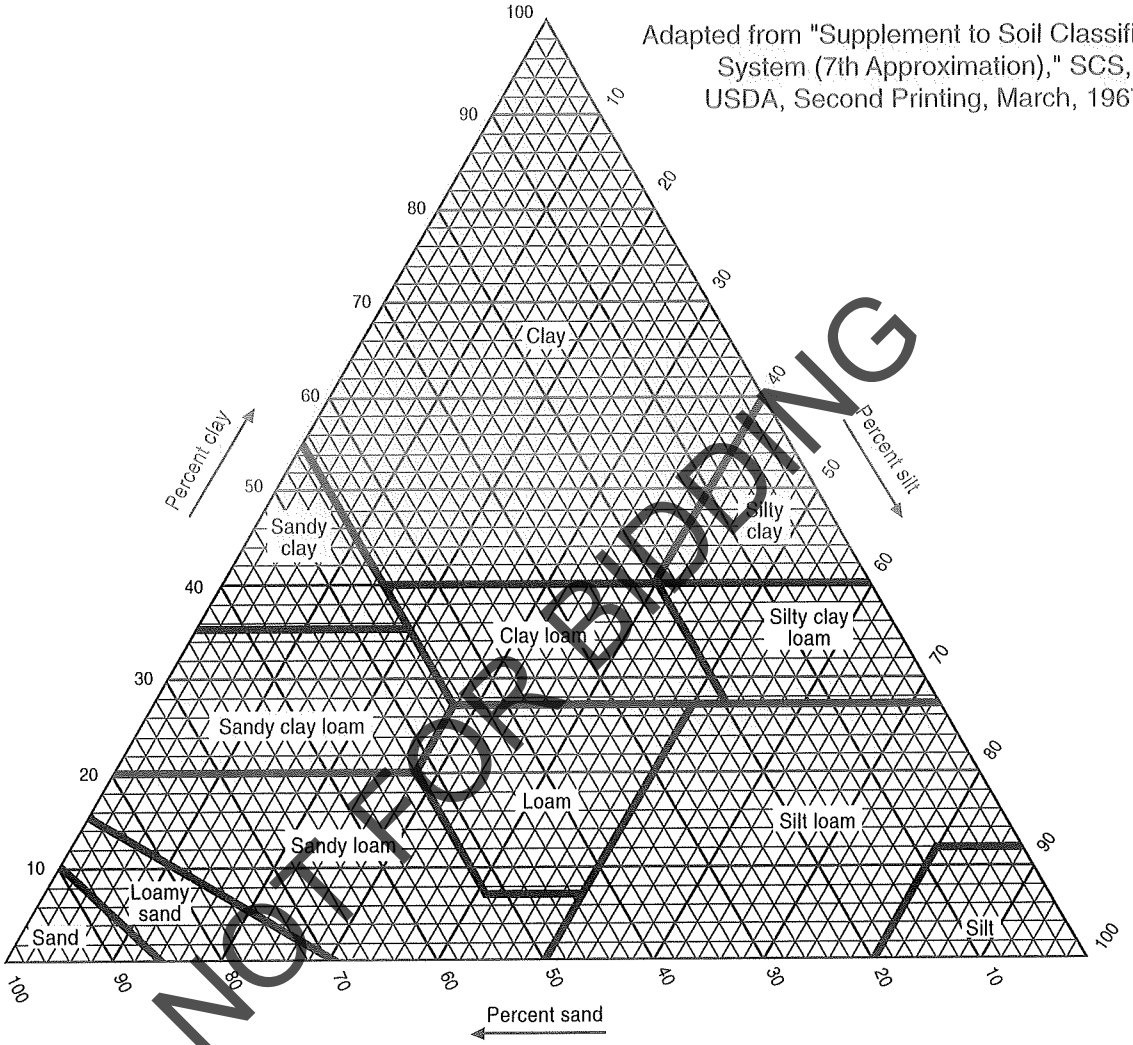
USDA SOIL CLASSIFICATION SYSTEM

Adapted from "Supplement to Soil Classification System (7th Approximation)," SCS, USDA, Second Printing, March, 1967



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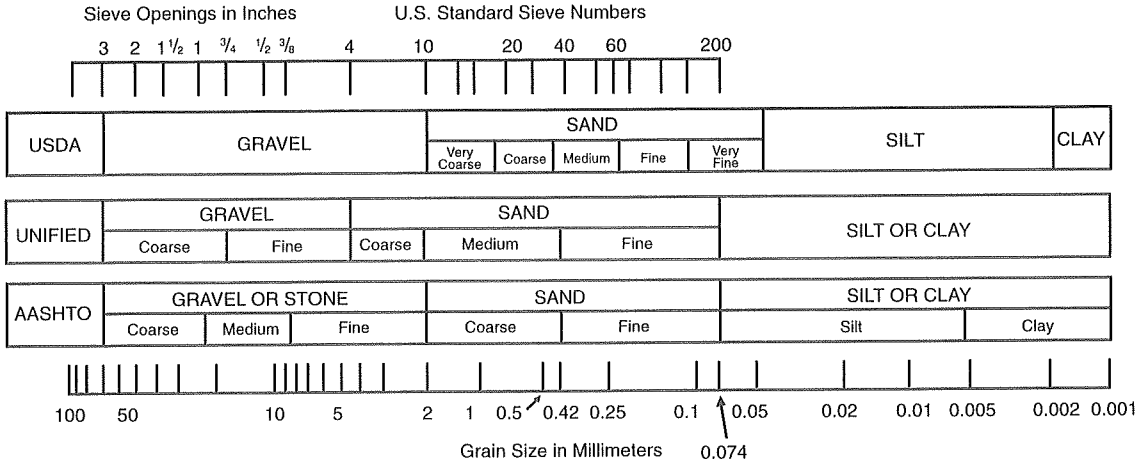
COMPARISON OF PARTICLE - SIZE SCALES



Soil triangle of the basic soil textural classes. (U.S. Soil Conservation Service.) 288-D-2782.

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Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

NOT FOR BIDDING

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by:* the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

NOT FOR BIDDING

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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U.S. Department of Labor
Employment Standards Administration
Wage and Hour Division

PAYROLL

(For Contractor's Optional Use; See Instructions, Form WH-347 Inst.)

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

Rev. April 2006

NAME OF CONTRACTOR ☐ OR SUBCONTRACTOR ☐ | ADDRESS | OMB No.: 1215-0149 Expires: 04/30/2009

PAYROLL NO. | FOR WEEK ENDING | PROJECT AND LOCATION | PROJECT OR CONTRACT NO.

(1) NAME, ADDRESS, AND SOCIAL SECURITY NUMBER OF EMPLOYEE	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	OT. OR ST.	(4) DAY AND DATE HOURS WORKED EACH DAY	(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS FICA	WITH-HOLDING TAX			OTHER	TOTAL DEDUCTIONS	(9) NET WAGES PAID FOR WEEK
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NOT FOR BIDDING

The Copeland Act (40 U.S.C. 3145) requires contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) Regulations 29 CFR Part 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. Compliance with these requirements is mandatory. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

We estimate that it will take an average of 56 minutes to complete this collection of information, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection of information, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, ESA, U. S. Department of Labor, Room S3502, 200 Constitution Avenue, N. W., Washington, D. C. 20210.

Date _____

I, _____ _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
(Contractor or Subcontractor)

_____; that during the payroll period commencing on the
(Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____, all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 CFR Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948; 63 Start. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. 276c), and described below:

_____

_____

_____

_____

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination Incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, of if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

☐ – in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in Section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

☐ – Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in Section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.

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* U.S. G.P.O.:1997 519.861

SECTION 011100 – SUMMARY OF WORK

PART 1 – GENERAL

1.1 Drawings and general provisions of contract, including General and Supplementary Conditions and other Division – 1 Specifications Sections, apply to this Section.

1.2 PROJECT DESCRIPTION

A. This part of the project consists of the Bid Pac C Contracts No. 1 thru 13.

Bid Pac C

Contract 1	Concrete Work
Contract 2	Masonry Work
Contract 3	Steel Work
Contract 4	Carpentry & General Work
Contract 5	Roofing Work
Contract 6	Furnish Hollow Metal/Doors/Hardware
Contract 7	Aluminum Storefront/Windows/Glass and Glazing
Contract 8	Drywall/Metal Framing
Contract 9	Painting/Caulking
Contract 10	Mechanical
Contract 11	Electrical
Contract 12	Post Frame Construction
Contract 13	Greenhouse

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1.3 CONTRACTOR USE OF PREMISES

A. General: During the construction period the contractor will be allowed reasonable use of the premises. However, the contractors use of the premises will not limit the Owners use of premises.

1.4 The Construction Managers scope of work is part of this section and denotes the work to be performed.

1.5 MISCELLANEOUS PROVISIONS

A. Miscellaneous Provision

1. The construction will start in June 2026. Note that weekend and evening work may be required to meet the schedule. All materials may be procured early so that they are readily available. The Owner will pay ninety-five percent (95%) of stored materials providing they are properly insured, stored and can be verified.

B. Project Meetings

1. Pre-Construction Conference: Attendance by Owner, Architect, Engineers, Construction Manager, Contractor, major Subcontractors, and Suppliers.

2. Progress Meetings: Bi-weekly; attendance by Owner, Architect, Engineers, Construction Manager, Contractor, applicable Subcontractors, and Suppliers.

NOTE: Meetings may be held more frequently as required. Must attend these meetings and missing meetings will not be tolerated from Primary Contractors. Missing meetings will result in a penalty of $200.00 dollars per meeting if your firm was requested to attend at the previous progress meeting.

C. Record Drawings

1. The contractors of Contracts 1 thru 13 shall be responsible for maintaining record "as builts" throughout construction as indicated in Section 017000.

D. Schedule

Construction starts June 2026. Project has to be finished by May 2027
Please provide sufficient manpower in your cost to meet the completion date of May 2027.

NOT FOR BIDDING

Bid Pac C

Contract 1	Concrete Work
Contract 2	Masonry Work
Contract 3	Steel Work
Contract 4	Carpentry & General Work
Contract 5	Roofing Work
Contract 6	Furnish Hollow Metal/Doors/Hardware
Contract 7	Aluminum Storefront/Windows/Glass and Glazing
Contract 8	Drywall/Metal Framing
Contract 9	Painting/Caulking
Contract 10	Mechanical
Contract 11	Electrical
Contract 12	Post Frame Construction
Contract 13	Greenhouse

Bid Pac C

The following parts of the specifications are to be considered part of Bid Pac C, Contracts No. 1 thru 13. However, they shall not be listed with the Scope of Work for each of the Scopes of Work for the contracts. They will be referred to as the Administrative Sections with each of the Scope of Work for the contracts.

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

000111	PROJECT CONTACTS
000115	LIST OF DRAWINGS
000116	ADVERTISEMNET FOR BIDS
002113	INSTRUCTIONS TO BIDDERS
004126	BID FORMS INCLUDING:
	BID FORM
	SUB LISTING
	NON-COLLUSION STATEMENT
	AFFIDAVIT OF EMPLOYEE DRUG TESTING PROGRAM
	AFFIDAVIT OF CONTRACTOR QUALIFICATIONS
004313	STATE OF DELAWARE BID BOND

CONTRACTING INFORMATION

005226	AGREEMENT INCLUDING STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR (AIA A132 – 2019)
006113.13	STATE OF DELAWARE PERFORMANCE BOND FORM
006113.16	STATE OF DELAWARE PAYMENT BOND FORM
006276	MONTHLY REQUISTION & CONTINUATION SHEET (AIA G732-2019 & G703-2021)
006300	STANDARD FORMS CERTIFICATES AND MODIFICATION FORMS
007226	GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION (AIA A232-2019)
007300	SUPPLEMENTARY GENERAL CONDITIONS A232-2019 INCLUDING ATTACHMENT "A" CONSTRUCTION MANAGER GENERAL CONDITIONS
007316	INSURANCE INCLUDING SAMPLE CERTIFICATE OF INSURANCE
007346	DELAWARE PREVAILING WAGE RATES
008013	GENERAL REQUIREMENTS
008114	DRUG TESTING FORMS
009300	REFERENCE MATERIALS
	GEOTECHNICAL REPORTS (BORING LOGS)
	PAYROLL REPORT FORM

DIVISION 01 – GENERAL REQUIREMENTS

011100	SUMMARY OF WORK
011200	MULTIPLE CONTRACT SUMMARY
011216	ALTERATION PROJECT PROCEDURES
011400	WORK RESTRICTIONS
012000	PRICE AND PAYMENT PROCEDURES
012100	ALLOWANCES
012200	UNIT PRICES
012300	ALTERNATES
012500	SUBSTITUTION PROCEDURES

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012600	CONTRACT MODIFICATION PROCEDURES
012900	PAYMENT PROCEDURES
012973	SCHEDULE OF VALUES
013100	PROJECT MANAGEMENT AND COORDINATION
013113	PROJECT COORDINATION
013216	CONSTRUCTION SCHEDULE
013233	CONSTRUCTION PROGRESS DOCUMENTATION
013300	SUBMITTAL PROCEDURES
013319	FIELD ENGINEERING
013500	SAFETY
014000	QUALITY CONTROL
014013	QUALITY REQUIREMENTS
014200	REFERENCES
015000	TEMPORARY CONSTRUCTION UTILITIES, FACILITIES & CONTROLS
016000	MATERIALS AND EQUIPMENT PRODUCT REQUIREMENTS
017000	CONTRACT CLOSEOUT
017329	CUTTING AND PATCHING
017419	CONSTRUCTION WASTE MANAGEMENT
017700	CLOSEOUT PROCEDURES
017836	WARRANTIES
017839	PROJECT RECORD DOCUMENTS
017900	DEMONSTRATION AND TRAINING

NOT FOR BIDDING

SCOPE OF WORK - Bid Pac C
CONTRACT NO. 1 CONCRETE WORK

A. The administrative sections, prints, addendums, and technical specifications 030516, 033000 & 079200.

B. Provide all layout for the building foundations, locations and elevations by a registered surveyor complete.

C. Install all anchor bolts and the leveling, grouting and setting of the bearing plates for the structural steel material furnished by Contract No. 3 Steel Work and Contract No. 8 Drywall/Metal Stud materials. Steel and metal stud shop drawings to be used for layout of anchor bolts.

D. Provide all perimeter insulation under concrete slabs and foundation walls. Provide rigid insulation between concrete and decking.

E. Provide all site select fill for the building, site concrete and parking areas.

F. Provide sufficient layout work in regards to the foundation so that the masonry contract can provide wall foundations. Maintain batter boards and lines until masonry contractor starts work after the masonry contract accepts layout and starts work. It is the masonry Contractors responsibility to maintain work from that point forward.

G. Provide all grading and grading of sub-grades for footings, foundation, floors and cast in place walls.

H. Provide all excavation required for foundation work and the backfill required to do the poured in place concrete work.

I. Provide all concrete foundations and rebar complete including any foundations outside the building foot print.

J. Compact and backfill all trenches, foundations and other concrete work associated with this work only. Provide removal off-site of all excess soils due to excavation of your work.

K. Provide all floor slabs complete including weather (hot and cold) protection, mesh, vapor barriers, water proof barriers, composite waterproof membrane, expansion and control joints, caulking and perimeter insulation under slab for a complete system. Refer to Division 9 Flooring Sections in reference to floor finish tolerances. Concrete sealers and curing Compounds must be compatible with flooring adhesives. Any irregularities in concrete surfaces at expansion joints to be ground flat to meet flooring contractor's specifications.

L. Provide all concrete slab work to the exterior face of the enclosed building area, including of the, poured in place stairs and retaining wall complete.

M. Provide stone drainage fill under all concrete slabs within the building footprint or under exterior concrete provided by this contract.

NOT FOR BIDDING

N. Provide all excavation and backfill required to accomplish the work of this Contract, including the proper compaction of all backfill materials. Provide the removal off site of any and all excess fill. Provide compaction testing. Provide all final grading of site.

O. **NOTE:** The item 'W' in the site work contract scope of work. All fill in the building, step and ramps are by this contract. This Contract is responsible to handle all fill and preparation for the completion of the concrete work.

P. Provide all depressed concrete for floor mats at entrance and all other items that need concrete depressions. Locations and sized to be coordinated with other contracts.

Q. All cast in place concrete beams, lintels and walls to be included in this contract. Bond beams and CMU grouting is responsibility of Masonry Scope.

R. It is the responsibility of this contract to coordinate with the Mechanical and Electrical Contractors, the elevation and locations of all imbedded items, at the time of pour including the proper sloping of floors to floor drains and troughs.

S. Concrete footings to be clean of all debris and dirt prior to sign off to Masonry Contractor.

T. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

U. Provide all concrete testing, inspections or special inspections as noted in related sections of this manual including retaining services from the geotechnical engineer for testing of soil as noted. All testing is by contractor whether noted otherwise in other locations in the documents.

V. Notify mechanical and electrical contractors with a schedule of when the concrete is to be poured so these contractors can verify their equipment locations.

W. Provide colored concrete finish complete and pattern concrete if noted in the plans or specifications.

X. Provide an allowance of $10,000 for cold weather protection. All protection to be approved by construction manager before work is performed.

Y. All concrete debris to be disposed of off-site in a required manner meeting all local, state and federal laws.

Z. Provide installation of steel edging in concrete as noted. Contract No. 3 Steel will furnish.

AA. Provide polished concrete finish complete including sealing and staining of concrete if noted.

BB. The concrete contractor is to coordinate with surveyor on the amount of locations and elevations the surveyor is to locate. Concrete contractor is responsible for accuracy of the layout.

CC. Provide testing of trenches that are opened and backfilled pertaining to your scope of work.

DD. Provide dewatering if needed for your scope of work.

NOT FOR BIDDING

EE. Provide reinforcement for all concrete provided by this contract.

FF. Provide self adhering sheet waterproofing and composite waterproofing complete.

GG. Provide termite control system.

HH. Provide concrete wash out station.

II. Provide insulation that is under concrete pads.

JJ. Provide all site concrete work as shown. Run all concrete work to the face of the buildings to meet interior concrete work performed by the this contract. Provide all concrete slab work that is under a canopy or roof that is not fully enclosed. Provide all stone bases and preparation work to install the site concrete. Provide all pads, loading areas and frost walls at exterior. Provide colored and patterned concrete if noted in contract documents.

KK. This Contract is responsible for all concrete pads and frost walls up to the face of building including all exterior steps and ramps.

LL. This contract is to provide the building, step and ramp fill to an elevation of plus or minus one (1") inch.

MM. Provide exterior caulking of expansion joints at all concrete locations including sidewalks and curbs.

NN. Provide all soil and compaction testing including any other testing , inspections and special inspections noted in your related specifications or noted on the project drawings that relates to your scope of work. Contractor to provide all testing whether noted otherwise in other locations in the documents."

OO. Provide all fencing complete including all footings and hardware complete. Also provide all gates as shown.

PP. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

QQ. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

RR. See section 012300 Alternates and bid form for your responsibility for the alternates.

SS. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

TT. It is the contractor's responsibility to review all other contract scopes of work.

NOT FOR BIDDING

SCOPE OF WORK – Bid Pac C
CONTRACT NO. 2 – MASONRY WORK

A. The administrative sections, prints, addendums, and technical specification sections 042000, 047200 & 076200.

B. Provide all masonry work complete including cmu block, ground face cmu units, decorative block and polished block. All hollow metal doors and frames are to be stored and set by Contract No.4 Carpentry and General Work.

C. Provide all concealed and thru wall flashings.

D. Provide cavity wall insulation and other insulation attached between masonry walls and masonry veneer. Perimeter foundation wall insulation to be provided by Contract No. 1 Concrete Work. Provide cavity drainage mat system. Provide all rigid insulation that is located between masonry and masonry veneer. Contract No. 8 Drywall/Metal Stud will provide riged insulation where attached to metal stud framing or masonry wall and no masonry veneer is located. Provide transition membrane around window and doors, etc... Where there is masonry backup and veneer.

E. Provide the installation of all bearing plates and bolts associated with the masonry for the steelwork and cold formed metal framing. The plates and bolts will be furnished by Contract No. 3 Steel Work. Steel contractor and masonry contractor to coordinate locations and placement of items at the time of masonry construction.

F. Install all steel lintels attached or resting on masonry work finished by contract No. 3 Steel Work. Provide masonry pockets and grout filling of masonry cores where steel beams are attached or resting on masonry work. All structural steel beams provided and installed by Contract No. 3 Steel Work.

G. Provide all cast stone and architectural precast concrete as shown including window sills, bands, accents and modular units.

H. Provide the concrete and rebar for all the filling of block cores, bond beams and bearing points. Include all reinforcements, wall anchors and fasteners to attach to sub surface.

I. Install joist bearing plates furnished by Contract No. 3 Steel Work. Coordinate with Contract 3 Steel Work..

J. See Item F Contract No. 1 Concrete Work for the layout and maintenance responsibility. This contract is responsible for layout of their portion of their work.

K. Provide all grouting of masonry walls required. Also provide grouting of new doors and frames in openings.

L. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

M. Provide fire stopping and protection for masonry walls including fire safing with mineral wool insulation. Provide wall markings for masonry fire and smoke partitions. Provide fire or acoustical sealant where wall intersects with floor or roof deck.

NOT FOR BIDDING

N. All masonry debris to be disposed of off-site in a required manner meeting all local, state and federal laws.

O. Provide masonry opening required for mechanical and electrical equipment. Location and sizes must be coordinated with each contractor. Also include masonry openings for other trades and access panels and doors as noted by these trades.

P. Provide an allowance of $10,000 for cold weather protection. All protection to be approved by construction manager before work is performed.

Q. All wall penetrations to be patched prior to painting or cost of touch up painting to be deducted from contract.

R. Provide bituminous damp proofing, sheet waterproofing and all related accessories as noted on the project documents that is attached to masonry.

S. Furnish all wall anchors that are welded to steel beams and coordinate with Contract No. 3 Steel Work for the welding of these anchors only. All other wall anchors are to be furnished by the mason.

T. All anchor bolts set in CMU is to be furnished by Contract 3 Steel Work and installed by Contract 2 Masonry. Any fasteners required other than anchor bolts provided by each contractor for their scope of work.

U. Masonry contractor to coordinate the cleaning of debris from the foundation with the concrete contractor in a timely manner. Concrete contractor to clean foundation one time.

V. Provide all masonry and grout testing, inspections and special inspections including all other testing noted in your related specifications or noted on project drawings that relate to your scope of work. Contractor to provide all testing whether noted otherwise in other locations in the documents.

W. Provide temporary protection for final wash down/cleaning of masonry. This includes covering and protecting the curtain wall, storefront, doors, windows, etc..

X. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

Y. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

Z. See section 012300 Alternates and bid form for your responsibility for the alternates.

AA. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of for the project.

BB. **It is this contractor's responsibility to review all other contract scopes of work.**

NOT FOR BIDDING

SCOPE OF WORK – Bid Pac C
CONTRACT NO. 3 STEEL WORK

A. The administrative sections, prints, addendums, and technical specification sections 051200, 052100, 053100 & 055133.

B. Furnish all anchor bolts and bearing plates to be installed in concrete by Contract No. 1 Concrete Work. Steel contractor is responsible for verifying dimensions and elevations of these items prior to setting steel.

C. Provide all steel framing for the canopies complete.

D. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

E. Provide all steel and composite decking, including any decking that maybe fastened to cold form metal trusses if shown. See specification for different types of decking. Include deck cell insulation on cellular acoustical deck. Provide cutting out of deck that is pictured framed with steel for ductwork, ladder openings, hatches, etc.. Also provide metal ladders complete.

F. Provide welding of wall anchors furnished and located by Contract No. 3 Masonry Work that are attached to steel.

G. Provide all structural steel testing, inspections and special inspections including all other testing noted in your related specifications or noted on project drawings that relate to your scope of work. Contractor to provide all testing whether noted otherwise in other locations in the documents.

H. No electrical power for this contractor's equipment or welders will be provided. Electrical power to be provided as needed by this contract.

I. Furnish all steel bollards required on the site to Contract No. 1 Concrete Work for their installation. Also furnish stainless steel and lighted bollards complete.

J. Provide all miscellaneous steel items along with support system for each item including wall termination plates and angles where walls terminate next to steel decking. Provide miscellaneous steel framing for overhead coiling doors, operable partitions and other suspension systems. Provide all gauge bent plate and continuous gauge plate. Provide elevator sump pit cover.

K. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

L. Provide all steel products that are anchored in to the walls. Provide steel post supports in stud walls complete. Also provide top of wall steel angle bracing, grating, edge guards, and metal nosing. Provide metal fabrication complete. Provide bent plates and angles complete.

NOT FOR BIDDING

M. Provide all steel and composite decking, including any decking that maybe fastened to cold form metal trusses if shown. See specification for different types of decking. Include deck cell insulation on cellular acoustical deck.

N. Provide loose lintels, angles, plates and all other miscellaneous metal products.

O. Provide steel c-channel fascia with bolts and rivits.

P. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

Q. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

R. See section 012300 Alternates and bid form for your responsibility for the alternates.

S. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

T. It is this contractor's responsibility to review all other contract scopes of work.

NOT FOR BIDDING

SCOPE OF WORK – Bid Pac C
CONTRACT NO. 4 CARPENTRY & GENERAL WORK

A. The administrative sections, prints, addendums, and technical specification sections 061000, 061600, 062000, 083313, 083323, 087100, 096723, 101419, 101423, 102113.19, 102813, 104400, 105113, 107316.13, 123600 & 133413.13.

B. Provide the installation and proper storage of all hollow metal and security frames furnished by Contract No. 6 Furnish Hollow Metal/Doors Hardware. These items will be tailgate delivery.

C. Provide the installation and the proper storage of all wood, fiberglass, security and hollow metal doors furnished by Contract No. 6 Furnish Hollow Metal/Doors Hardware. These items will be tailgate delivery.

D. Provide the installation and the proper storage of all hardware furnished by Contract No. 6 Furnish Hollow Metal/Doors Hardware. These items will be tailgate delivery.

E. Provide all toilet partitions and wood blocking required in walls to install the toilet partitions.

F. Provide wood door jambs complete. Provide installation of Dutch doors and barn doors.

G. Provide all lockers and benches including wood blocking required to install the lockers. The concrete bases are provided by Contract No. 1 Concrete Work. Coordinate work with this Contract.

H. Provide fire extinguishers, cabinets, defibrillators, fire blankets and accessories including any wood blocking required to install the cabinets and extinguishers.

I. Provide all toilet accessories and mirrors including all concealed wood blocking to install the toilet accessories and mirrors or cutting of masonry to install toilet accessories. Contract No. 10 Mechanical will provide lavatory shields at required locations.

J. Provide all expansion and architectural control joint covers assemblies as shown. Coordinate with other contracts involved. Roof joint covers provided by roofing contract.

K. Provide all plywood sheathing and wood framing required. Include all hurricane ties as shown. Provide fire rated plywood and lumber if noted in project documents. Provide wood blocking and furring for roof curbs. Provide wood trusses and all associated connections and fasteners complete if required.

L. Provide all wood blocking required on the project whether shown on the contract documents or not.

M. Provide all architectural louvers that are required other than the louvers required by the mechanical equipment provided by Contract No. 10 Mechanical. Louvers that is required for mechanical systems to be provided by Contract No. 10 Mechanical Complete. Contract No. 4 Carpentry and General Work to provide all other louvers complete that are not required for mechanical equipment.

NOT FOR BIDDING

N. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

O. Provide all wood and metal storage shelving in closets and other areas.

P. Provide all wood blocking required at roofing locations so that the roofer can install his work. **NOTE**: all locations included but not limited to skylights, roof hatches, roof curbs and other items. This includes rooftop mechanical items and wood roof curbs as required.

Q. Provide overhead coiling doors, sectional doors, overhead doors complete, including openers and all related items head house building.

R. Provide roof, wall and floor access doors or panels and materials to install compete. Mechanical, and Electrical contractors to provide access panels or doors for their portion of work. All other panels or doors by this contract if shown on drawings.

S. Provide window roller shades and blinds including electric roller shades at all windows noted.

T. Provide knox box complete.

U. Provide decorative formed & metal closures, columns, trims and all related items for complete systems.

V. Provide asphalt felt barrier between all treated wood blocking that comes in contact with steel or cold formed framing.

W. Provide all signage and cast letters, flat cut metal signage, directories, dimensional letters, exterior wall logo, site LED signs and plaques for a complete system including wood blocking. Provide pin mounted lettering and aluminum panel sign. Provide monument sign. Provide vinyl graphics and letters.

X. Provide pre manufactured aluminum or metal canopies complete including anchoring system.

Y. Provide wood safety barricades to extend top of roof parapets to OSHA required height during Construction. Coordinate removal and replacement of wood safety barricades with metal wall cap Installation.

Z. Include the lump sum of the following amount $ 50,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

AA. Provide low-voltage wiring required for overhead doors automatic door operators for head house.

BB. All rough carpentry related to the exterior skin of the building and roof areas, including wood nailers and blocking, roof blocking, curb blocking, MEP blocking coordinated with MEP trade, fire shutter blocking etc. as required. Include blocking for roller shades.

CC. All rough carpentry related to the interior of the building including blocking, wood nailers, etc. for the installation of fire extinguishers, doors, windows, toilet accessories, cabinets, toilet

NOT FOR BIDDING

partitions, casework, millwork, AED's, gas and air cabinets, rollup doors, coiling doors, kitchen equipment and accessory blocking, etc. including fire treating as required.

DD. Provide and maintain temporary handrails per OSHA standards at all stair assemblies. The below section is a guideline and doesn't replace the OSHA regulations Stairs having two or more risers or rising more than 30 inches (76 cm), whichever is less, shall be equipped with: At least one handrail; and one stairrail system along each unprotected side or edge. The height of stairrails shall be not less than 36 inches from the upper surface of the stairrail system to the surface of the tread, in line with the face of the riser at the forward edge of the tread. Handrails shall provide an adequate handhold for employees grasping them to avoid falling. Handrails that will not be a permanent part of the structure being built shall have a minimum clearance of 3 inches (8 cm) between the handrail and walls, stairrail systems, and other objects. Midrails, and intermediate vertical members, or equivalent intermediate structural members, shall be provided between the top rail of the stairrail system and the stairway steps. Midrails, when used, shall be located at a height midway between the top edge of the stairrail system and the stairway steps. When intermediate vertical members, such as balusters, are used between posts, they shall not be more than 19 inches (48 cm) apart.

EE. This contractor shall provide temporary rails at all exterior opening on the building until permanent window/doors/curtainwall etc. installed.

FF. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

GG. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

HH. See section 012300 Alternates and bid form for your responsibility for the alternates.

II. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of for the project.

JJ. It is this contractor's responsibility to review all other contract scopes of work.

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SCOPE OF WORK Bid Pac C
CONTRACT NO. 5 ROOFING

A. The administrative sections, prints, addendums, and technical specification sections 074113, 074213075300, 076200 & 077200.

B. Provide all roof membrane and all other roofing complete including all rigid insulation, tapered insulation and dens deck cover board and all composite and nail board insulation. This includes metal roofing complete. Metal siding and roofing on post frame barn provided by Contract 12.

C. Provide all flashing required to make a complete roof system including fiberglass and hypalon flashing. Also, include any flashing necessary for the waterproofing of new mechanical and electrical equipment. Provide EPDM flashing with termination bar and sealants as noted in the project documents. Also provide all roof expansion joint covers.

D. Provide all aluminum fascia, trim, soffit, parapet wall caps, , equipment rails, conductor heads, copings, overflow scuppers, roof accessories, traffic pads, walkways, ridge vent, gutters and downspouts, roof hatches, splash blocks, roof curbs and roof accessories as shown.

E. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

F. Provide all caulking sealants that are related to roofing that is provided under this contract. Provide reglets and counter flashings for all roof locations and Masonry Contract No. 2 will provide thru-wall flashings. Coordinate with Contract No. 2 Masonry for flashing compatibility.

G. Provide all flashing for prefabricated roof curbs to make water proof.

H. Provide bituminous damp proofing and self adhering sheet waterproofing on roofing areas complete. Masonry Contract 2 will provide bituminous damp proofing applied to masonry and Contract No. 1 Concrete will provide waterproof barriers and composite waterproof membrane under concrete.

I. Coordinate final connections of downspouts to underground piping with site contractor.

J. Provide the metal soffits and fascias and all other exterior soffits and fascias including all accessories for a complete system.

K. Carpentry contract to provide floor, wall and ceiling expansion joint covers. Roofing contract to provide roof expansion joint cover.

L. Provide the metal wall panel soffit flashing, foam closure and metal and metal soffit and fascia complete.

M. Provide composite and metal material wall panels complete including all furring and fasteners and trims. Provide rain screen system. Provide all aluminum trims.

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N. Provide all types of metal wall panels, metal composite panels, thin calcium silicate units, acrylic stucco finish panels and metal trims complete including all flashings, connections, joint sealants, rain screens and accessories.

O. Provide the cladding support system complete.

P. Provide flashings of panel's integral with the panel system.

Q. Provide caulking of panels as required to provide a complete system. Vertical joints where metal panels meet adjacent materials shall be caulked by the Caulking and Sealant contractor.

R. Provide verification of field dimensions, it is the responsibility of this contract. Coordination and review window openings, door openings and others during the shop drawings process is required so materials can be ordered to accommodate schedule. Material may be required to be ordered in advance of the ability to field measure. This coordination is the responsibility of this contract.

S. Provide all flashing as identified with metal panel installation. Provide hat channels and sub-girts for the panel installation. Coordinate with the work of other contractors related to the spray foam installation.

T. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

U. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

V. See section 012300 Alternates and bid form for your responsibility for the alternates.

W. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope for the project.

X. It is this contractor's responsibility to review all other contract scopes of work.

NOT FOR BIDDING

SCOPE OF WORK Bid Pac C
CONTRACT NO. 6 FURNISH HOLLOW METAL/DOORS/HARDWARE

A. The administrative sections, prints, addendums, and technical specification sections 081113 & 087100.

B. Furnish all hollow metal frames, security frames, hollow metal barrow lites, all hollow metal doors, all wood doors, all fiberglass doors, all security doors and all hardware complete. Furnish wood infill panels window and door and louvers mullions that are fastened in hollow metal frames. Contract No. 4 is responsible to place material in their storage area. Contract No. 6 to tailgate deliver to storage area. All materials need to be properly marked and identified for installation by Contract No. 4 Carpentry and General Work. Develop a sign-off system so that both parties of Contract No. 4 Carpentry and General Work and Contract No. 6 Furnish Hollow Metal/Doors Hardware agree the correct amount of material has been delivered.

C. Provide all required hardware templates and reference material so that Contract No. 4 Carpentry may install the material. Contract No. 6 Furnish Hollow Metal/Doors Hardware will be responsible for providing and coordinating information with all other trades that interfaces such as Contract No. 4 Carpentry and General Work and Contract No. 7 Aluminum Storefront/Windows/Glass and Glazing and Contract No. 11 Electrical.

D. Furnish the hardware to Contract No. 7 Aluminum Storefront/Windows/Glass and Glazing Contractor to install.

E. Access control system is to be provided by Contract 11 Electrical, doors/frames are to be prepped for them under your contract. Provide all hardware accept card readers as noted in the hardware specifications.

F. Electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

G. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

H. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

I. See section 012300 Alternates and bid form for your responsibility for the alternates.

J. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

K. It is this contractor's responsibility to review all other contract scopes of work.

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SCOPE OF WORK Bid Pac C
CONTRACT NO. 7 ALUMINUM STOREFRONT/WINDOWS/GLASS AND GLAZING

A. The administrative sections, prints, addendums, and technical specification section 084313.

B. Provide all aluminum entrances, storefront, aluminum windows, aluminum window sills, kalwall, and doors complete. Provide all break metal around new windows and doors complete. Provide all window and door mullions that are attached to aluminum windows and doors. Also provide window panning, low pressure foam insulation around window units, and simulated divided lite with applied grids if shown.

C. Install all hardware for the aluminum doors. Coordinate with Contract No.6 Furnish Hollow Metal/Doors/Hardware.

D. Provide all glass and glazing including monolithic, fire rated, safety and insulated glazing.. Include all doors and windows furnished by Contract No. 6 Furnish Hollow Metal/Doors/Hardware.

E. Provide all caulking for work installed by this contract exterior complete.

F. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

G. Provide cleaning of glass and frames at completion of installation (remove stickers).

H. Temporary closures may not be necessary during the period of construction. Once the interior finishes are to begin installation; temporary closures will be needed. If windows and doors are not available for installation when openings are ready; Contract No. 12 Aluminum Storefront is to provide temporary closures for the openings until finished windows and doors are installed.

I. Provide aluminum head and sill flashings and all other associated flashings for your product for a complete system.

J. Provide safety and security films complete.

K. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

L. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

M. See section 012300 Alternates and bid form for your responsibility for the alternates.

N. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

O. It is this contractor's responsibility to review all other contract scopes of work.

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SCOPE OF WORK Bid Pac C
CONTRACT NO. 8 DRYWALL/METAL STUD

A. The administrative sections, prints, addendums, and technical specification sections 054000, 072100, 072119 & 092116,

B. Provide all batt insulation (walls and ceilings). Provide all rigid and spray foam insulation that attaches to all metal framing and masonry walls. Provide mineral wool board insulation.

C. Provide all metal stud, framing, furring and drywall work complete. Provide all tile backer board complete. Provide sealants to top and bottom of partitions and at penetrations to seal. Provide slide clip that attach to metal stud and structural steel.

D. Provide all metal blocking required.

E. Coordinate with Contract No. 7 Carpentry so that they can install any wood blocking required in the metal stud walls.

F. Provide all bulkhead, soffit framing complete.

G. Provide all drywall suspended ceilings, walls, shaft walls, gyp. liner panels, fire rated ceilings, fascias and soffits called for on the prints complete including all framing required. Coordinate with Contract No. 10 Mechanical, and No. 11 Electrical. Provide framing for access panels supplied by this contract.

H. Provide all expansion control required for drywall and all gypsum board moldings and Z reveal trim. Provide sealant and caulk for the Z reveal trim.

I. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

J. Provide fire protection for metal stud walls or ceilings as shown including fire safing mineral wool insulation and fire or acoustical sealant also fire protection between floors. Provide spray fire proofing complete. Provide intumescent fire protection complete.

K. Provide all hurricane ties and clips complete that are fastened to cold form framing.

L. As part of the warranty portion. Provide an inspection of drywall and plaster with the owner after 1 year of substantial completion and identify locations to be re pointed due to flaws and cracks in the drywall and plaster. Repair all areas and repaint as needed. Any defect caused by abuse will be charged to the owner.

M. Provide wall labeling for smoke and fire walls for drywall/metal stud walls or ceilings.

N. Provide all cold formed metal framing testing, inspections and special inspections as noted in your related specifications or noted on drawings that relates to your scope of work. Contractor is to provide all testing and inspections whether noted otherwise in other locations in the documents.

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O. Provide all spray applied cellulosic and polyurethane foam insulation complete if noted.

P. Provide sprayed acoustical insulation and prep of surface to receive coating.

Q. Provide fire stopping for your scope of work.

R. Provide metal studs, framing, insulation, gypsum wallboard, taping, spackling and specified wall finishes. (Level 5 where identified) Include all trims and finish pieces for a complete installation.

S. Bidders are advised to pay particular attention to top of wall conditions, fire and smoke safing of slabs and acoustical sealants. This work is include within the scope of this contract.

T. This contractor to provide caulking at the base and top of drywall partitions, furred walls and all drywall conditions.

U. Provide metal furring whether shown or not on drawings at all locations including masonry walls for attachment of metal sidings or other substrates. Also provide all cold formed metal trusses and all brackets and clips complete. Provide girts and hat channels complete. Provide all structural metal stud, framing and furring complete.

V. Provide all metal blocking required.

W. Provide parapet wall framing and framing for cants at roof complete. Provide z-furring and metal strapping for soffits and siding.

X. Provide all gypsum sheathing work complete, including all vapor barrier and air infiltration barriers, weather barriers and building wrap or building paper. This contractor is responsible for maintaining the proper attachment of the barriers and building paper to the building until the final veneer covers the area.

Y. Provide all exterior drywall suspended ceilings, walls, shaft walls, gyp liner panels, fire rated ceilings, fascias and soffits called for on the prints complete including all framing required. Coordinate with Contract No. 10 Mechanical, and No. 11 Electrical. Provide framing for access panels supplied by this contract.

Z. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

AA. Provide fire protection for metal stud walls or ceilings as shown including fire safing mineral wool insulation and fire or acoustical sealant also fire protection between first and second floors. Provide spray fire proofing complete. Provide intumescent fire protection complete if shown.

BB. Provide all hurricane ties and clips complete that are fastened to cold form framing.

CC. Provide wall labeling for smoke and fire walls for drywall/metal stud walls or ceilings.

DD. Provide all cold formed metal framing testing, inspections and special inspections as noted in your related specifications or noted on drawings that relates to your scope of work. Contractor is

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to provide all testing and inspections whether noted otherwise in other locations in the documents.

EE. Provide all spray applied cellulosic and polyurethane foam insulation complete if noted.

FF. Provide insulated air barrier system to the complete exterior of the building including masonry and metal framed wall systems.

GG. Provide the insulation of all cold formed headers complete.

HH. Provide fire stopping for your scope of work.

II. Provide fluid applied rubberized vapor membrane to all exterior wall system, metal stud and masonry wall systems.

JJ. This contract shall provide all weather with intumescent coatings, special paint layer per NFPA 285, and all "Self-Adhering Flashing Tape" at all locations (vertical and horizontal) behind vertical brick, block, metal panels, canopies and overhangs. The Flashing tape shall be applied to seal all exterior openings, including but not limited to doors, louvers, windows, curtain walls, storefronts etc. This includes all exterior sheathed areas, and block back up areas, whether behind masonry or not. Include weather barrier termination angles as needed for the weather barrier Coordination of work with other trades shall be required and final installation work to be coordinated with project schedule and CM. Provide a "complete system" in its entirety for this project.

KK. Provide structural stud assembly for the exterior skin of the building. Including but not limited to Metal Studs, bent plates and angles, gyp sheathing, Fire safing, weather barriers and delegated design on the exterior wall assembly.

LL. Provide rock wool thermal insulation at area where noted in exterior walls.

MM. This contractor shall be responsible to coordinate with the masonry contractor as related to the exterior wall assembly and the installation of the weather barrier.

NN. Steel stud construction as related to the roof parapet construction.

OO. Provide secondary support framing as required.

PP. Clips, anchors, supports and other accessories that interface between steel framing and steel studding and steel studding with masonry interaction.

QQ. Provide engineered drawings (delegated design requirements.)

RR. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

SS. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

NOT FOR BIDDING

TT. See section 012300 Alternates and bid form for your responsibility for the alternates.

UU. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of for the project.

VV. **It is this contractor's responsibility to review all other contract scopes of work.**

NOT FOR BIDDING

SCOPE OF WORK Bid Pac C
CONTRACT NO. 9 PAINTING/CAULKING

A. The administrative sections, prints, addendums, and technical specification sections 079200, 099113, 099123 & 099600.

B. Provide all exterior and interior painting including the preparation of new surfaces to receive the new paint. Provide painted graphics as noted in project documents.

C. Provide the cleaning and painting of all exterior lintels, steel rails and other metals including bollards and exposed ceilings.

D. Reference the finish schedules for the scope of work as well as the prints.

E. Provide all epoxy, high performance coatings, painting, concrete sealer paint and exposed ceiling and structure painting including the preparation of the areas to receive painting. See the finish schedule.

F. Painters option to apply finish coat of paint after all finishes are installed or be responsible for ALL touch up necessary.

G. Electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

H. Drywall returns, sills and etc. would be the responsibility of this contract to caulk. Caulk between the top of wood base and wall.

I. Provide the painting of exposed conduit, sprinkler, plumbing and mechanical piping and duct work if noted. Painting Contractor shall coordinate work with Mechanical and Electrical Contractors. Provide painting of exposed ceilings.

J. Provide staining and varnishing of job site finished wood products include prep of material complete.

K. Provide painting of exterior metal fascia complete.

L. Provide required caulking at control and construction joints.

M. Provide all preformed joint sealant products including but not limited to Emseal expansion joint as required.

N. Provide caulking of masonry to masonry.

O. Provide caulking of vertical joints on exterior metal panels to adjacent materials (Metal Panel Contractor to provide sealants and caulking between panels and as required to seal their assembly, including where metal panels sit on masonry.

P. Provide caulking of exterior perimeter of hollow metal door frames. (including overhead doors.)

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Q. Provide caulking of interior perimeter of hollow metal door frames to masonry. (HM frames to drywall shall be provided by the Painting contractor)

R. Provide caulking of all hollow metal frames to the floor. Coordinate caulking with flooring materials.

S. Provide caulking of all interior exposed concrete slab control joints, expansion joints and perimeter slab to walls.

T. Examine areas and conditions where joint sealers are to be installed and correct any conditions detrimental to the proper and timely completion of this scope of work. Do not proceed with work until unsatisfactory conditions are corrected to permit proper installation.

U. Protection and cleaning of adjacent surfaces to be the responsibility of this contractor.

V. All subbase preparation, priming etc. to be performed before caulking is applied.

W. Provide all exterior and interior caulking required except the caulking required by Contract No. 7 Aluminum Storefront/Windows/Glass and Glazing, Contract No. 1 Concrete Work. Prepare the surfaces to receive the new caulking. Also, include any location where dissimilar materials meet not covered in above contracts. Provide caulking for metal wall panels and all other areas of construction except those contracts listed above.

X. Provide all caulking and sealants for concrete slabs completely.

Y. Provide caulking for control joints in masonry, expansion joints in masonry, cast stone joints and any place that are similar products with masonry. Any masonry to a dissimilar product is to be by this contract.

Z. Provide interior caulking to **all** windows and door frames except for all aluminum frames. Drywall returns, sills and etc. would be the responsibility of this contract to caulk. Caulk between the top of wood base and wall.

AA. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

BB. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

CC. See section 012300 Alternates and bid form for your responsibility for the alternates.

DD. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

EE. It is this contractor's responsibility to review all other contract scopes of work.

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SCOPE OF WORK – Bid Pac C
CONTRACT NO. 10 MECHANICAL

A. The administrative sections, prints, addendums and technical specification sections 033000, 078413, 133413.13, 220500, 220505, 220701, 224000, 224050, 230500, 230505, 230548, 230593, 260600, 230701, 230900, 230923, 233000 & 235523.Technical specifications are noted on mechanical and plumbing contract drawings. Also, refer to electrical drawings for any mechanical or plumbing equipment.

B. Provide all plumbing complete including hook up to residential and commercial equipment including grease interceptor system, trench drains. Also provide caulking of plumbing fixtures to countertops, walls or other surfaces. Provide lavatory shields complete.

C. Provide all testing and permits for the plumbing work. Provide chlorination on all water lines.

D. Provide Fire stopping and patching of wall, floor and ceiling areas that require mechanical penetration. Coordinate with other trades. Provide access panels and doors as required. This contract to install the access doors.

E. Provide all final connections from 5'outside of building to building for all site utilities. Includes water, sewer, and storm sewer.

F. It is the responsibility of the plumbing contractor to coordinate and inspect at the time of pour all imbedded mechanical items in concrete or masonry units for proper elevations and locations.

G. This contract is responsible to restore sub-grade to within 1"+ / - of final grade. Provide compaction and testing as required.

H. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

I. Provide gas piping and final connections and all related items.

J. Provide coordination of all plumbing penetrations with all trades involved. Hammer penetrations will not be tolerated. All wall penetrations to be patched prior to painting or cost for touch up paint to be deducted from contract.

K. Provide hook-ups and connections of kitchen equipment complete. All refrigerant piping associated with the walk in boxes shall be insulated and jacketed under this scope.

L. Coordinate the hook up with the storm water system provided by Contract No. 1 Site Work. Provide all final connections from 5'outside of building to building for all site utilities. Includes water, sewer, and storm sewer. Contract No. 1 Site Work will provide rain water conductor and cast iron rainwater boots.

M. In regards to coordination drawings, the plumbing contractor has the responsibility to coordinate all the trades and producing a coordination drawing showing all trades.

N. Provide two gas regulators for kitchen equipment hook-up complete.

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O. Provide coordination of all blocking needed for hanging and supporting of equipment with carpentry contract.

P. Provide all sleeves for piping and ductwork complete.

Q. Provide grease interceptor complete.

R. Provide all pipe insulation, insulation coverings, valve insulation, labeling and identification of plumbing lines.

S. Excavation and backfill for underground plumbing work as detailed below is the responsibility of this Contractor. Soil types shall be in accordance with the contract documents Refer Section 312300 for requirements on soils. (Geo-Tech reports included for reference and use)

T. Backfilling is the responsibility of this Contractor. Soil types shall be in accordance with project documents. It is the intent to use on site material and not imported fill. The use of this on site material shall conform with the compaction requirements identified in Section 312300. Excavated materials shall be covered immediately and protected from moisture mitigation. If Materials become unusable, this contractor shall own purchasing #10 stone dust to utilize as backfill in all trench or structure locations. Excess unsuitable materials from plumbing excavations shall be removed from the site by this contractor. (includes water meter pit installation) it is not acceptable for anu UG piping to e in the stone layer installed by the concrete contractor, all UG piping must be installed in the subbase with adequate soil coverage.

U. Equipment bases and housekeeping pads identified on the structural drawings are to be provided by the Contract 2 concrete contractor. Any required pads or bases for the scope of this contract not identified on the documents will be provided by this contractor.

V. Valve tags, charts and labeling shall be a part of this contractor's responsibility complete.

W. Testing and balancing shall be provided under this contract, plumbing contractor is to coordinate for all required testing and balancing that pertains to your scope of work.

X. Provide roof drains, sumps and all related anchoring, support and adjustment that is required for your work complete.

Y. Gas piping, meter and pressure regulator valve. (Proper sizing of the regulators is the responsibility of this contractor.) Include anchoring this equipment to the concrete pad provided by Contract 1 concrete contractor and anchoring the piping and stand to the exterior wall.

Z. Provide complete water sterilization, testing and reporting complete.

AA. Provide all HVAC work complete including all required louvers for the mechanical work. Provide fire dampers as required by all codes that apply. Louvers that is required for mechanical systems to be provided by Contract No. 10 Mechanical Complete. Contract No. 9 Painting/Caulking is responsible for the caulking of the louvers. Contract No. 4 Carpentry and General Work to provide all other louvers complete that are not required for mechanical equipment.

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BB. Testing and balancing of the HVAC system is to done by this contract. Provide assistance with commissioning.

CC. Provide Fire stopping and patching of wall, floor and ceiling areas that require mechanical penetration. Coordinate with other trades. Provide access panels and doors as required. This contract to install the access doors.

DD. Provided all roof curbs for all mechanical items.

EE. It is the responsibility of the mechanical contractor to coordinate and inspect at the time of pour all imbedded mechanical items in concrete or masonry units for proper elevations and locations.

FF. This contract is responsible to restore sub-grade to within 1"+ / - of final grade. Provide compaction and testing as required.

GG. This contract is responsible for all temporary heat as needed through duration of construction. See allowances.

HH. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

II. Provide coordination of all mechanical penetrations with all trades involved. Hammer penetrations will not be tolerated. All wall penetrations to be patched prior to painting or cost for touch up paint to be deducted from contract.

JJ. Provide all concrete housekeeping pads for mechanical equipment as required.

KK. Provide installation only of duct mounted smoke and heat detectors. Other Contractor will provide all control wiring as needed for a complete system as required by all codes that apply.

LL. Provide hook-ups and connections of kitchen equipment complete. All refrigerant piping associated with the walk in boxes shall be insulated and jacketed under this scope.

MM. Provide the allowance of $20,000 in the contract for temporary heat fuel cost. Cost of work to be determined by fuel company receipts with amount of fuel and cost per gallon. All equipment and labor for temporary heat is part of the contract. This allowance is for fuel cost only.

NN. Provide painting of roof top equipment if noted.

OO. Provide rooftop units, acoustical package, inertia pads, fire and smoke dampers, heat pumps, radiant heat, boilers, energy recovery ventilation, make-up air unit, air curtains, fans, compressed air system, pumps, heat exchanger, finned tube radiation , unit heaters, sound attenuating unit, kitchen make up air, circulating pumps, air separators, chemical feed systems, glycol fed systems, ERV, pumps, air separator pressure tanks, flow measuring station, smoke vents and all other mechanical equipment complete.

PP. Provide the mechanical controls system complete including low voltage wiring and raceways. Electrical contractor will provide power only.

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QQ. In regards to coordination drawings, the HVAC contractor has the responsibility to coordinate all the trades and producing a coordination drawing showing all trades.

RR. Provide coordination of all blocking needed for hanging and supporting of equipment with carpentry contract.

SS. Provide all sleeves for piping and ductwork complete.

TT. This contractor shall provide all raceways, conduits, pull strings and boxes required for the complete ATC system.

UU. Provide kitchen hood ventilation control system complete if shown.

VV. This contractor shall include all piping, fittings, and connections required for the installation of the complete HVAC system.

WW. Provide all insulation, wraps, covers etc. for work of this contract. Include all labelling and identification markers as directed by the contract documents.

XX. Division 16 of the specifications should be reviewed as it relates to the power wiring and other requirements for HVAC equipment including the coordination of furnishing and installing motor starters as provided in the specifications.

YY. Pipe insulation, insulation coverings, valve insulation, labelling and identification of mechanical piping, ductwork, shafts, connections to systems etc. shall be provided by this contractor.

ZZ. Roof curbs, rails, etc. to be provided and loaded to the roof by this contractor. Layout and installation by this contractor, coordinate with the carpentry contractor for blocking and the roofing contractor for flashing and roofing details. Include any doghouses or raceways for service lines, including coordination of flashing.

AAA. Final connection of kitchen equipment and appliances related to the mechanical piping and HVAC system provided by this contractor. Coordination with other trades (Special Systems, Electrical, Fire Alarm etc.) for final interconnections of these systems shall be provided by this contractor.

BBB. This contractor shall provide all required fire dampers, connections and remote controllers for the HVAC system.

CCC. Provide all VFD’s complete for electrical contractor to install.

DDD. Provide (3) sets of filters for construction use. Include changing out the filters during the construction phase. Additionally include a complete change out of all filters prior to turn over to the owner (these filters shall be separate from the attic stock filters required) Providing a complete filter listing as part of the closeout documents is required.

EEE. This contractor shall provide the work of Section 230900 Instrumentation and Controls of HVAC system in its entirety. Coordinate with all other trades as required. Provide all instrumentation, controls, coordination of work, testing as required to provide a complete ATC system for this project. This work shall include but not be limited to instrumentation and controls for: Provide all

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instrumentation, controls, coordination of work, testing as required to provide a complete ATC system for this project.

FFF. Provide electrical thermostats intended for automatic temperature controls with subbase or adapter plates to mount standard electrical box.

GGG. Provide control wiring and or air piping required for all automatic temperature controls supplied under separate contract.

HHH. Provide wiring for remote thermostats and remote prewired auxiliary control panels for packaged equipment.

III. Provide boiler feed water control wiring.

JJJ. Provide the magnetic starter coil and relay coils intended for automatic temperature controls including interlocking between starts and relays when controlled automatically.

KKK. Provide water and air testing and balancing.

LLL. Provide complete signed and sealed testing report prior to substantial completion and final inspection as required by Sussex County.

MMM. This contractor has been allotted 30 days to complete all work and provide final, sealed balancing report by the Construction Manager. This contractor will need to work closely with the Construction Manager and all MEP trades to sequence work so that the completion of the balancing is completed in a manner that does not delay acceptance from by the owner.

NNN. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

OOO. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

PPP. See section 012300 Alternates and bid form for your responsibility for the alternates.

QQQ. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

RRR. It is this contractor's responsibility to review all other contract scopes of work.

NOT FOR BIDDING

SCOPE OF WORK Bid Pac C
CONTRACT NO. 11 ELECTRICAL

A. The administrative sections, prints, addendums, and technical specification sections 033000, 087100, 133413.13, 260500, 260519, 260520, 260526, 260528, 260529, 260533, 260535, 26053, 260553, 260573, 260800, 260919, 260923, 260943, 261120, 262200, 262416, 262726, 262813, 262816, 262913, 263600, 264113, 265100, 280500 & 283111. Technical specifications are noted on the electrical contract drawings. Also, refer to mechanical and plumbing drawings for any technical equipment.

B. Provide temporary lighting as required for all areas of construction.

C. Provide the patching and fire stopping required for any electrical penetration thru walls, ceilings and floors including division 270000 and 280000 penetrations also. Provide access doors and panels as required. This contract is to install their own panels.

D. Provide all electrical power rough-ins and final connections to the commercial and residential equipment, kitchen equipment and mechanical equipment, equipment, etc...

E. Provide all equipment, material, testing, permits, and inspections required for a complete electrical system for the entire project.

F. Provide all concrete work for the installation of all electrical equipment.

G. Electrical contractor shall provide a complete to fire alarm system as required by code complete.

H. Electrical contractor shall provide line voltage power to all electric door hardware. This shall include wall boxes and conduit where necessary. Electrical contractor shall coordinate with Hardware contract and alarm company. This shall include wall boxes, conduit and installation of control boxes. Low voltage wiring by others; electrical contractor is to provide line voltage to all electric door hardware.

I. Provide temporary distribution panel with six (6) 60-amp, 120/240 volt, single phase, 3-wire power for construction trailers for other contractors. Electrical hook-up, including conduit and wiring to trailer location shall be the responsibility of the Contractor requesting power not the Electrical Contract.

J. This contract is responsible to restore sub-grade to within 1” + / - of final grade.

K. If the Electrical contractor requires power for his construction trailer, he shall provide power to his trailer from the temporary distribution panel provided. Electrical contractor is responsible for all material, labor, and equipment necessary to extend power from panel to electrical site trailer. Electrical contractor shall make connection to panel

L. Provide all heat and smoke detector power wiring per all codes that apply.

M. Provide electrical connections for owner purchased equipment.

N. Provide final connection of all power wiring from building to the utility company connection point.

NOT FOR BIDDING

O. Provide all conduits, wire and all related material to install all underground electric utilities complete.

P. Provide all site lighting complete including concrete bases, conduit, wire and fixtures.

Q. Provide proper compaction and testing of all trenches associated with electrical work.

R. Provide coordination of all electrical penetrations with all trades involved including sections in division 270000 and 280000 penetrations also.. Hammer penetrations will not be tolerated. All wall penetrations to be patched prior to painting or cost of touch up painting to be deducted from this contract.

S. Provide lightning protection system complete.

T. Provide heat terminals complete.

U. Provide the patching and fire stopping required for any electrical penetration thru walls.

V. Provide only pathways, conduit, boxes, raceways, cable trays, floor boxes, distribution backboards, electrical protection, bonding and grounding and power supplies for sections in division 270000 and 280000.

W. Provide underground and overhead exterior electrical work including conduit, manholes and hand holes complete.

X. In regards to coordination drawings, the electrical contractor has the responsibility to coordinate all the trades and producing a coordination drawing showing all trades.

Y. Provide analysis and coordination study of electrical system.

Z. Provide electrical power to electric hand dryers.

AA. Provide all lighting for project; including bollard lights and performance lighting.

BB. Provide all lighting complete including the testing of lighting and control systems.

CC. Provide heat trace system complete.

DD. Provide Electrical power and lighting to all canopies complete.

EE. Electrical Scope Clarification –Division 27 and 28 Items
270500 – Telecommunication Pathways and Spaces – Provided by Contract 11 Electrical.
271000 – Structured Cabling –Provided by Contract 11 Electrical.
272000 – Network Equipment – Provided by Contract 11 Electrical.
274000 – Classroom and Conference Room AV Equipment – Provided by Contract 11 Electrical.
274100 – Specialized AV System – Provided by Contract 11 Electrical.
274166 –Auditorium Audio & Video Systems – Provided by Contract 11 Electrical.
275000 – Public Address/Clock – Provided by Contract 11 Electrical.

NOT FOR BIDDING

280500 – Common Work results for Electronic Safety and Security – Provided by Contract 11 Electrical.
280501 – Security Pathways and Spaces – Provided by Contract 11 Electrical.
281000 – Intrusion Detection System – Provided by Contract 11 Electrical.
281100 – Access Control System – Provided by Contract 11 Electrical.
282000 – Video Surveillance System – Provided by Contract 11 Electrical.
283111 – Digital Addressable Fire Alarm System – Provided by Contract 11 Electrical.

FF. Provide an Allowance of $20,000 in you price for short circuit analysis gear revisions.

GG. Provide all concrete housekeeping pads for electrical equipment required.

HH. Provide grounding and bonding of all systems.

II. This contract is to review Division 15 of the specifications for all power related items for the HVAC equipment including coordinating the furnish and install of motors and controllers complete.

JJ. Provide all conduits, raceways and boxes required for thermostats and sensors installation.

KK. Contract 10 Mechanical will supply all VFD's to the electrical contractor for installation and powering.

LL. Provide all smoke damper, power and remote controllers as required by the contract documents.

MM. Provide all exterior underground raceways and infrastructure as shown on project documents.

NN. Provide electrical rough in and final connection and related work for equipment provided under other contracts.

OO. Provide all electrical permits and inspections. Pay all fees associated with permits and inspections.

PP. Provide all primary service work including all utility company related costs/fees for this work. Coordination with the utility company is the responsibility of this contract.

QQ. Provide fire alarm system complete. Water flow devices are supplied and installed by the sprinkler contractor and wired by the contract.

RR. Provide all infrastructure, conduit and raceways required for all special systems work. Include all required sleeving, sealing and fire sealing for raceways and conduits through walls, floors, ceilings, etc..

SS. Coordinate and provide a complete grounding system for the entire project.

TT. Provide audio and audiovisual systems complete.

UU. Provide rough-in and final connections of kitchen equipment and appliances complete.

VV. Provide wireless clock system including all equipment, cable and accessories.

NOT FOR BIDDING

WW. Provide intercom/public address system. Structured cabling contractor will provide all network cabling including wiring, devices and terminations at the source (MDF/IDF patch panel) and communication port (jack).

XX. Provide electrical power and connections of lighted bollards.

YY. Provide utility cord reels complete.

ZZ. Provide surface raceways for electrical systems complete.

AAA. Provide central battery equipment for emergency lighting.

BBB. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

CCC. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

DDD. See section 012300 Alternates and bid form for your responsibility for the alternates.

EEE. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

FFF. It is this contractor's responsibility to review all other contract scopes of work.

NOT FOR BIDDING

SCOPE OF WORK Bid Pac C
CONTRACT NO. 12 POST FRAME CONSTRUCTION

A. The administrative sections, prints, addendums, and technical specification sections 033000, 061753, 062000, 072100, 072119, 079200 & 133418.

B. Provide post frame beams, columns, purlins and bracing for a complete building.

C. Provide wood trusses for post frame building and all connections and hurricane clips.

D. Provide all sheathing on post frame building.

E. Provide all metal siding, roofing, soffit, fascia's and trims complete.

F. Provide overhead and coil doors for post frame building, including operators and all control wiring.

G. Provide excavation and concrete foundation for setting of post columns. Provide concrete slab and perimeter insulation.

H. Provide all ceiling and interior wall liner panels and all interior framing.

I. Provide gutters and downspouts complete. Provide cupola.

J. Provide animal pens shown on interior and animal enclosure fencing on exterior.

K. Provide building wall and ceiling insulation complete.

L. Provide engineering of post frame building.

M. Provide installation of all entry doors on post frame building.

N. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

O. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

P. See section 012300 Alternates and bid form for your responsibility for the alternates.

Q. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

R. It is this contractor's responsibility to review all other contract scopes of work.

NOT FOR BIDDING

SCOPE OF WORK Bid Pac C
CONTRACT NO. 13 GREENHOUSE

A. The administrative sections, prints, addendums, and technical specification section 133413.13.

B. Provide greenhouse complete including all components and hardware. Concrete and masonry is provided by contracts 1 & 2.

C. Provide all louvers and fans and mechanical units in technical specifications complete.

D. Provide anchoring system of greenhouse; coordinate with Contract 2 Masonry.

E. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

F. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

G. See section 012300 Alternates and bid form for your responsibility for the alternates.

H. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

I. It is this contractor's responsibility to review all other contract scopes of work.

END OF SECTION 011100

NOT FOR BIDDING

SECTION 011200 – MULTIPLE CONTRACT SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes certain responsibilities of the Contractors. These instructions shall be strictly followed unless more stringent requirements are contained within other Specification sections or written directions from the Construction Manager state otherwise.

Protection of Existing Conditions
Project Supervision
Project Coordination
Protection of Existing Conditions
Systems Coordination Drawings
Field Engineering
Testing
Fees, Licenses, and Permits
Sleeves, Hangers, and Inserts
Chases and Recesses
New and Existing Openings
Penetrations
Fireproof Repair
Equipment Foundations
Cutting and Patching
Access Doors and Panels
Touch-up Painting
Starters and Disconnects
Final Cleaning

NOT FOR BIDDING

1.2 PROTECTION OF EXISTING CONDITIONS

A. Existing finished surfaces to remain in place in the existing site, shall be protected by the Trade Contractor performing the work in that area, by whatever materials and means are required to prevent any damage. Other surfaces shall be protected with tarpaulins, drop cloths, and similar coverings, as required.

B. At the completion of the work, or when protection is no longer required, temporary enclosures, tarpaulins, building paper, drop cloths and other temporary materials, shall be removed and existing work and finishes in altered portions of the existing site shall be cleaned and left in condition acceptable to the Owner, Architect, and the Construction Manager.

1.3 PROJECT SUPERVISION

A. Every Trade Contractor shall be responsible for the supervision of their work. Adequate supervision as required to maintain the progress schedule, shall be required within the scope of work within the contracts. When more than one major building phase is being constructed at different locations on the project site, separate supervision must be assigned to each phase when work of that contract is being performed. When performing construction work to maintain the progress schedule requires extended hours, multiple shifts, and/or additional work days, adequate

separate supervision shall be required for each Trade Contractor during these times. The competence level and ability of supervisory personnel must be adequate to perform the construction activities involved.

B. Although these various second level supervision personnel may be reassigned from time to time, each contractor shall retain one superintendent with full responsibility while performing work on the project.

C. The Construction Manager shall have the authority to direct the Trade Contractor to assign additional supervisory personnel to ensure compliance with the contract schedule and quality requirements at no addition to the contract price.

1.4 PROJECT COORDINATION

A. Every Trade Contractor shall be responsible for the coordination of the progress of their work with the progress of all other Trade Contractors work.

B. Inasmuch as Project completion within the time limit is dependent upon cooperation of those engaged therein, it is imperative that each Trade Contractor perform his work at such time and in such a manner as not to delay or otherwise interfere with work progress of other Trade Contractors. If any Trade Contractor's work depends upon proper execution or results of another Trade Contractor's work, the former shall inspect the work and report any defects therein to the Construction Manager.

C. Trade Contractors shall afford each other every reasonable opportunity for installation of their work, and shall work in conjunction with each other in order to facilitate proper and intelligent execution of work.

D. Plans are generally diagrammatic, and each Trade Contractor shall coordinate his work with the work of others, so that interference between mechanical, electrical, architectural and structural work does not occur. Each Trade Contractor shall furnish and install offsets, bends, turns, and the like in connection with his work to avoid interference with work of other Trade Contractors, to conceal work where required, and to secure necessary clearance and access for operation and maintenance. In case of interference or lack of clearance and access, the Construction Manager will be notified immediately, and shall, in turn, notify the Architect. The Architect will decide which work shall be relocated, regardless of which was installed first.

E. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

F. Verify utility requirements and characteristics of operating equipment are compatible with utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.

G. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

H. After Owner occupancy, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

NOT FOR BIDDING

1.5 FIELD ENGINEERING

H. Inspection:

1. Each Trade Contractor shall confirm locations of survey control points prior to starting work. Promptly notify Construction manager of any discrepancies discovered.

2. The Trade Contractor shall verify all measurements of the site and shall be responsible for the correctness of same. No extra charge or compensation will be allowed on account of differences between actual dimensions and the measurements indicated on the Drawings; any difference which may be found should be submitted to the Architect for consideration before proceeding with the work.

I. The Owner shall secure a professional engineer or surveyor licensed in the State of Delaware to perform the following:

1. Provide benchmark elevation to serve as the basis for the construction layout of the project.

J. Construction Layout:

1. The Sitework Trade Contractor shall be responsible to perform the layout and elevations required to complete his work.

2. The Site Concrete Work Trade Contractor shall layout to complete the scope of their work.

3. Each Trade Contractor shall layout the remainder of his own work and be responsible for all lines, levels, grades, elevations, and measurements.

1.6 TESTING

A. The owner shall employ and pay for the services of a testing agency to perform the required construction material testing for specification divisions 1 through 3. Refer to section 014000 Quality Control for testing agency qualifications and test reporting requirements.

1.8 FEES, LICENSES, AND PERMITS

A. The following permits shall be purchased by the Owner:

1. Building Permit

B. All remaining fees, licenses, and permits shall be obtained and paid for by the trade contractor requiring them at no additional cost to the Owner to complete their work.

1. All Trade Contractors are advised that the Owner has reached an agreement with the County of Sussex and the City of Rehoboth Beach to pay for the following permit fees: Building Construction.
2. Each respective contractor will still be required to obtain license from the County of Sussex and the City of Rehoboth Beach.
3. Additionally, all contractors are still responsible to coordinate required applicable inspections.

NOT FOR BIDDING

1.9 SLEEVES, HANGERS, AND INSERTS

A. Each Trade Contractor shall furnish sleeves and inserts required to accommodate his work, together with instructions regarding their placement and location in the structure. Sleeves and inserts shall be furnished promptly in accordance with the established construction schedule so that they may be built-in as construction progresses.

B. Trade Contractors to furnish all embeds, sleeves, inserts, etc., that are to be cast in concrete or built in masonry to the appropriate Trade Contractor for installation.

C. Each Trade Contractor shall furnish and install hangers required to accommodate his work.

1.10 CHASES AND RECESSES

A. Each Trade Contractor shall provide all blockouts shown on the Contract Documents and having either or both dimensions greater than 10" to the appropriate Trade Contractor for installation into his work. Any openings with dimensions smaller than 10" or not shown on drawings but required by a Trade Contractor shall be furnished and installed by the Trade Contractor requiring the same.

B. It is the responsibility of the Trade Contractors requiring openings, chases, etc., to furnish information regarding size and location promptly in accordance with the established construction schedule, so that they may be built-in as construction progresses and avoid delays. Failure to provide the information promptly will result in the responsible Trade Contractor incurring any cost associated with the delay and the installation.

C. Trade Contractors shall cooperate fully with each other in the performance of above work, as cutting and patching of new work is neither contemplated nor will it be tolerated.

1.11 NEW AND EXISTING OPENINGS

A. Upon removal of existing work, which penetrates floors, walls, or ceilings, openings shall be immediately closed with material matching that adjacent to the opening. This shall include whatever structural support is required. The closing of existing openings shall be performed by the Trade Contractor who is responsible to perform this work as if it is new construction.

B. Each Trade Contractor shall be responsible to install any new openings required to install his works in any existing construction and to furnish and install any additional structural support. All cutting and patching must be performed by journeymen or master trade mechanics for the trade work of the cutting/patching. Costs for all patching work are the responsibility of the trade contractor requiring the new opening.

C. This structural support shall maintain the structural integrity of the building.

D. Prior to cutting or drilling of any new openings that require additional structural support, the contractor shall submit a shop drawing to the Construction manager for review and acceptance by the Architect prior to demolition.

NOT FOR BIDDING

E. Openings required by any Trade Contractor in new construction shall be coordinated with the Trade Contractor(s) performing adjacent work.

1.12 PENETRATIONS

A. Each Trade Contractor shall be responsible to seal his own penetrations in walls, floors, and ceilings, using fire resistant materials, as required.

B. All roofing work shall be performed by the Roofing Trade Contractor, including patching penetrations made by the other Trade Contractors. Unless assigned specifically in section 011100 the cutting of roof openings, structural reinforcement, roof curbs, and counter flashing, shall be provided and installed by each Trade Contractor whose work penetrates the roofing surface, including all additional blocking associated with penetration.

1.13 FIREPROOF REPAIR

A. Existing and new spray-on fireproofing which is damaged by Trade Contractors shall be repaired by the Trade Contractor who caused the damage. The repair work shall be performed by tradesman qualified and certified to perform the repair.

1.14 EQUIPMENT FOUNDATIONS

B. The Concrete Work Trade Contractor shall provide all interior foundations and housekeeping pads indicated on the Contract Documents. The Sitework Concrete Contractor shall place all exterior equipment foundations and housekeeping pads indicated on the Contract Documents. All other foundations, equipment, and housekeeping pads not shown, but required, shall be by the Trade Contractor requiring the same.

C. Each Trade Contractor shall furnish anchor bolts and other accessories required to anchor his equipment in place, together with instructions regarding their placement and location in the foundation. Anchor bolts and other accessories shall be furnished promptly in accordance with the established construction schedule so that they may be built-in as construction progresses.

1.15 CUTTING AND PATCHING

A. Responsibility: A Trade Contractor requiring the cutting of openings in new work, or in the existing work installed by others shall have such openings cut and patched by the trade which installed the original work and such cutting and patching shall be at the expense of the Trade Contractor requiring the opening.

B. Approval: Approval to do such cutting and patching shall be received from the Architect through the Construction Manager prior to proceeding with the work. Approval of any structural cutting must be received from the structural engineer and architect before proceeding.

C. Inspection:

1. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
2. After uncovering, inspect conditions affecting performance of work.
3. If, in the course of cutting and patching the existing building for alteration work, a material is

NOT FOR BIDDING

uncovered which appears to contain asbestos, the Contractor shall immediately notify the Construction Manager. Contractors shall perform other construction activities until the area in question can be cleared.

D. Preparation:

1. Provide supports to assure structural integrity of surroundings, devices, and methods, to protect other portions of Project from damage.
2. Provide protection from elements for areas which may be exposed by uncovering work.

E. Performance:

1. Execute work by methods to avoid damage to other work and which provide proper surfaces to receive patching and finishing.
2. Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements and sight-exposed surfaces.
3. Restore work with new products in accordance with requirements of Contract Documents.
4. Fit work tightly to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
5. At penetrations of fire-rated wall, ceiling or floor construction, completely seal voids with fire-resistant materials as required to achieve fire-rating indicated.
6. Where fire protection materials are damaged or removed, reapply fire protection materials to achieve a rating equivalent to existing construction or as noted.
7. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

1.16 ACCESS DOOR AND PANELS

A. Access doors and panels, shown on architectural drawings, shall be furnished and installed by each Trade's Contractor whose product needs to be accessible.

B. Access doors and panels shall be furnished by the trade contractor requiring access and delivered to the Drywall and Metal Studs Trade Contractor for installation.

1.17 FINAL CLEANING

A. Trade Cleaning: Each contractor is responsible for final cleaning their own work as outlined in Section 011100 - Summary of Work. This initial cleaning must be completed before requesting inspection for Certification of Substantial Completion. This cleaning shall include, but not be limited to:

1. Clean surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned. Comply with Product manufacturer instruction and recommendations.
3. Within limits of Contract, clean site, sweep paved areas, rake clean landscaped surfaces.
4. Provide additional cleaning as required within individual Specification sections.
5. Remove waste and surplus materials, rubbish and construction facilities from the site. Dispose of in a legal manner.
6. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective

NOT FOR BIDDING

condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.

7. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
8. Wipe down all walls, equipment, fixtures, casework and shelving to a dust-free sanitary condition.
9. Sweep, vacuum and mop all floors.
10. Clean all windows, glass and glazing.

1.18 TOUCH-UP PAINTING

A. The Caulking and Painting Contractor shall coordinate and schedule his final coat as directed by the Construction Manager to reduce the amount of touch-up painting required.

B. After the final coat has been applied, all touch-up paint and patching required to repair damage caused by other trade shall be reviewed by the Construction Manager and paid for from the construction contingency or back charged to the Trade Contractor who the Construction Manager determines is responsible.

1.19 STARTERS AND DISCONNECTS

A. The Electrical Contractor shall furnish and install starters, power and starter control wiring per the electrical drawings and the specifications. The Electrical Contractor shall furnish and install starters in the motor control center.

B. Individual starters and disconnects shown on other drawings and specifications shall be furnished by that Trade Contractor and will be installed and connected by the Electrical Contractor.

NOT FOR BIDDING

END OF SECTION 011200

SECTION 011216 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Products and installation for patching and extending work.

B. Transition and adjustments.

C. Repair of damaged surfaces, finishes, and cleaning.

1.2RELATED SECTIONS

A. Section 013100 – Project Management and Coordination: Work sequence, owner occupancy, maintenance of utility services.

B. Section 017329 - Cutting and Patching: Cutting and patching.

C. Section 015000 – Temporary Construction Facilities and Temporary Controls: Temporary enclosures, protection of installed work, and cleaning during construction.

D. Section 024119 – Selective Demolition

NOT FOR BIDDING

PART 2 - PRODUCTS

2.1 PRODUCTS FOR PATCHING AND EXTENDING WORK

A. New Materials: As specified in product sections; match existing Products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing Products where necessary, referring to existing Work as a standard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that demolition is complete and areas are ready for installation of new Work.

B. Beginning of restoration Work means acceptance of existing conditions.

3.2 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and

deteriorated masonry and concrete. Replace materials as specified for finished Work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Prepare surface and remove surface finishes to provide for proper installation of new work and finishes.

E. Close openings in exterior surfaces to protect existing work and salvage items indicated from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

3.3 INSTALLATION

A. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate Owner occupancy.

B. Remove, cut and patch work in a manner to minimize damage and to provide a means of restoring Products and finishes to original condition in accordance with Section 024500.

C. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes in accordance with Section 024500.

D. Project, Designated Areas, Rooms and Spaces, and Finishes: Complete including operational mechanical and electrical work.

E. In addition to specified replacement of equipment and fixtures, restore existing plumbing, heating, ventilation, air conditioning, electrical, and other systems to full operational condition.

F. Re-cover and refinish work that exposes mechanical and electrical work exposed accidentally during the work.

G. Install Products as specified in individual sections.

NOT FOR BIDDING

3.4 TRANSITIONS

A. Where new work abuts or aligns with existing, perform a smooth and even transition. Patch Work to match existing adjacent work in texture and appearance.

B. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect/Engineer.

3.5 ADJUSTMENTS

A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

B. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a

smooth transition for Architect/Engineer review.

C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.

D. Fit work at penetrations of surfaces as specified in Section 01045.

3.6 REPAIR OF DAMAGED SURFACES

A. Patch or replace portions or existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

B. Repair substrate prior to patching finish.

3.7 FINISHES

A. Finish surfaces as specified in individual Product sections.

B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.8 CLEANING

A. In addition to cleaning specified in Section 015000, clean Owner occupied areas of work.

END OF SECTION 011216

NOT FOR BIDDING

SECTION 011400 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy of site.

2. 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.

1.3 OCCUPANCY REQUIREMENTS

A. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011400

NOT FOR BIDDING

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment criteria applicable to portions of the Work performed under a unit price payment method.

B. Defect assessment and non-payment for rejected work.

1.2 AUTHORITY

A. Measurement methods delineated in the individual specification sections complement the criteria of this section.

B. Take all measurements and compute quantities. The Construction Manager will verify measurements and quantities.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

1.3 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form as defined in individual Specification sections are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Construction Manager shall determine payment.

B. If the actual Work requires more or fewer quantities than those quantities indicated, provide the required quantities at the unit sum/prices contracted.

C. If the actual Work requires a 10 percent or greater change in quantity than those quantities indicated, the Owner may claim for a Contract Price adjustment.

1.4 MEASUREMENT OF QUANTITIES

A. Measurement Devices:

1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
3. Metering Devices: Inspected, tested and certified by the applicable State department within the past year.

B. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.

C. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

NOT FOR BIDDING

D. Measurement by Area: Measured by square dimension using mean length and width or radius.

E. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

F. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

1.5 PAYMENT

A. Payment Includes: Full compensation for all required labor, Products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item or the Work; overhead and profit.

B. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the Architect/Engineer multiplied by the unit sum/price for Work which is incorporated in or made necessary by the Work.

1.6 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Architect, it is not practical to remove and replace the Work, the Architect will direct one of the following remedies:

1. The defective Work may remain, but the unit sum/price will be adjusted to a new sum/price at the discretion of the Architect.
2. The defective Work will be partially repaired to the instructions of the Architect, and the unit sum/price will be adjusted to a new sum/price at the discretion of the Architect.

C. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.

D. The authority of the Architect to assess the defect and identify payment adjustment is final.

1.7 NON-PAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.

NOT FOR BIDDING

1.8 SCHEDULE OF UNIT PRICES

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 012000

NOT FOR BIDDING

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements due to unknown conditions or to defer selection of actual materials and equipment and/or installation to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.
5. Testing and inspecting allowances.

C. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
2. Division 1 Section "Unit Prices" for procedures for using unit prices.
3. Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
4. Divisions 2 through 35 Sections for items of Work covered by allowances.

NOT FOR BIDDING

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

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

1.6 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials selected by Architect or specified herein and shall include taxes, freight, and delivery to Project site.

B. Related costs for Supervision, field operation and temporary facilities; general overhead; profit; bond premiums; and taxes. costs are part of the Contract Sum.

1.7 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.8 UNUSED MATERIALS

A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

NOT FOR BIDDING

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Include the lump sum of following amount $10,000 in the contract for cold weather protection of concrete work. Cost of work to be determined on a time and material basis.

B. Allowance No. 2: Include the lump sum of following amount $10,000 in the contract for cold weather protection of masonry work. Cost of work to be determined on a time and material basis.

C. Allowance No. 3: Include the lump sum of the following amount $50,000in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

D. Allowance No. 5: Include the lump sum of following amount $20,000 in the contract for temp. heat fuel cost. Cost of work to be determined by fuel company receipts with the amount of fuel and cost per gallon. All equipment and labor for temp heat is part of the contract. This allowance is for fuel cost only.

E. Allowance No. 6: Include the lump sum of following amount $20,000 in the contract for electrical gear revisions resulting from the short circuit analysis specified in Section 260573 “Power Systems Studies”. This allowance includes material cost, receiving, handling, installation and Contractor overhead and profit.

END OF SECTION 012100

NOT FOR BIDDING

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:

1. Division 1 Section "Allowances" for procedures for using unit prices to adjust quantity allowances.
2. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Unit price is **an amount proposed by bidders, stated on the Bid Form, as** a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased. **Owner reserves the right to reject unit prices submitted with bid deemed unreasonable.**

B. Unit prices include necessary material, overhead, profit and applicable taxes.

C. Unit price shall include all costs related or required for the complete installation, including the cost of material and delivery; installation labor including fringe benefits, insurance, social security, workmens' compensation; rental value of equipment and machinery; incidental expense, supervision, field operation and temporary facilities; general overhead; profit; bond premiums; and taxes.

D. Material only unit price shall include the cost of material and shipping. All other Contractor's costs including storage, handling, labor; equipment and machinery; supervision; temporary facilities; general overhead; profit; bond premiums; and taxes shall be included in the contract sum and not the allowance.

E. Refer to individual Sections for construction activities requiring establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

NOT FOR BIDDING

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, **applicable taxes,** overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A **"Unit Price Schedule"** is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials and methods described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 LIST OF UNIT PRICES

END OF SECTION 012200

NOT FOR BIDDING

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
2. Include as part of each alternate all costs of related coordination, modification or adjustment.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

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

NOT FOR BIDDING

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

NONE USED

END OF SECTION 012300

NOT FOR BIDDING

SECTION 012500 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1. Multiple Prime Contracts: Provisions of this Section apply to the construction activities of each prime contractor.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
2. Division 1 Section "Submittals" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.
3. Division 1 Section "Materials and Equipment" specifies requirements governing the Contractor's selection of products and product options.

NOT FOR BIDDING

1.3 DEFINITIONS

A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:

1. Substitutions requested during the bidding period, and accepted by Addendum prior to award of the Contract, are included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
2. Revisions to the Contract Documents requested by the Owner or Architect.
3. Specified options of products and construction methods included in the Contract Documents.
4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

A. Substitution Request Submittal: The Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received more than 60 days after commencement of the Work may be considered or rejected at the discretion of the Architect.

1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for change-order proposals.
2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

    a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors that will be necessary to accommodate the proposed substitution.
    b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
    c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
    d. Samples, where applicable or requested.
    e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
    f. Cost information, including a proposal of the net change, if any in the Contract Sum.
    g. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
    h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

4. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Architect will notify the Contractor of acceptance or rejection of the substitution within 2 weeks of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a change order.

    a. Use the product specified if the Architect cannot make a decision on the use of a proposed substitute within the time allocated.

NOT FOR BIDDING

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Architect will receive and consider the Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by the Architect. If the following conditions are not satisfied, the Architect will return the requests without action except to record noncompliance with these requirements.

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents.
3. The request is timely, fully documented, and properly submitted.
4. The specified product or method of construction cannot be provided within the Contract Time. The Architect will not consider the request if the product or method cannot be provided as a result of

failure to pursue the Work promptly or coordinate activities properly.

5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.

6. The requested substitution offers the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner's additional responsibilities may include compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner, and similar considerations.
7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.
9. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.
10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
11. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of products.

B. The Contractor's submittal and the Architect's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 012500

NOT FOR BIDDING

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signature: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments:

NOT FOR BIDDING

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

B. Related Sections include the following:

1. Division 1 Section "Unit Prices" for administrative requirements for using unit prices.
2. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect or Construction Manager 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."

1.4 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 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.

NOT FOR BIDDING

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.

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 an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

NOT FOR BIDDING

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections include the following:

1. Division 1 Section "Unit Prices" for administrative requirements governing use of unit prices.
2. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 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 the following:

a. Application for Payment forms with Continuation Sheets.
b. Submittals Schedule.

2. Submit the Schedule of Values to Architect through the construction manager at earliest possible date but no later than 14 days before the date scheduled for submittal of initial Applications for 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.

NOT FOR BIDDING

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.

        1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

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.

    a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

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.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.

    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702/CMa 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. Construction Manager 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.

NOT FOR BIDDING

2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 4 signed and notarized original copies of each Application for Payment to Construction Manager 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 liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested, before 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 Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.

    a. Submit final Application for Payment with or proceeded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

5. Waiver Forms: Submit 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. Products list.
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.

NOT FOR BIDDING

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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

NOT FOR BIDDING

SECTION 012973 – SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-0 Specification Sections, apply to this section.

1.2 CONTRACT SUM BREAKDOWN

A. Within ten (10) days of receipt of Contract, each Trade Contractor shall submit to the Construction Manager for review a Contract Sum Breakdown, the total of which shall be equal to the initial contract sum.

B. The General Trade Contractor shall list quantities and unit prices that correspond to the activities he is responsible for. All unit prices should include labor, tools, equipment, overhead, and profit required to perform a complete installation.

1.3 FORM AND CONTENT

A. The breakdown shall be prepared on the forms provided with this Section. The schedule shall also indicate:

1. Title of project and location
2. Architect's name
3. Name and address of Contractor
4. Date of submission

B. Provide a separate line item for General Conditions which would include home office support, bonds, insurance premiums, mobilization, field supervision, temporary construction utilities, facilities, and controls.

1. Contractor must include line item amounts for General Condition Requirements as follows:

Submittals
Progress Meetings
Clean up
Progress Schedule Development
Coordination Drawing
Project Record Drawings

2. Breakdown of major construction activities shall be submitted per building wing, per floor, separating labor and material values.

END OF SECTION 012973

NOT FOR BIDDING

SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Coordination.
B. Field engineering.
C. Preconstruction meeting.
D. Site mobilization meeting.
E. Progress meetings.
F. Preinstallation meetings.
G. Examination.
H. Preparation.

1.2 RELATED SECTIONS

A. Section 011200 – Multiple Contract Summary
B. Section 013113 –Project Coordination
C. Section 017329 – Cutting and Patching

1.3 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify utility requirements and characteristics of operating equipment are compatible with utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean up of work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

F. After Owner occupancy, co-ordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.4 FIELD ENGINEERING

A. Contractor to locate and protect survey control and reference points.

B. Control datum for survey is that established by Owner and shown on drawings.

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C. Verify set-backs and easements, confirm drawing dimensions and elevations.

D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

1.5 PRECONSTRUCTION MEETING

A. Construction Manager will schedule a meeting after Notice of Award.

B. Attendance Required: Owner, Architect/Engineer, Contractors.

C. Agenda:

1. Submission of executed bonds and insurance certificates.
2. Distribution of Contract Documents.
3. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule not previously required.
4. Designation of personnel representing the parties in contract, Architect and other Consultants.
5. Procedures and processing of field decisions, submittals, substitutions, Applications for Payments.
6. Scheduling.
7. Scheduling activities of inspection and testing service.

D. Construction Manager will record minutes and distribute copies within two days after meeting to participants, with copies to those affected by decisions made.

1.6 SITE MOBILIZATION MEETING

A. Construction Manager shall schedule a meeting at the project site prior to Contractor occupancy.

B. Attendance Required: Owner, Architect/Engineer, Special Consultants, Contractor, Contractors Superintendent, major Subcontractors, and other parties as required.

C. Agenda:

1. Use of premises by Owner and Contractor.
2. Owner’s requirements and occupancy.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and layout.
6. Security and housekeeping procedures.
7. Schedules.
8. Procedures for testing.
9. Procedures for maintaining record documents.
10. Requirements for start-up of equipment.
11. Inspection and acceptance of equipment put into service during construction period.

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D. Construction Manager shall record minutes and distribute copies within two days after meeting to participants, with copies to Architect/Engineer, Owner, participants, and those affected by decisions made.

1.7 PROGRESS MEETINGS

A. Construction Manger shall schedule and administer meetings throughout progress of the work at weekly intervals unless otherwise required by the work.

B. Construction Manger shall make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Job superintendents, Prime Trade Contractors, Owner, Architect/Engineer, Special Consultants as required and parties as appropriate to agenda topics for each meeting.

D. Agenda

1. Review minutes of previous meetings.
2. Review work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Current safety changes.
14. Other business relating to Work.

E. Construction Manager shall record minutes and distribute copies within two days after meeting to participants, with copies to Architect / Engineer, Owner, participants, and those affected by decisions made.

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1.8 PREINSTALLATION MEETING

A. When required in individual specification sections, the respective Contractor shall convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting or affected by, work of the specific section.

C. Notify Architect, Owner and Construction Manager four days in advance of meeting date.

D. Contractor shall prepare agenda and preside at meeting:

1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within five days after meeting to participants, with copies to Architect, Owner, Construction Manager, participants, and those affected by decisions made.

1.9 ADDITIONAL MEETING

A. The Construction Manager may conduct additional meetings as required by the Project conditions or changes. All contractors must attend these meetings at no additional cost to the Owner.

B. Daily Coordination meeting of approximately 15 minute duration will be conducted by the Construction Manager for all Contractor's superintendents on site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specifications sections.

D. Verify that utility services are available, of the correct characteristics, and in the correct location.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply any manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

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END OF SECTION 013100

SECTION 013113- PROJECT COORDINATION

PART I - GENERAL

1.1 SECTION INCLUDES

A. Project coordination by the Project Coordinator.
B. Construction Mobilization.
C. Schedules.
D. Submittals.
E. Coordination drawings.
F. Closeout procedures.

1.2 RELATED SECTIONS

A. Document 007226- General Conditions – AIA G232-2009 CMA: Duties of the Construction Manager.

B. Document 007300- Supplementary Conditions of the Contract.

C. Section 011100 - Summary of Work: Work covered by each Contract. Work sequence. Owner occupancy.

D. Section 013100 – Project Management and Coordination: Project meetings. Pre-construction Meetings. Progress meetings.

F. Section 013300 - Submittals: Submittal procedures.

F. Section 017700- Contract Closeout: Contract Closeout Procedures.

1.3 PROJECT COORDINATOR

A. Project Coordinator: Construction Manager.

1.4 CONSTRUCTION MOBILIZATION

A. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field office and
sheds, for construction and Owner access, traffic, and parking facilities.

B. During construction, coordinate use of site and facilities through the Project Coordinator.

C. Comply with Project Coordinator's procedures for intraproject communications; submittals, reports and records, schedules, coordination drawings and recommendations; and resolution of ambiguities and conflicts.

D. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities.

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F. Coordinate field engineering and layout work under instructions of the Project Coordinator.

1.5 SCHEDULES

A. Submit preliminary manpower loaded bar chart schedule in accordance with Section 01310.

B. After review, revise and resubmit schedule to comply with revised Project schedule.

C. During progress of work, revise and resubmit with Applications for Payment or as directed.

1.6 SUBMITTALS

A. Provide submittals to Project Coordinator for review and transmittal to Architect / Engineer.

B. Submit requests for interpretation of Contact Documents, and obtain instructions through the Project Coordinator.

C. Process requests for substitutions, and change orders, through the Project Coordinator.

D. Deliver closeout submittals for review and preliminary inspection reports, for transmittal to

I .7 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Systems Coordination Drawings are required from the Mechanical, Electrical, Plumbing and General
Trade Contractors with the lead role assigned to the Mechanical Trade Contractor.

C. The Mechanical Trade Contractor shall prepare 1/4” = 1 ft. scale Reproducible Systems Drawings for all areas with piping and ductwork. Drawings to indicate spatial relationship HVAC piping and ductwork.

D. The Mechanical Trade Contractor shall prepare and submit to the Construction Manager a regularly updated schedule indicating the development and review of these drawings with other Trade Contractors. The drawing development and review schedule must follow the project construction schedule.

E. The Mechanical Trade Contactor shall provide the Reproducible Systems Coordination the other Trade Contractors for their input and review. The routing is as follows: HVAC Ductwork / Piping, Plumbing, General Trades with the drawings being reamed to be Contractor.

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F. Each Trade Contractor will add the work of his Contract on the Systems Coordination Drawings to -avoid interferences. All piping, equipment, light fixtures and in-ceiling equipment, such as rolling gates, must be shown on these drawings to include elevations and dimensions.

G. Prior to forwarding the Systems Coordination Drawings to the next Trade Contractor, an approval stamp, initialed and dated, should be affixed by the reviewing Trade Contractor. This approval by the reviewing Trade Contractor will install his work accordingly.

H. During the Systems Coordination Drawing process, the Construction Manager will conduct regularly scheduled meetings. Each Trade Contractor is required to attend these meetings. The Construction Manager is responsible for recording and distributing meting minutes to all Trade Contractors and the Architect / Engineer. The purpose of the meetings will be to review and discuss interferences and conflicts as well as any modifications to the Systems Coordination Drawings, All resolutions of interferences and conflicts which required modifications shall be initiated by the appropriate Trade Contractors on the Systems Coordination Drawings. At each meeting, the General Trade Contractors will review and update the Systems Coordination Drawing Schedule.

I. Once reviewed and approved by each General Trade Contractor, the Mechanical Trade Contract will prepare the Final Reproducible Systems Coordination Drawings with the work of all trades included. Submit the Reproducible Drawings along with two (2) prints to the Construction Manager who will forward to the Architect for his review.

J. The Mechanical Trade Contractor shall indicate any unresolved conflicts or interferences on the Systems Coordination Drawings. Those should be delineated by clouding, numbering and referencing to he affected contract drawings,

K. Review drawings prior to submission to Architect / Engineer.

L. The Architect will review and return drawings to the Construction Manager. The Construction Manager will distribute the number of drawings to the Trade Contractors for installation of their work.

M. The Systems Coordination Drawings DO NOT REPLACE any fabrication and layout drawings required by individual Specification Sections.

1.8 CLOSEOUT PROCEDURES

A. Notify Project Coordinator when work is considered ready for Substantial Completion. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in Contractors Notice of Substantial Completion.

B. Comply with Project Coordinator’s instructions to correct items of work listed in executed Certificates of Substantial Completion and for access to Owner occupied areas.

C. Notify Project Coordinator when Work is considered finally complete. Accompany

NOT FOR BIDDING

Project Coordinator on preliminary final inspection.

D. Comply with Project Coordinators instructions for completion of items of Work determined by Architect / Engineers final inspection.

PART 2 - PRODUCTS – (NOT USED)

PARTS - EXECUTION— (NOT USED)

END OP SECTION 013113

NOT FOR BIDDING

SECTION 013216 - CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Scheduling requirements and coordination.

B. Construction Phasing Plans

C. Construction Milestone Schedules (by Phase and by Trade)

1.2 RELATED DOCUMENTS

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

1.3 DEFINITIONS

A. Activity: An activity is any single identifiable step in the Project. It depends upon preceding and succeeding activities.

1.4 CONSTRUCTION SCHEDULE

A. The Construction Schedule, as reviewed by the Construction Manager and Owner, will be an integral part of the Contract, and will establish interim work completion dates for the various activities. Each Trade Contractor shall be responsible to achieve Starting Dates, Milestones or Target Dates, and Completion Dates established for each Phase of the overall Project.

B. The Construction Schedule may vary in accordance with construction conditions. Each Contractor shall delay or expedite material and equipment deliveries, and modify the required labor forces to accommodate these varying conditions.

C. This is a phased project. Multiple trips may be required to complete this Project.

D. Within fifteen (15) days after receipt of Notice of Intent to Award, each Contractor shall submit a preliminary Construction Schedule, in accordance with the milestone construction schedule included in these documents under the summary of work, to the Construction Manager. The schedule will include breakdowns of total man days of field labor into major categories of work, time estimates of various categories of work, crew size for each category, and quantity and type of equipment to be utilized.

E. Each Contractor shall provide to the Construction Manager a separate list of critical submittal dates for Shop Drawings, Product Data, and Samples, indicating delivery dates/lead times that may impact the construction schedule or completion of the Work. The critical submittal list shall accompany the Preliminary Submittal List as identified in Section 013300 - Submittals.

NOT FOR BIDDING

F. Each Contractor shall organize his Construction Schedule per Phase, Building, Wing, Floor, and Area as required by the Construction Manager.

G. The Construction Manager shall schedule a meeting with the Contractors, to review the contents of each Contractor's preliminary Construction Schedule, review the sequence of Work, and make all revisions required. The Construction manager shall have the final authority concerning the sequence of Work and durations of each activity. Each Contractor shall revise his schedule in accordance with that meeting and submit his schedule to the Construction Manager for review. The Construction Manager will then develop the Project Construction Schedule. Each Contractor shall schedule and perform his work in compliance with the Construction Manager's Project Construction Schedule.

H. The Schedule shall be the basis for the dates to start and complete Work for the various portions of each Contract, and to complete Work (including changes) for the Project. IT shall be the duty of the Contractor to conform to the current Schedule and to arrange his work in such a manner that it will be installed in accordance with the Schedule.

I. Each Contractor shall submit two (2) copies of a monthly updated Construction Schedule comparing the original schedule to actual work in progress and project work along with the Application for Payment.

J. As required, a representative of each Contractor shall meet with the Construction Manager and furnish to him information necessary for such re-evaluating and updating of the Project schedule. Information with regard to changes in the work and the Contractor's proposed effort to overcome any delays incurred shall be provided (in writing) to the Construction Manager.

K. Two (2) days after the Contractor has failed to Start on Schedule, Meet Assigned Milestone or Target Dates, or Completion of items such as Shop Drawing Submissions, Material - Equipment Deliveries, or Tasks according to the Master Construction Schedule or Revised Master Construction Schedule, the Construction Manager will forward a letter of Non-Conformance, via Facsimile Transmission and/or forward a letter of Non-Conformance, via Facsimile Transmission and/or Express Mail, to the Contractor and a copy to the Owner. Upon receipt of this notice, the Contractor is required to execute whatever measures as so directed by the Contract Manager including, but not specifically, assigning additional labor, shifts, overtime, materials, expediting of submittals or deliveries, equipment, scaffold, or any combination of these as deemed appropriate and necessary by the Construction Manager to return the above referenced activities back on schedule, without additional compensation to the Contractor.

L. Costs incurred by the Construction Manager in connection with maintaining the Construction Schedule, caused by the Contractor's noncompliance with the scheduling requirements, shall be reimbursed to the Construction Manager by the Contractor.

M. It is expressly understood and agreed that failure by the Construction Manager to exercise the option to either order the Contractor to expedite work, or to expedite the work by other means, shall not be considered precedent-setting for any other activities.

NOT FOR BIDDING

1.5 SCHEDULE COMPUTERIZATION

A. All Trade Contractors shall provide all their scheduling information via a computer assisted scheduling program, acceptable to the Construction Manager. Format to be Bar Chart.

B. All schedule information and updates for the above Contractors shall be provided to the Construction Manager on 3.5" diskettes in format and density as required.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

PART 4 – SCHEDULE

Construction starts June 2026. Project has to be finished by May 2027
Please provide sufficient manpower in your cost to meet the completion date of May 2027

END OF SECTION 013216

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SECTION 013233 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Field condition reports.
6. Special reports.
7. Construction photographs.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

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1.3 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 is an activity that must be completed before a given activity can be started.

B. Event: The starting or ending point of an activity.

C. 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.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

D. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

E. Major Area: A story of construction, a separate building, or a similar significant construction element.

F. Milestone: A key or critical point in time for reference or measurement.

G. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article and in-house scheduling personnel to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. 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 and Construction Manager’s final release or approval.

C. Preliminary Construction Schedule: Submit three printed copies.

D. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.

E. Daily Construction Reports: Submit two copies at weekly intervals.

F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

G. Special Reports: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting.

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B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations, content, and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing, work stages, area separations, and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for completion and startup procedures.
9. Review and finalize list of construction activities to be included in schedule.
10. Review submittal requirements and procedures.
11. Review procedures for updating schedule.

1.6 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.

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

D. Each trade contractor is to submit preliminary manpower loaded bar chart schedule in accordance with section 013100.

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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. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead-time for manufacture or fabrication.

    a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. 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.

C. 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 120 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than 7 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect and Construction Manager's administrative procedures necessary for certification of Substantial Completion.

D. 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. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

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4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Startup and placement into final use and operation.

5. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Permanent space enclosure.
    c. Completion of mechanical installation.
    d. Completion of electrical installation.
    e. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.

G. 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.

H. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within 14 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60

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days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the 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.

2.5 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Meter readings and similar recordings.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Construction Change Directives received.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial Completions and occupancies.
17. Substantial Completions authorized.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report.

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List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 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.
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 013233

NOT FOR BIDDING

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting Applications for Payment.
2. Division 1 Section "Project Coordination" for submitting Coordination Drawings.
3. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
4. Division 1 Section "Quality Control" for submitting test and inspection reports and Delegated-Design Submittals.
5. Division 1 Section "Closeout Procedures" for submitting warranties Project Record Documents and operation and maintenance manuals.
6. Division 1 Section "Closeout Procedures" for submitting Record Drawings, Record Specifications, Record Product Data, and operation and maintenance manual requirements.
7. Division 1 Section "Substitutions for submitting products substitutions during bidding and after Award of Contract.

NOT FOR BIDDING

1.3 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 approval. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. General: **Upon request,** Architect will provide electronic copies of CAD Drawings of the Contract Drawings for Contractor's use in preparing submittals. **Contractor shall sign a release form provided by the Architect and payment of $200 processing fee for each consultant's CADD files. Only plan drawings and backgrounds to be provided**

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. 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. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
3. **All submittals by suppliers and fabricators shall be reviewed by Installing Contractor for compliance and coordination with other work prior to submission to the architect. Contractor's failure to review shop drawings and product data will be cause for rejection.**

C. Submittals Schedule: Comply with requirements in Division 1 Sections "Construction Progress Documentation" and "Construction Schedules" for list of submittals and time requirements for scheduled performance of related construction activities.

D. 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.

1. Initial Review: Allow not less than 15 working days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow not less than 21 working days for initial review of each submittal.

3. If intermediate submittal is necessary, process it in same manner as initial submittal.

4. Allow 15 working days for processing each re-submittal.

5. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

6. All contractors to provide all submittals and color samples to the Construction Manager within 45 days of your contract date. Any rejected submittals to be resubmitted within 15 days. A penalty of $100.00 per calendar day will be accessed for late submittals and color samples.

E. 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 4 by 5 inches (100 by 125 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:

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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 tracking number based on specification section
i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Other necessary identification.

F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.

G. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, received from sources other than Contractor.

1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
3. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Submittal tracking number based on specification section
g. Category and type of submittal.
h. Submittal purpose and description.
i. Submittal and transmittal distribution record.
j. Remarks.
k. Signature of transmitter.

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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 action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Number of Copies: Submit number of copies requested but not less than seven copies of each submittal, unless otherwise indicated. Architect will return two copies plus copies for maintenance binders. Mark up and retain one returned copy as a Project Record Document.

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. Standard color charts.
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Printed performance curves.
h. Operational range diagrams.
i. Mill reports.
j. Standard product operating and maintenance manuals.
k. Compliance with recognized trade association standards.
l. Compliance with recognized testing agency standards.
m. Application of testing agency labels and seals.
n. Notation of coordination requirements.

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: Include the following information, as applicable:

a. Dimensions.
b. Identification of products.

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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. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.

2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 42 inches (750 by 1000 mm).

D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."

E. Samples: Prepare physical units of materials or products, including the following:

1. Comply with requirements in Division 1 Section "Quality Requirements" for mockups.
2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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.
3. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:

a. Generic description of Sample.
b. Product name or name of manufacturer.
c. Sample source
d. Project Name
e. Date.

4. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.

a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.

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b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

5. Number of Samples for Verification: Submit minimum three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.

a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

F. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.
2. Number and name of room or space.
3. Location within room or space.
4. Project identification as described in submittal procedures above.

G. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Project identification as described in submittal procedures above.

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

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signed by an officer or other individual authorized to sign documents on behalf of that entity.

3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."

B. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."

C. 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.

D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. 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 and, where required, is authorized for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

I. 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.

J. 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.

K. 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.

L. 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.

M. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by

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manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

N. 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. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures Operation and Maintenance Data."

P. 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.

Q. 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. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

R. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

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S. 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.

T. Within 15 working days of award of contract and notice to proceed each prime the contractor shall provide written confirmation that Contractor shall comply with requirements contained herein. Architect of record shall then provide (1) six pack of beer as selected by the contractor.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check 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.

C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 013300

NOT FOR BIDDING

SECTION 013319 FIELD ENGINEERING

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work on this section.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

C. Delaware Department of Transportation Specifications for Road and Bridge Construction, August 2001 and as amended.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Stormwater Regulations.

1. 2 SUMMARY

Work included: Provided at the Contractor's expense, such field engineering services as are required for proper completion of the Work including, but not necessarily limited to:

A. The Contractor shall be responsible for all stakeouts and elevation checks required for construction. All such Work shall be performed by a professional land surveyor. The surveyor shall verify adequacy of benchmarks before starting construction.

B. Before the start of any building construction, the Contractor shall have a professional land surveyor locate and stake building corners, driveway entrances, driveways, parking areas and playfields. If there are any discrepancies between the actual layout and the project site plan, they shall be brought to the attention of the Architect and resolved before Work proceeds. A building and site stake out drawing stamped and signed by a professional land surveyor may be submitted in lieu of this preliminary stake out.

C. After the corners of the exterior walls have been started, the Contractor shall obtain a wall check survey certificate made by a professional land surveyor. This survey shall show the accurate location of the building with reference to property lines.

D. After the first sections of slab-on-grade have been placed in the building, the Contractor shall have a professional land surveyor verify and record the finish floor elevations on the wall check survey.

E. At the end of the project, the Contractor shall have a professional land surveyor prepare and certify an as-built survey showing the accurate horizontal and vertical locations of all building corners, paved areas, sidewalks, utilities (including inverts), fencing, site walls, etc. located within the project area.

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F. As-Built survey shall be included in a standard C.A.D. format such as AutoCad and/or MicroStation and shall include 2-foot contours within the project limits.

G. A complete stormwater management as-built shall also be completed in accordance with DNREC's Standard Stormwater Management checklist. The Contractor's shall have a professional land surveyor prepare and certify an interim and final as-built, and the testing and inspection agent shall have a professional engineer certify the construction checklist at the interim and final stages of stormwater management facility construction.

H. The contractor will be responsible for preparing and submitting to the project engineer five (5) copies of the interim and final stormwater management facility as-built, and additional facility information in accordance with the requirements set forth by DNREC.

1.3 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

B. Additional requirements for field engineering also may be described in other Sections of these Specifications.

1.4 QUALITY ASSURANCE

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

1.5 SUBMITTALS

A. Comply with pertinent provisions of Section 013300-Submittals.

B. Upon request of the Architect, submit;

1. Data demonstrating qualifications of persons proposed to be engaged for field engineering services.

2. Documentation verifying accuracy of field engineering work.

3. Certifications, signed by the Contractor's retained field engineer, certifying that elevations and locations of improvements are in conformance with requirements of the Contract Documents.

4. All certifications and surveys described in the Summary section of this specification.

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1.6 PROCEDURES

A. In addition to procedures directed by the Contractor for the proper performance of the Contractor's responsibilities:

1. Locate and protect control points before starting Work on the site.

2. Preserve permanent reference points during process of the Work.

3. Do not change or relocate reference points or items of the Work without specific approval from the Architect.

4. Promptly advise the Architect when a reference point is lost or destroyed, or requires relations because of other changes in the Work.

a) Upon direction of the Architect, require the field engineer to replace reference stakes or markers.

b) Locate such replacements according to the original survey control.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

Not Applicable

END OF SECTION 013319

NOT FOR BIDDING

SECTION 013500 - SAFETY

1.1 SAFETY REQUIREMENTS

A. All work shall be performed in accordance with rules, regulations, procedures and safe practices and/or OSHA and all other Government agencies having jurisdiction over the project.

1.2 SAFETY PRECAUTIONS AND PROGRAMS:

A. Each Contractor shall be responsible for initiating, maintaining and supervising safety precautions and programs in connection with the work. The name of the safety officer for each contractor shall be provided to the Construction Manager.

B. All Contractors shall comply with the provisions of the "Occupational Safety and Health Act" and Federal, State and local requirements.

C. If a Contractor fails to maintain the safety precautions required by law or directed by the Construction Manager, the Construction Manager may take such action as necessary and charge the Contractor therefore. The failure of the Construction Manager to take any such action shall not relieve the Contractor of his obligations.

D. The Contractor individually shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods and for any damage which may result from their failure or their improper construction, maintenance or operation.

E. Prior to mobilizing to the job, the Contractor shall submit to the Construction Manager in writing, a description of his safety program for review and comment. Failure of the Construction Manager to make any changes shall not relieve the contractor of his obligations. During the conduct of the work, the Contractor shall immediately notify the Construction Manager in writing of all accidents and shall submit a written report describing in detail the circumstances of each accident within 24 hours of its occurrence.

F. All Contractors shall notify the Construction Manager of any flammable, combustible and/or toxic materials intended for use on the project and shall furnish the Construction Manager with literature pertinent to the use and control of all materials, including, but not limited to M.S.D.S. sheets.

G. Each Contractor shall delegate one representative who shall be responsible to maintain all safety requirements of the Contractor, and shall attend all project meetings scheduled by the Construction Manager.

1.3 SAFETY OF PERSONS AND PROPERTY:

A. The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage or loss to:

1. All Cape Henlopen School District personnel and all other persons who may be affected thereby.

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2. All the work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-Subcontractors.

3. Other property at the site or adjacent thereto, including but not limited to trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction and underground property.

B. The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority, including the Owner's requirements bearing on the Safety of persons or property or their protection from damage, injury or loss.

C. The Contractor shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection, including danger signs and other warnings against hazards. He shall comply with safety regulations and notify the Construction Manager, until he is in compliance.

D. The Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by the Contractor, his Subcontractors, his Sub-Subcontractors, or anyone directly employed by any of them, or by anyone for whose acts any of them be liable.

E. The Contractor shall not load or permit any part of the work to be loaded so as to endanger its integrity and safety.

F. Contractors using a method of blasting to perform work on the project shall use all proper methods, including adequate safety matting and/or overburden, progressive time sequences and scaled distances, in accordance with all governmental regulations.

G. The use of audio equipment and headsets will not be permitted on the construction site.

1.4 PERSONAL PROTECTION REQUIREMENTS

A. All persons entering the project shall wear hard hats in good condition and meet ANSI Z89.1-1981 and ANSI Z89.2-1971. The hats shall be worn in the proper manner.

B. All persons entering the project shall wear proper work boots, clothing attire including long trousers and shirts.

C. All job site personnel are expected to strictly adhere to the following rules and regulations:

1. Use of approved eye protection by all Company personnel shall be required during all types of percussions and reciprocating work or when owner requirements govern.

2. Approved respiratory equipment shall be worn by all personnel exposed to hazardous volumes of toxic or noxious dusts, fumes, mists, or gases. Check

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M.S.D.S. if not sure.

3. Personal protective equipment is to be used under unusual conditions, such as high temperature work, handling caustic or corrosive liquids, or molten metals.

4. When lifting material, keep back straight, bend knees, and lift with your legs. Get help if the load is too heavy.

5. Work clear of suspended loads. If a load is moved above where your are working or walking, stand clear until it has passed.

6. Unless it is part of your regular work, do not attempt to repair or adjust any electrical equipment.

7. Kill any circuit before attempting to work on it. Even voltages lower than 110 will cause death under certain conditions.

8. Treat all electric wires as live. Do not touch exposed wires. Report them immediately to your supervisor.

9. The Contractor is responsible for providing safety training to all of his employees.

10. All shipments to the site shall have the required documentation and labels attached and the documentation and labels shall be maintained while the material is on site.

11. As defined in the occupational Safety & Health Act, safety belts, complete with lanyards, or parachute-style harness, complete with lanyard, are to be used where there is a danger of falling.

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1.5 HOUSEKEEPING

A. Materials and equipment must be piled up or stored in a safe manner. Aisles must be kept clear.

B. All drop cables/extension cords shall be elevated above the ground or protected in such a way to allow traffic to pass.

C. Smoking will only be permitted in designated areas.

D. Consumption of food and beverages in other than Company-designated areas and at specified times.

E. Glass-bottled refreshments will not be allowed in the workplace.

F. Graffiti will not be tolerated on the jobsite.

G. All compressed gas cylinders must be stored in an upright position and tied off with the

cap placed on top.

H. The cords and connections at temporary panels must be maintained in an orderly fashion at all times to prevent tripping.

I. Welding stubs and shells from explosive activated tools shall be collected and properly disposed of by Contractor.

J. Nails are to be bent over and/or removed from wood.

K. Aisles and stairwells as well as base areas of ladders are to be kept clear at all times.

1.6 M.S.D.S.-CONTROLLED PRODUCTS

A. The Contractor is responsible for notifying R.Y. Johnson & Son, Inc of any controlled products that they bring or cause to have brought onto the site. The Contractor shall provide R.Y. Johnson & Son, Inc. with a copy of the Material Safety Data Sheet (M.S.D.S.) for the controlled product, and the Contractor shall retain a copy of the M.S.D.S. on site for their reference. The legal storage, use, and disposal of any controlled product is the responsibility of the Contractor.

B. The Contractor shall comply with OSHA Communications' Standards 29 CFR 1910-1200 for hazardous materials. The Contractor shall maintain a Material Safety Data Sheet on file at the jobsite for each chemical brought to the site. M.S.D.S. sheets shall be submitted to R.Y. Johnson & Son, Inc. for record purposes.

C. Temporary storage of hazardous materials shall be located in containment dikes provided by the Contractor requiring same in area identified by the Construction Manager. All tanks, drums, and containers are to be labeled with appropriate warnings (i.e., flammable, no smoking). Periodic inspections for leakage shall be the responsibility of the Contractor. Final cleanup and removal shall be by the Contractor.

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1.7 EMERGENCIES

A. In any emergency affecting the safety or persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss and shall immediately notify the Construction Manager of such emergency conditions. Any claims made by the Contractor for additional compensation or extension of time on account of emergency work shall be processed in accordance with Article 7, of the Supplementary Conditions.

1.8 ACCIDENT INVESTIGATION AND REPORTING

A. All accident/incidents shall be reported.

B. The Contractor shall submit an accident/incident report to R.Y. Johnson & Son, Inc. no later than 10 hours on the working day following the incident. A detailed report is to follow within 24 hours.

1.9 FIRST AID PROCEDURE

A. The Contractor is to provide his own First Aid service.

B. Each Contractor shall supply to R.Y. Johnson & Son, Inc. a list of their qualified First Aid personnel. Each Contractor is to have a minimum of one full-time qualified First Aid personnel on site. Contractor First Aid certificates shall be posted in the Contractor's site office and photocopies supplied to R.Y. Johnson & Son, Inc.

1.10 INDEMNIFICATION

A. Contractors shall indemnify and hold harmless the Owner, the Construction Manager and the Architect/Engineer, all municipal authorities, and their agents and employees from and against all claims, damages, losses, and expenses including, but not limited to attorney's fees arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other work than the work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not is caused in part by a party indemnified hereunder.

B. In any and all claims against the Owner, the Construction Manager or the Architect/Engineer or any of their agents or employees by any employee of a Contractor, and Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the type of damages, compensation or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.

C. To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Construction Manager, the Owner, and the Architect and their agents and employees from and against all claims, including citations and penalties imposed by the Occupational Safety and Health Administration, damages, losses, expenses and judgments including, but not limited to attorneys' fees, arising out of or resulting from performance of the work in an area which is unsafe, harmful, dangerous, or hazardous and which is caused in whole or in part by any act or omission of the Contractor, anyone directly or indirectly employed by it, or anyone for whose acts it may be liable, regardless of whether the claim, citation, penalty, damage, loss, expense or judgment results from unsafe, harmful, dangerous, hazardous or toxic materials or substances or whether from any other unsafe, harmful, dangerous or hazardous conditions.

D. The obligations of the Contractor under this paragraph shall not extend to the liability of the Architect/Engineer or the Construction Manager, his agents or employees arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, design or specifications, or (2) the giving of or the failure to give directions or instructions by the

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Architect/Engineer of the Construction Manager, their agents or employees provided such giving or failure to give is the primary cause of the injury or damage.

E. No provision of this Subparagraph shall give rise to any duties on the part of the Architect or the Construction Manager not otherwise provided for by contract or by law.

F. In the event that any party is requested but refuses to honor the indemnity obligations hereunder, then the party refusing to honor such requests shall, in addition to all other obligations, pay the cost of bringing any such action, including attorney's fees to the party requesting indemnity.

END OF SECTION 013500

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SECTION 014000 - QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality-control services.

B. Quality-control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

E. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.
2. Division 1 Section "Submittals" specifies requirements for development of a schedule of required tests and inspections.

1.3 RESPONSIBILITIES

A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.

1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.

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B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.

1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.

C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:

1. Provide access to the Work.
2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
4. Provide facilities for storage and curing of test samples.
5. Deliver samples to testing laboratories.
6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
7. Provide security and protection of samples and test equipment at the Project Site.

D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
3. The agency shall not perform any duties of the Contractor.

E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.4 SUBMITTALS

A. Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

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2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:

    a. Date of issue.
    b. Project title and number.
    c. Name, address, and telephone number of testing agency.
    d. Dates and locations of samples and tests or inspections.
    e. Names of individuals making the inspection or test.
    f. Designation of the Work and test method.
    g. Identification of product and Specification Section.
    h. Complete inspection or test data.
    i. Test results and an interpretation of test results.
    j. Ambient conditions at the time of sample taking and testing.
    k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
    l. Name and signature of laboratory inspector.
    m. Recommendations on retesting.

1.5 QUALITY ASSURANCE

A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.

    1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 014000

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SECTION 014100- REGULATORY REQUIREMENTS

PART I - GENERAL

1.1 SECTION INCLUDES

A. Safety and Health Regulations.

B. Housekeeping.

C. M.S.D.S. Controlled Products.

D. Emergencies.

E. Employment Policy.

F. Environmental Statutes and Regulations.

G. Miscellaneous Regulations.

I. Standard of Quality.

I.2 RELATED SECTIONS

A. General and Supplementary Conditions of the Contract.

I.3 SAFETY AND BEALTH REGULATIONS

A. These Contract Documents and the joint and several phases of construction hereby contemplated are to be governed, at all lines by applicable provisions of the Federal law(s), including but not limited to, the latest amendments of the following:

1. Williams-Steiger Occupational Safely and Health Act of 1970, Public Law 91-596,
2. Part 1910 - Occupational Safety and Health Standards, Chapter XIII of Title 29, Code of Federal Regulations.

B. Nothing contained in these Contract Documents for construction shall be construed by the Contractor as relieving him in any way of his responsibility for strict compliance with the rules and regulations contained in the above mentioned Occupational Safety and Health Act.

C. The use of products containing asbestos will not he permitted.

D. All work shall be performed in accordance with rules, regulations, procedures and safe practices and/or OSHA

and all other Government Agencies having jurisdiction over the project.

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E. Each Contractor shall be responsible for initiating, maintaining and supervising safety precautions and programs in connection with the work. The name of the safety officer for each contactor shall be provided to the Construction Manager.

F. All Contractors shall comply with the provisions of the Occupational Safety and Health Act and Federal, State and local requirements.

G. If a Contractor fails to maintain the safety precautions required by law or directed by the Construction Manager, the Construction Manager may take such action necessary and charge the Contractor therefore. The failure of the Construction Manager to take any such action shall not relieve the Contractor of his obligations.

H. The Contractor individually shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods and for any damage which may result from their failure or their improper construction, maintenance or operation.

I. Prior to mobilizing to the job, the Contractor shall submit to the Construction Manager in writing, a description
of his safety program for review and comment. During the conduct of the work, the Contractor shall immediately notify the Construction Manager in writing of all accidents and shall submit a written report describing in detail the circumstances of each accident within 24 hours of its occurrence.

J. All Contractors shall notify the Construction Manager of any flammable, combustible and/or toxic materials intended for use on the project and shall famish the Construction Manager with literature pertinent to the use and control of all materials, including, but not limited to M.S.D.S sheets.

K. Each Contractor shall delegate one representative who shall be responsible to maintain all safety requirements of the Contractor, and shall attend all project meetings scheduled by the Construction Manager.

L. The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage or loss to: -

1. All school personnel, employees on the work site and all other persons who may be affected thereby.
2. All the work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or
Sub-Subcontractors.
3. Other property at the site or adjacent thereto, including but not limited to trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction and underground property.

M. The Contractor shall give all notices and comply with all applicable laws, ordinances,

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rules, regulations and lawful orders of any public authority, including the Owner's requirements bearing on the Safety of persons or property or their protection from damage, injury or loss.

N. The Contractor shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection, including danger signs and other warnings against hazards. He shall comply with safety regulations and notify the Construction Manager, until he is in compliance.

O. The Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by the Contractor, his Subcontractors and his Sub-Subcontractors or anyone directly employed by any of them, or by anyone for whose acts any of them be liable.

P. The Contractor shall not load or permit any part of the work to be loaded so as to endanger its
integrity and safety.

Q. Contractors using a method of blasting to perform work on the project shall use all proper

R. The use of audio equipment and headsets will not be permitted on the construction site.

S. All persons entering the project shall wear hard hats in good condition and meet ANSIZ89.1-1981 and
ANSI Z89.2-1971. The hats shall be worn in the proper manner.

T. All persons entering the project shall wear proper work boots, clothing attire including long trousers and shirts.

U. All job site personnel are expected to strictly adhere to the following rules and regulations:

I. Use of approved eye protection by all company personnel shall be required during all types of percussions and reciprocating work or when owner requirements govern.
2. Approved respiratory equipment shall be worn by all company personnel exposed to hazardous volumes of toxic or noxious dusts, fumes, mists, or gases. Check M.S.D.S. if not sure.
3. Personal protective equipment is to be used under usual conditions, such as high temperature work, handling caustic or corrosive liquids or molten metals.
4. When lifting material, keep bask straight, knees bent, and lift with your legs. Get help if the load is
too heavy.
5. Work clear of suspended loads. If a load is moved above where you are working or walking, stand clear until it has passed.
6. Unless it is part of your regular work, do not attempt to repair or adjust any electrical equipment.
7. Kill any circuit before attempting to work on it. Even voltages lower than 110 will cause death under certain conditions.
8. Treat all electric wires as live. Do not touch exposed wires; report them immediately to your supervisor.
9. The Contractor is responsible for providing safety training to all of his employees.

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10. All shipments to the site shall have the required documentation and labels attached and the documentation and labels shall be maintained while the material is on site.
11. As defined in the Occupational Safety & Health Act, safety belts, complete with lanyards or
parachute style harness, complete with lanyards, are to be used where there is a danger of falling.

1.4 HOUSEKEEPING

A. Materials and equipment must be piled up or scored in a safe manner. Aisles must be kept clear.

B. All drop cables/extension cords shall be elevated above the ground or protected in such a way to allow traffic to pass.

C. Smoking will only he permitted in designated areas.

D. Consumption of food and beverages in other than Company-designated areas and at specified times are prohibited.

E. Glass-bottled refreshments will not be allowed in the workplace.

F. Graffiti will not be tolerated on the job-site.

G. All compressed gas cylinders must be stored in an upright position and tied off with the cap placed on top.

H. The cords and connections at temporary panels must be maintained in an orderly fashion at all times to prevent tripping.

I. Welding stubs and shells from explosive activated tools shall be collected and properly disposed of by the Contractor.

J. Nails are to be bent over and/or removed from wood,

K. Aisles and stairwells as well as base areas of ladders are to be kept clear at all times.

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1.5 M.S.D.S.-CONTROLLED PRODUCTS

A. The Contractor is responsible for notifying R.Y. Johnson Construction Management of any controlled products that they bring or cause to have brought onto the site. The Contractor shall provide
RY. Johnson Construction Management with a copy of the Material Safety Sheet (M.S.D.S.) for the controlled product and the Contractor shall retain a copy of the M.S.D.S. on site for their own reference. The legal storage, use, and disposal of any controlled product is the responsibility of the Contractor.

B. The Contractor shall comply with OSHA Communication Standards 29 CFR 1910-1200

for hazardous materials. The Contractor shall maintain a Material Safety Data Sheet on file at the job-site for each chemical brought to the site, M.S.D.S. sheets shall be submitted to R.Y. Johnson Construction Management for record purposes

C. Temporary storage of hazardous materials shall be located in containment dikes provided by the Contractor requiring same in area identified by the Construction Manager. All tanks, drums, and containers are to be labeled with appropriate warnings (i.e., flammable, no smoking). Periodic inspections for leakage shall he the responsibility of the Contractor. Final clean-up and removal shall be by the Contractor.

1.6 EMERGENCIES

A. In any emergency affecting the safety or persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss and shall immediately notify the Construction Manager of such emergency conditions. Any claims made by the Contractor for additional compensation or extension of time on account of emergency work shall be processed in accordance with Article 7, of the Supplementary Conditions.

I.7 EMPLOYMENT POLICY

A. Acceptance of a contract based on these specifications constitutes agreement by the Contractor to comply with State Policy as established by joint Resolution No. 16 of the General Assembly of l958, which is: That on all public works being paid for in whole or in part with State or other public funds, preference shall be given to available persons who have been residents of Delaware for a period of at least six (6) months immediately prior to availability of positions for employment of laborers, mechanics and others, not including supervisor personnel not to exceed ten percent (10%) of the total working force.

B. Competent Workmen: No person shall be employed to perform any work under the Contract who is not a competent and first-class workman or mechanic, as applicable. For purposes of this section, no workman or mechanic, as applicable, shall be regarded as competent and first class unless he shall be duly skilled in the applicable branch of labor and shall be paid not less than such rates of wages and for such hours work as shall be established and current rates of wages paid for such hours by employers of organized labor in performance of similar work in the locality where the work is to be performed.

C. It is understood that the provisions of Title VI of the Civil Rights Act 1964 are hereby included in this contract to the end that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or otherwise subjected to discrimination under this Agreement.

The Contractor agrees to make such reports and to maintain and make available, such records as may be required to ensure compliance with ART.38, par. b and c. - this means permitting access by appropriate State or Federal officials during normal business hours to such facilities, records and other sources of information as may be pertinent to ascertain compliance with the regulations.

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D. All Contractors shall be subject to, and responsible for all costs relating to Contractor licensing ordinances and regulations.

1.8 ENVIRONMENTAL STATUES AND REGULUATIONS

A. Contractor shall comply with all applicable provisions of federal and state laws dealing with the prevention of environmental pollution and the preservation of natural resources, including but not limited to Act No 247 approved October 26, 1962; the Federal Air Quality Act of 1967; the Clean Air Act; the Clean Water Restoration Act; the Water Pollution Control Act Amendments of 1956; the Water Quality Act of 1965; the Water Quality Improvement Act of 1970; The Water Pollution Control Act Amendments of 1972; The Water Facilities Act (see Consolidated Farmer's Home Administration Act of 196l); the Watershed Protection and Flood Prevention Act; the Pennsylvania Air Pollution Control Act; the Clean Streams Law; the Solid Waste Management Act; the Municipal Waste Planning, Recycling and Waste Reduction Act, A.H.E.R.A.; and all rules and regulations there under, including, but not limited to, those formulated by the United States Environmental Protection Agency, the Pennsylvania Department of Environmental Resources and the Department of Environmental Protection. Nothing contained in the Contract shall be construed as relieving Contractor in anyway of Contractors
responsibility for strict compliance with all governmental requirements pertaining to environmental protection.

B. These Contact Documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of Federal and State Law(s) dealing with the prevention of environmental pollution and the preservation of public natural resources, including but not limited to the latest amendments of the following:

1. Act No. 247 of the General Assembly oft he Commonwealth of Pennsylvania relating to the prevention of environment pollution and the preservation of public natural resources in construction projects, enacted October 26, 1972.

C. Pursuant to Act No. 247 of the 1972 Pennsylvania General Assembly, all proposals will be subject to all the provisions of all Federal and State statutes dealing with the prevention of pollution and preservation of public natural resources including, but not limited to; the Federal Air Quality Actor 1967; Clean Air Act, as amended: Clean Water Restoration Act; Water Pollution Control Act Amendments of 1956, Water Quality Act or 1965, Water Quality improvement Act of 1970. and Water Pollution Control Mt Amendments of 1972; the Water Facilities Act (see Consolidated Farmers Home Administration Act of 1961); the Watershed Protection and Flood Prevention Act; the Pennsylvania Air Pollution Control Act; Clean Streams Law; Solid Waste Management Act; Sewerage Facilities Act; and all rules and regulations there under including, but not limited to, those formulated by the United States Environmental Protection Agency and the Pennsylvania Department
of Environmental Resources.

D. Act No. 247 provides that if the successful bidder must undertake additional

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work due to enactment of new or the amendment of existing statues, rules or regulations occurring after the submission of the successful proposal, the Authority shall issue a change order setting for the additional work that must be undertaken, which shall not invalidate the contract. The cost of such a change order to the Authority shall be determined in accordance with the provisions of the contract for change orders or force accounts, or if n such provision is set forth in the contract, then the cost to the Authority shall be the contractors costs for wages, labor costs other than wages, wage taxes, materials,
equipment rentals, insurance and subcontractors attributable to the additional activity plus a reasonable sum for overhead and profit; provided however, that such additional costs to undertake work not specified in the invitation for proposal shall not be approved unless written authorization is given the successful bidder prior to his undertaking such additional activity. In the event of a dispute between the Authority and the successful bidder, arbitration procedures maybe commenced under the applicable
terms of the construction contract, or, if the contract contains no such provision for arbitration, the then obtaining rules of the American Arbitration Association. I

E. Nothing contained in the Contract Documents for construction shall be construed by the Contractor as relieving him in any way of his responsibility for strict compliance with the statutes, rules and regulations contained in the above mentioned Environmental Protection Act.

l.9 MISCELLANEOUS REGULATIONS

A. Standard of Quality: The various materials and products specified in the specification by name or description are given to establish a standard of quality and of cost for bid purposes. It is not the intent to limit the acceptance to any one material or product specified, but rather to name or describe it as the absolute minimum standard that is desired and acceptable. A material or product of lesser quality would not be acceptable. Where proprietary names are used, whether or not followed by the words Approved equal®, they shall be subject to equals only as approved by the Architect and /or Engineer.

PART 2 -~ PRODUCTS (NOT USED)

PART 3- EXECUTION (NOT USED)

END OF SECTION 014100

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": The term "approved," when used to convey Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.

D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, and protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is the 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.

J. The term "experienced," when used with an entity, 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.

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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.

K. "Project site" is the space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: 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.

1. 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.

D. Copies of Standards: Each entity engaged in construction on Project must 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 and make them available on request.

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

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

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PRIVATE tbl1@dom1

AA	Aluminum Association, Inc. (The) www.aluminum.org	(202) 862-5100
AAADM	American Association of Automatic Door Manufacturers www.taol.com/aaadm	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AAN	American Association of Nurserymen (See ANLA)	
AASHTO	American Association of State Highway and Transportation Officials www.aashto.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 429-5155
ACI	American Concrete Institute/ACI International www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
ADC	Air Diffusion Council	(312) 201-0101
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AFPA	American Forest & Paper Association (See AF&PA)	
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AHA	American Hardboard Association www.ahardbd.org	(847) 934-8800
AHAM	Association of Home Appliance Manufacturers	(202) 872-5955

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	www.aham.org	
AI	Asphalt Institute www.asphaltinstitute.org	(606) 288-4960
AIA	American Institute of Architects (The) www.aiaonline.org	(202) 626-7300
AISC	American Institute of Steel Construction, Inc. www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction	(303) 792-9559
ALA	American Laminators Association (See LMA)	
ALCA	Associated Landscape Contractors of America www.alca.org	(800) 395-2522 (703) 736-9666
ALSC	American Lumber Standard Committee	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANLA	American Nursery & Landscape Association (Formerly: AAN - American Association of Nurserymen) www.anla.org	(202) 789-2900
ANSI	American National Standards Institute www.ansi.org	(212) 642-4900
AOSA	Association of Official Seed Analysts www.zianet.com/AOSA	(402) 476-3852
APA	APA-The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(941) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ASCA	Architectural Spray Coaters Association	(856) 848-6120

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	www.ascassoc.com	
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	American Society for Testing and Materials www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industries International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (See WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(817) 326-6300
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 661-4261
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International)	(616) 285-3963

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	www.bifma.com	
CCC	Carpet Cushion Council www.carpetcushion.org	(203) 637-1312
CCFSS	Center for Cold-Formed Steel Structures www.umr.edu/~ccfss	(573) 341-4471
CDA	Copper Development Association Inc. www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association (The) www.canelect.ca	(613) 230-9263
CFFA	Chemical Fabrics & Film Association, Inc. www.taol.com/cffa	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 412-0900
CGSB	Canadian General Standards Board www.pwgsc.gc.ca/cgsb	(819) 956-0425
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.com (under construction)	(301) 596-2584
CPA	Composite Panel Association (Formerly: National Particleboard Association) www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association Division of Plastics Pipe Institute www.cppa-info.org	(800) 510-2772 (419) 241-2221
CRI	Carpet and Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200

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CSA	CSA International (Formerly: IAS - International Approval Services) Division of Canadian Standards Association www.iasapprovals.org	(216) 524-4990
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 462-8961
CTI	Cooling Tower Institute www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA/TIA	Electronic Industries Alliance/Telecommunications Industry Association www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eifsfacts.com	(800) 294-3462 (770) 968-7945
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
FCI	Fluid Controls Institute www.fluidcontrolsinstitute.org	(216) 241-7333
FGMA	Flat Glass Marketing Association (See GANA)	
FM	Factory Mutual System (See FMG)	
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmglobal.com	(401) 275-3000
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America (Formerly: FGMA - Flat Glass Marketing Association) www.glasswebsite.com/gana	(785) 271-0208
GRI	Geosynthetic Research Institute www.drexel.edu/gri	(610) 522-8440

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GTA	Glass Tempering Division of Glass Association of North America (See GANA)	
HI	Hydraulic Institute	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute Division of Gas Appliance Manufacturers Association www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association Division of National Association of Architectural Metal Manufacturers (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc.	(410) 838-6550
IAS	International Approval Services (See CSA International)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(508) 394-4424
ICRI	International Concrete Repair Institute www.icri.org	(703) 450-0116
IEC	International Electro technical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America (The) www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 938-7444
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
IRI	HSB Industrial Risk Insurers www.industrialrisk.com	(800) 520-7300 (860) 520-7300
ITS	Intertek Testing Services	(800) 345-3851

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	www.itsglobal.com	(607) 753-6711
IWS	Insect Screening Weavers Association (Now defunct)	
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LGSI	Light Gage Structural Institute www.loseke.com	(972) 625-4560
LMA	Laminating Materials Association (Formerly: ALA - American Laminators Association) www.lma.org	(201) 664-2700
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864 (847) 577-7200
LSGA	Laminated Safety Glass Association (See GANA)	
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association	(312) 644-6610
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(614) 228-6194
ML/SFA	Metal Lath/Steel Framing Association (See SSMA)	
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry, Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NAAMM	North American Association of Mirror Manufacturers (See GANA)	
NACE	NACE International	(281) 228-6200

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	(National Association of Corrosion Engineers International) www.nace.org	
NAIMA	North American Insulation Manufacturers Association (The) www.naima.org	(703) 684-0084
NAMI	National Accreditation and Management Institute, Inc.	(304) 258-5100
NAPM	National Association of Photographic Manufacturers (See PIMA)	
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(414) 248-9094
NCTA	National Cable Television Association www.ncta.com	(202) 775-3669
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	International Electrical Testing Association www.electricnet.com/neta	(303) 697-8441
NFPA	National Fire Protection Association www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-6372
NGA	National Glass Association www.glass.org	(703) 442-4890
NHLA	National Hardwood Lumber Association	(901) 377-1818

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	www.natlhardwood.org	
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NPA	National Particleboard Association (See CPA)	
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(301) 587-1400
NSA	National Stone Association www.aggregates.org	(800) 342-1415 (202) 342-1100
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NTMA	National Terrazzo & Mosaic Association (The) www.ntma.com	(800) 323-9736 (703) 779-1022
NWWDA	National Wood Window and Door Association (See WDMA)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting and Decorating Contractors of America www.pdca.com	(800) 332-7322 (703) 359-0826
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (508) 230-3516
PGI	PVC Geomembrane Institute/Technology Program University of Illinois-Urbana Champaign //pgi-tp.ce.uiuc.edu	(217) 333-3929
PIMA	Photographic & Imaging Manufacturers Association (Formerly: NAPM - National Association of Photographic Manufacturers) www.pima.net	(914) 698-7603
RCSC	Research Council on Structural Connections c/o AISC	

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	www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute	(Contact by mail only)
RIS	Redwood Inspection Service Division of the California Redwood Association www.calredwood.org	(888) 225-7339 (415) 382-0662
RMA	Rubber Manufacturers Association www.rma.org	(800) 220-7620 (202) 682-4800
SAE	SAE International www.sae.org	(724) 776-4841 (724) 776-4960 (publications)
SDI	Steel Deck Institute www.sdi.org	(847) 462-1930
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabfurn.com	(843) 689-6878
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 938-7444
SIGMA	Sealed Insulating Glass Manufacturers Association www.sigmaonline.org/sigma	(312) 644-6610
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SPI	The Society of the Plastics Industry, Inc. www.plasticsindustry.org	(202) 974-5200
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPI/SPFD	The Society of the Plastics Industry, Inc. Spray Polyurethane Foam Division (See SPI)	

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SPRI	SPRI (Single Ply Roofing Institute) www.spri.org	(781) 444-0242
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSMA	Steel Stud Manufacturers Association (Formerly: ML/SFA - Metal Lath/Steel Framing Association) www.ssma.com	(312) 456-5590
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(800) 837-8303 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TPI	Truss Plate Institute	(608) 833-5900
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 705-9898
UFAC	Upholstered Furniture Action Council www.ufac.org	(336) 885-5065
UL	Underwriters Laboratories Inc. www.ul.com	(800) 704-4050 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association //members.aol.com/unibell	(972) 243-3902
USG	United States Gypsum Company A Subsidiary of USG Corporation www.usg.com	(800) 874-4968 (312) 606-4000
USITT	United States Institute for Theatre Technology, Inc. www.culturenet.ca/usitt	(800) 938-7488 (315) 463-6463
USP	U.S. Pharmacopeia www.usp.org	(800) 822-8772 (301) 881-0666

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WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Formerly: AWCMA - American Window Covering Manufacturers Association) www.windowcoverings.org	(212) 661-4261
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WIC	Woodwork Institute of California www.wicnet.org	(916) 372-9943
WMMPA	Wood Molding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

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

PRIVATE tbl2

BOCA	BOCA International, Inc. www.bocai.org	(708) 799-2300
CABO	Council of American Building Officials (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials (The) www.iapmo.org	(909) 595-8449
ICBO	International Conference of Building Officials www.icbo.org	(800) 284-4406 (562) 699-0541
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.intlcode.org	(703) 931-4533
SBCCI	Southern Building Code Congress International, Inc. www.sbcci.org	(205) 591-1853

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

PRIVATE tbl3@dom1

CE	Army Corps of Engineers CRD Standards	(601) 634-2355
CFR	Code of Federal Regulations www.access.gpo.gov/nara/cfr	(202) 512-1800
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-0990
DOC	Department of Commerce www.doc.gov	(202) 482-2000
DOD	Department of Defense DOD Specifications and Standards //astimage.daps.dla.mil/online	(215) 697-6257
EPA	Environmental Protection Agency www.epa.gov	(202) 260-2090
FAA	Federal Aviation Administration Department of Transportation www.faa.gov	(202) 366-4000
FCC	Federal Communications Commission www.fcc.gov	(202) 418-0190
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
FED-STD	Federal Standard (See FS)	
FS	Federal Specification (Available from DOD, GSA, and NIBS)	
FTMS	Federal Test Method Standard (See FS)	
GSA	General Services Administration www.gsa.gov	(202) 708-5082 (202) 619-8925 (Federal Specifications)
HUD	Department of Housing and Urban Development	(202) 401-0388

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	www.hud.gov	
LBL	Lawrence Berkeley Laboratory (See LBNL)	
LBNL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-5605
MILSPEC	Military Specification and Standards (See DOD)	
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-2000
OSHA	Occupational Safety & Health Administration (See CFR 29) www.osha.gov	(202) 219-5000
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2933
USDA	Department of Agriculture www.usda.gov	(202) 720-8732
USPS	Postal Service www.usps.gov	(202) 268-2000

NOT FOR BIDDING

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014219 – REFERENCE STANDARDS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specification Format.

B. Specification Language and Form.

1.2 RELATED SECTIONS

A. The specifications have been arranged in accordance with CSI / CSC "masterformat" master list of titles and numbering system.

1.3 FORMAT

A. The imperative language of the technical sections of the specifications is directed to the Contractor unless specifically noted otherwise.

B. Portions of the specifications have been derived from an automated master specification production system and may include minor deviations from traditional writing forms. Such deviations must be recognized as a normal result of this production technique and no other meaning will be implied or permitted.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 014219

NOT FOR BIDDING

SECTION 015000 -TEMPORARY CONSTRUCTION UTILITIES, FACILITIES & CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies requirements for temporary construction, utilities, facilities, and controls required to support the successful construction of the project and maintain services until the permanent utilities, facilities, and controls are complete. They shall be installed, maintained, and removed subject to the Construction Manager's approval.

TABLE OF PARTS

PART 1 - General
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1.4 Project Conditions
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PART 2 - Products
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3.2 Temporary Utility Installation
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3.4 Water Service
3.5 Electrical Power
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3.7 Telephones
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3.12 Field Offices
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3.21 Barricades, Warning Signs, and Lights
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3.24 Environmental Protection, NPDES, and PPC
3.25 Workday
3.26 Lunch Wagon
3.27 Erosion Control
3.28 Excavation
3.29 Blasting
3.30 Material Inventories
3.31 Deliveries
3.32 Operation, Termination, and Removal
3.33 Snow Removal

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

Municipal and Labor & Industry Building Code requirements
Health and safety regulations
Utility company regulations
Police, Fire Department and Rescue Squad rules
Environmental protection regulations

B. Inspections: Arrange for authorities, having jurisdiction, to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site. They shall be removed, relocated as required by the progress of the work, or directed by the Construction Manager.

1.5 EXISTING UTILITIES AND SYSTEMS

A. Precaution must be taken to protect existing sanitary sewer, electrical, water and gas lines that cross the site. All existing building utility systems such as electrical, water, gas will be demolished and reconstructed during this project.

B. Trade Contractors interrupting services due to their construction operations shall provide temporary utility lines, as required, to maintain services.

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PART 2 PRODUCTS

2.1 MATERIALS

A. General: Provide new materials; if acceptable to the Construction Manager, undamaged, previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Lumber and Plywood: Comply with requirements in Division-6 Section "Rough Carpentry."

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

D. Water: Provide potable water approved by local health authorities.

E. Open-Mesh Fencing: Provide 11-gauge, galvanized two (2) inch, chain link fabric fencing, six (6) feet high with galvanized steel pipe posts, 1-1/2" I.D. for line posts and 2-1/2" I.D. for corner posts. Drive posts 30" into the ground at no less than 15' spacing.

2.2 EQUIPMENT

A. General: Provide new equipment; if acceptable to the Construction Manager, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light, for connection of power tools, equipment, and GFI breakers.

D. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress.

E. Electrical Welding Outlets: These will not be provided. Each Trade Contractor will be responsible for his own welding power.

F. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

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G. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.

H. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

I. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber, reinforced polyester shell or similar nonabsorbent material.

J. First Aid Supplies: Comply with governing regulations.

K. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

Comply with NFPA 10 classification, extinguishing agent and size required by location and class of fire exposure.

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PART 3 EXECUTIONS

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.

3.3 USE CHARGES

A. Cost for temporary facilities are to be paid by the Trade Contractor requiring or providing the temporary facility unless noted otherwise.

B. Owner will pay utility consumption costs during construction.

3.4 WATER SERVICE

A. The Plumbing Contractor shall install water service and distribution piping of sizes and pressures adequate for construction. As a minimum, provide a manifold pipe with two 3/4" hose bibs at the building water riser point of entrance until portions of the permanent piping system can be used to support construction activities. Water service may be run from a temporary or permanent source. Coordinate needs with Construction Manager.
1. Sterilization: Sterilize temporary water piping prior to use.
2. Protect system from freezing.
3. Utilize City water pressure.

3.5 ELECTRICAL POWER

A. After start of work at project site, when requested by the Construction Manager, the Electrical Contractor shall provide a temporary electrical power distribution system sufficient to accommodate temporary lighting and construction operations, including the use of power tools, and start-up of specified building equipment which must be tested, started or placed into use prior to completion of its permanent power connections. Provide weatherproof, grounded wiring with overload protection; with direct wired connections, where feasible, and for voltages up to 220/208 volts. Locate multiple outlets for 120 volt power, not less than 4 gang, at each story of construction, spaced so that the entire area of construction can be reached by power tools on a single extension cord of 100' maximum length. Maximum 20 Amp circuit breaker, four (4) receptacles per circuit breaker.

B. The Electrical Trade Contractor shall provide and pay for all maintenance, servicing, operation, and supervision of lines installed.

C. Provide service with ground fault circuit interrupter feature, as per NEC and OSHA requirements. The Electrical Trade Contractor shall have a cord inspection program in place. He shall maintain the inspection records on site.

D. As permanent power distribution system is accepted as substantially complete, either entire system or usable portions thereof, the Electrical Trade Contractor shall make suitable provisions for temporary use thereof, and remove unused portions of temporary system.

E. If required, provide meters for electrical power.

F. When temporary electrical lines are no longer required, they shall be removed by the Electrical Trade Contractor and any part, or parts, of the grounds or buildings disturbed or damaged shall be brought back to their original condition.

G. Electricity from existing lines may be used at no charge to the Trade Contractor, except for heating units, temporary offices, or storage. Each trade shall provide extension cords from the existing facilities, as required, for the execution of the Work. Electrical power for

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welding equipment will not be available.

H. The Electrical Trade Contractor shall maintain and operate permanent electrical supply and distribution system until time of final acceptance and transfer of operation to Owner's personnel.

I. The Electrical Trade Contractor shall install switching controls for all lighting which will enable turning off temporary lighting during off-construction hours. The Electrical Trade Contractor shall provide manpower to control light switching and be responsible for it.

J. Temporary power supplies to the Construction Manager's Office Conference/Office Complex shall be installed with service connection by the Electrical Trade Contractor.

K. The Electrical Trade Contractor will provide power for oil or gas fired temporary heaters, if required by the Construction Manager. It will be connected so that it can remain "live" when the lighting has been turned off.

L. The Electrical Trade Contractor will provide 24-hour temporary power to any heat tape (installed by others) on temporary water and/or fire line. All temporary heat work will comply with existing OSHA requirements.

M. Construction circuits shall be separate and independent from temporary lighting.

N. The Electrical Trade Contractor will extend a temporary electrical service and provide a termination box in the Trade Contractor's office trailer area for hook-up of the Trade Contractor's trailers. Cost for individual Trade Contractor trailer hook-up will be born by the Trade Contractor requiring this service. Use of electric heaters in those trailers and shanties will not be permitted.

3.6 LIGHTING

A. Whenever overhead floor or roof deck has been installed, the Electrical Trade Contractor shall provide temporary lighting with local switching.
The Electrical Trade Contractor shall provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight and general lighting as stated below:

1. Provide uniformly spaced general lighting utilizing one (1) 150 watt incandescent lamp equivalent to 1.0 watts/sq. ft. of floor areas, and one (1) 100 watt lamp per 50' of corridor or per flight of stairs. General lighting to have a minimum of 5' candles measured at floor level.

2. Limit lighting installations to intensities which will accommodate normal access and workmanship requirements, recognizing that each entity performing work requiring higher intensity lighting will provide supplementary plug in temporary lighting and localized areas where such work is in progress.

3. As permanent lighting system is substantially complete for each story or usable portion thereof, the Electrical Trade Contractor shall make suitable provisions for temporary use thereof and remove unused portions of temporary lighting system.

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4. The Electrical Trade Contractor shall maintain and operate permanent lighting system until time of final acceptance and transfer of operation to Owner's personnel, including turning off lighting during off-construction hours.

5. The Electrical Trade Contractor shall replace bulbs that are burned out or substantially dimmed by substantial hours of use.

6. Special lighting required for construction activities shall be provided by contractor requiring it.

7. The Electrical Trade Contractor shall provide safety lighting in the stairways, hallways, and exterior security lighting on a 24-hour basis.

8. Furnish and install dusk to dawn type security lights on poles as shown on the site construction staging plan.

9. If more lighting is necessary to install finishes, drywall, painting, etc., the contractor needing the extra lighting will provide.

3.7 TELEPHONES

A. The Construction Manager shall be responsible to provide telephone service to a demarcation point in the Trade Contractor office trailer area. Temporary phone service must support 10 office trailers that require phone and/or fax service. Cost for individual hook ups, telephones, and use fees, shall be the responsibility of each Trade Contractor.

B. The Construction Manager shall make arrangements for one (1) public telephone to be installed on the site and include monthly service cost for the duration of the project.

3.8 SANITARY FACILITIES

A. The Construction Manager shall provide temporary toilets. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

Provide toilet tissue for each facility.

B. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted. Provide means of locking facilities when construction is not in progress.

Provide one unit for use of Construction Manager=s office/conference meeting complex.

C. Drinking Water Facilities: Each trade contractor shall provide drinking water for it=s own personnel.

3.9 STORM SEWERS

A. If storm sewers are available, the Sitework Trade Contractor shall provide temporary

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connections to remove effluent that can be discharged lawfully. If sewers are not available, or cannot be used, the Sitework Trade Contractor shall provide drainage ditches, dry wells, stabilization ponds and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off the site in a lawful manner.

B. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.

C. Comply with the soil erosion and sedimentation control plan and local authorities having jurisdiction.

3.10 DEWATERING FACILITIES

A. For temporary drainage and dewatering facilities, and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division-2 Sections. Where feasible, utilize the same facilities. The Sitework Trade Contractor shall be responsible to maintain the site, excavations and construction free of water.

B. In the event that storm drain piping is not completed when needed for roof drain tie in, then the Plumbing Trade Contractor shall provide temporary storm water drainage from the building, and the Sitework Trade Contractor shall control roof drainage from building onto the site.

C. Sitework Trade Contractor shall be responsible to drain or pump water and remove debris from the site so as not to delay his continuous work or progress. This shall include operating pumps during second shift in order to facilitate next-day continuation of work.

D. Sitework Trade Contractor shall excavate in a manner that prevents all surface water from flowing into the building area. Sitework Trade Contractor shall be responsible to remove any runoff water or debris which enters the building area.

E. Sitework Trade Contractor shall continue to drain site and remove debris until designed grades are obtained.

F. Once building excavation grades are complete, the Concrete Work Contractor shall be responsible to remove all water and debris to install and backfill the building foundations.

G. Upon completion of building foundations, each Trade Contractor shall be responsible to remove water and debris required to complete his work.

3.11 HEATING AND VENTILATION

A. Temporary heating shall be provided and maintained by the Trade Contractor performing the work if the outside temperature falls below 40E F at anytime during the day or night for all exterior work or work performed prior to the building being enclosed by walls and roof.

B. The Trade Contractor shall furnish temporary heat by acceptable means to provide sufficient heat to maintain a temperature of 55E F, 24 hours a day throughout the entire

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area of the work for which the Trade Contractor is responsible prior to the building being enclosed by walls and roof.

C. Except where use of the permanent system is authorized, provide vented, self-contained LP gas or fuel oil heaters with individual space thermostatic control. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited. Temporary heating may not be provided using electrical heating equipment if using electrical power supplied by the Owner.

D. As soon as the building, or portions thereof, is generally enclosed with walls and roof and temporary heat is required for scheduled work, or required to facilitate proper workmanship, and permanent heating system is not yet operable or authorized for use, the HVAC Contractor shall arrange and provide temporary heat service for every entity authorized to do work at the project site. The HVAC Contractor shall maintain temperatures as indicated
by other Specification Sections for each type of work to be performed. The Construction Manager shall be the sole arbiter of when the building is considered generally enclosed.

E. Refer to paragraph 3.14 in section 01500 for responsibilities to install, maintain, and remove temporary enclosure of windows and doors until the permanent materials are in place.

F. After the conditions of construction require continuous 24 hour heat in the building, the HVAC Contractor shall provide, operate, and maintain temporary radiation or unit heaters to provide required temperatures (minimum 55E F) for the conduct of work. This service shall be continued until the permanent heating system has been completely installed and is in operation. The HVAC Contractor shall furnish and pay for all fuel as required for providing temporary heat after the building is generally enclosed.

G. As permanent heating/cooling system is substantially complete and operational for each story or usable portion thereof, the HVAC Trade Contractor shall make suitable provisions for use thereof in temporary heating and cooling. The HVAC Trade Contractor shall maintain and operate permanent system for temporary heating/cooling purposes, including service to occupied areas, if any, until time of final acceptance or transfer of operation to Owner's personnel, for major parts of system if not for entire heating system and air conditioning. The Owner shall pay for all fuel costs incurred by the permanent HVAC systems after acceptance of systems.

H. Warranty: The warranty as required by the contract specifications will not begin until final acceptance of the system has been given by the architect for all or part of a system. The warranty period does not start with the use of the equipment for temporary heating and cooling.

I. All permanent heating and air conditioning equipment used to supply temporary heat and air conditioning shall be completely cleaned and reconditioned by the HVAC Trade Contractor prior to final acceptance. Radiator traps and valves used in the heating system during the period of its operation to supply temporary heat shall not be reinstalled in the permanent system. Install new disposable filters and clean non-disposable filters prior to final acceptance. Replace significantly worn parts and parts that have been subject to unusual operating conditions.

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J. PARAGRAPH OMITTED

K. Temporary Ventilation: A Trade Contractor requiring ventilation for work shall provide fans or other necessary equipment to condition air, provided prior approval has been obtained from the Construction Manager.

L. Humidification: Where control of ambient humidity is required for proper performance of the work, or for curing/drying of installed work or for protection of installed work from deterioration due to variations in ambient conditions, each Trade Contractor shall provide his own temporary humidification or dehumidification equipment to maintain the required conditions. Coordinate the use of the equipment with temporary heating to produce the required conditions with a minimum overall use of energy.

M. Permanent electrical power needed to operate permanent heating system must be provided by the Electrical Trade Contractor in conjunction with building enclosure, or the Electrical Trade Contractor shall furnish adequate temporary power to operate permanent heating system.

N. In the event of permanent installed equipment failure, repairs or alternate equipment must be in place within 24 hours of failure or the Construction Manager will take action necessary to restore the heat to the design temperature and will deduct any and all charges from the HVAC Contractor.

O. If additional heating above 55 degrees F or cooling below 80 degrees F is required by a Contractor to properly install and maintain his work, he shall be responsible to provide the additional heating and cooling.

P. Connections for temporary electric to the temporary heat will be provided by the Electrical Contractor.

3.12 FIELD OFFICES

A. Trade Contractors shall provide offices for their own personnel. All type and location of jobsite offices and equipment will be approved by the Construction Manager.

B. Storage and Fabrication Sheds: Each Trade Contractor shall provide storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces. All steps and platforms connected to shelters must be per OSHA regulations.

C. All offices and sheds must have the Trade Contractor's identification on them.

3.13 ROADS AND PARKING

A. Sitework Trade Contractor shall construct and maintain temporary roads, construction parking and paving to adequately support the indicated loading and to withstand exposure to traffic during the construction period, in conjunction with the site logistics plan bound into this specification. Locate temporary paving for roads, storage areas and parking where

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the same permanent facilities will be located.

B. Sitework Trade Contractor shall be responsible for providing stable parking area for all construction personnel on the jobsite by use of crushed stone/binder paving, including permanent parking areas.

C. The Sitework Trade Contractor shall maintain truck tire wash facility at the construction entrance.

D. Snow removal will be performed by the Sitework Contractor.

3.14 ENCLOSURES

A. All temporary enclosures required for protection of exterior construction in progress and completed from exposure, bad weather, other construction operations, and similar activities and to maintain the progress schedule, shall be provided by each contractor as necessary to protect their work.

B. General Trades Contractor shall provide temporary building enclosure for protection of construction in progress, and completed, from exposure, foul weather, other construction operations, and similar activities. The extent of temporary enclosures will be as necessary to maintain the progress schedule.

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

The Aluminum, Storefront, Windows, Canopies, Glass and Glazing Trade Contractor shall be responsible to remove the temporary entrance enclosures and install the permanent entrances or reinstall parts of the temporary enclosures in such a manner that the building security is maintained at the end of each workday shift.

The Aluminum, Storefront, Windows, Canopies, Glass and Glazing Trade Contractor shall be responsible to provide temporary window enclosures, in the event that aluminum window rough openings are fully prepared to receive finish window installation and the finish materials are not ready for prompt installation to maintain the construction schedule.

The General Trade Contractor shall furnish and install temporary entrance doors and maintain them until such time the permanent entrances are installed.

D. Install tarpaulins securely with noncombustible wood framing and other materials. Close openings of 25 sq. ft. or less with plywood or similar materials.

E. Dust partitions and enclosures if indicated on the drawings shall be constructed, maintained, and removed by the General Trades Contractor.

F. Each Trade Contractor is required to construct, maintain, and remove dust partitions required to prevent dust from entering occupied areas due to the performance of his work.

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3.15 LIFTS AND HOISTS

A. Lifting and hoisting of all materials and equipment will be the responsibility of each Trade Contractor.

B. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and shall be provided by contractor requiring same.

C. Each Trade Contractor shall be responsible to provide all site and subsurface modification preparation and replacement required to use his lifting and hoisting equipment.

3.16 ELEVATORS

A. Existing Elevator to be demolished.

3.17 PROJECT IDENTIFICATION

A. The Construction Manager shall prepare project identification and other signs, as approved by the Owner, of the size indicated; install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood or steel. See attached sketches at end of this section.

B. The Construction Manager shall provide one (1) sign erected on the site, where directed, to identify the project. Sign shall include Project name, Owner's name, Architect's name, and Construction Manager's name. Size shall be 4' x 8'; color and lettering style shall be as designed by the Architect.
See attached sketches at end of this section.

C. Engage an experienced sign painter to apply graphics.

D. Temporary Signs: The Construction Manager shall prepare signs to provide directional information to construction personnel and visitors as required by the Construction Manager. See attached sketches at end of this section.

E. No other signs allowed on site unless approved by the Construction Manager.

3.18 WASTE DISPOSAL AND CLEANUP

A. The construction manager shall provide trash collection containers for construction debris, exclusive of roofing tear off debris, rock, earth, site work demolition waste, masonry and concrete debris and pay for all debris disposal cost for them. Each trade contractor on the project will be required to clean up and deposit in the dumpster, all debris generated by his trade contract work on a daily basis. Roofing contractor, Site work contractor, Masonry contractor and Concrete contractor must pay their own solid waste removal costs. All other contractors will be provided with collection containers for their use at no cost to the contractor.

This requirement shall be enforced by the Construction Manager and will result in cost

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assessment against a Trade Contractor who fails to perform daily clean-up within 48 hours of verbal or written notice from the Construction Manager. Each Trade Contractor will be responsible for flattening or crushing all trash as necessary when placed into the dumpster. Hazardous material shall not be placed in the collection container.

B. Contractors may be required to place salvageable and recyclable materials and debris in separate designated dumpsters or dispose of properly for their own salvage value.

C. All Contractors are to participate in a monthly eight (8) hour general clean up which will be coordinated by the Construction Manager. Each Contractor shall provide a minimum of on (1) clean-up person for every 15 or less people on the Contractor's average work force for the month with the appropriate brooms, shovels, and wheel barrows. Clean up will be supervised by the Construction Manager.

D. The Trades Contractors shall be responsible for weekly broom cleaning of all floor surfaces, for dust, dirt and general trash.

E. The Construction Manger will be responsible for providing trash receptacles, "55 gallon capacity". Emptying them with weekly cleanup or when filled to capacity, shall be done by the Contractors performing the work in that area.

F. The General Trades Contractor shall determine with the Construction Manager, a location for an enclosed trash chute to control dust for debris from second floor levels to the dumpster container. General Trades Contractor shall also erect a dimensional lumber guard railing around the trash chute to prevent jobsite personnel from exposure to falling debris.

3.19 CONSTRUCTION AIDS AND PROTECTION

A. The General Trades Contractor shall provide wood handrails and barricades on all stairs and landings, according to OSHA regulations. Provide barricades at all elevator shafts.

B. The Steel Work Trades Contractor shall furnish, install and remove at completion, all perimeter guard rails for elevated surfaces.

C. The General Trades Contractor shall install safety coverings, handrail around all recessed areas and openings on all floors. Building perimeters, roof, wall, or shaft openings shall have perimeter protection as required by OSHA. This work shall comply with all OSHA requirements and remain in place until permanent construction fills those openings.

D. The Roofing Trades Contractor shall install roof edge perimeter protections and guard rails or coverings, at all roof openings.

E. Each Trade Contractor, upon working in any of the areas named in the above paragraph, shall remove the safety covering and handrail to perform his work. Upon completion of his work for the day, lunch, or breaks, or any time when the individual Trade Contractor is not working in that opening, the safety covering and handrail must be replaced by the Trade Contractor removing it. At the end of each day, the General Trades Contractor will inspect the site and install all safety coverings and handrails. He shall report to the Construction Manager if coverings and handrails are not being reinstalled by other contractors.

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At the end of the project, or in order to install permanent construction, the General Trades Contractor shall remove all coverings and handrails.

F. The Trade Contractors requiring access to above grade work are responsible for providing ladders, scaffolding and appropriate methods to access their work. Trade Contractor desiring use of in place above grade work platforms must arrange directly with the party that owns the equipment and make all rental and insurance arrangements directly with that party.

G. All work platforms, scaffolding, etc., on the project shall be available for access by the Owner, Architect, Municipal Authority, Testing Agency and/or Construction Manager.

3.20 FIRE SAFETY

A. Existing fire protection shall be maintained in place until permanent sprinklered fire protection system is available for use. The Sprinkler System Trades Contractor shall provide the permanent sprinkler fire protection system for use at the earliest possible date after building enclosure and 55° F temperatures are maintained to protect the building structure.

B. The Construction Manager shall provide fire extinguishers, as required by OSHA standards or other codes.

C. Each Contractor shall store combustible materials in containers in fire-safe locations.

D. Each Contractor shall maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

E. Each Contractor shall provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

F. The Construction Manager shall provide the local fire company with a set of site and floor plans. He shall invite the local fire company to visit the project site and plan emergency response.

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3.21 BARRICADES, WARNING SIGNS, AND LIGHTS

A. All trade contractors requiring barricades, warning signs and lights shall comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against.

3.22 SITE ENCLOSURE FENCE

A. The Construction Manager shall perform all temporary fencing work as indicated on the site logistics drawing. This work shall be done immediately upon mobilizing for Work at the beginning of the Project.

B. The Sitework Contractor shall maintain permanent chain link fencing and fabric fencing

throughout the duration of the Project, particularly maintaining security function of gate devices.

3.23 BUILDING SECURITY, ENCLOSURE, AND LOCKUP

A. The General Trades Contractor shall install substantial temporary enclosure of partially completed areas of construction. Provide and maintain locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

B. Each Trade Contractor is responsible for the secure storage of their own material and equipment on and off the site.

3.24 ENVIRONMENTAL PROTECTION, NPDES, AND PPC

A. To the fullest extent permitted by law, the Trade Contractor shall indemnify and hold harmless the Owner and Construction Manager, their employees and agents, from claims, losses, damage, and expenses including, but not limited to, attorney's fees arising out of performance of the work as it relates to any type of pollution related situations. This would apply to bodily injury, sickness, disease or death, or to damages or destruction or contamination of tangible property arising out of the acts or omission of the Trade Contractor or the joint negligent acts of the Owner or Construction Manager, or anyone for whose acts the Trade Contractor may be liable.

B. Each Trade Contractor, prior to construction, must comply with the National Pollution Discharge Elimination System (NPDES) and submit and State and Local Preparedness, Prevention and Contingency Plans (PPC) to the Construction Manager before the start of work.

Each Trade Contractor must construct, operate and maintain storage of materials to provide protection for each individual worker, as well as the protection of property or real estate of the construction site and environment.

C. Each Trade Contractor shall provide protection, operate temporary facilities, and conduct construction in ways and methods that comply with all environmental regulations, and minimize the possibility that air, water, and soil from becoming contaminated or polluted as a result of work or storage of supplies and materials, or equipment usage.

D. Each Trade Contractor will designate and train a responsible employee in environmental contamination procedures, including, but not limited to, emergency responses, material and waste inventories, spills and leak precautions and responses, inspections, housekeeping, security, and external factors.

E. Open burning will not be permitted.

3.25 WORKDAY

A. The workdays for the project are defined as 7:00 a.m. to 3:30 p.m., Monday through Friday, with lunch period from 12:00B12:30 p.m. The progress schedule may require contractors to perform work other than the normal workday and in addition to the normal workday to meet milestones in the progress schedule for the project, or to make up time

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previously lost to regain the progress schedule requirements or to prevent interruption of the Owner's ongoing operations at no additional cost to the Owner.

B. Working times other than the normal workday or in addition to the normal work day, must be arranged in advance with the Construction Manager.

C. Trade Contractors who require additional workday hours to regain work time previously lost to meet the requirements of the project schedule shall be assessed for all costs including Construction Manager Supervision and other Trade Contractor cost necessary for the performance of their work.

3.26 LUNCH WAGON

A. Lunch wagons, catered events or other non-construction related functions shall not be permitted on the project site, except by the written permission of the Owner and Construction Manager.

B. No alcoholic beverages or controlled substances shall be allowed on the project at any time.

3.27 EROSION CONTROL

A. The Sitework Trade Contractor shall employ all methods required to comply with local regulatory authorities requirements to control erosion from the project site, including drainage control ditches, sediment basins, straw bale dikes, silt fencing and whatever procedure necessary to comply with requirements.

B. The Sitework Trade Contractor shall maintain these controls throughout the duration of the project.

3.28 EXCAVATION

A. Any Trade Contractor performing excavation shall protect all excavated materials from moisture, freezing and drying, so that the same materials excavated can be utilized for backfill.

B. Any Trade Contractor performing excavation shall have an OSHA trained person on site during all excavation operations. This person shall evaluate soil types and conditions to determine the required shoring and excavation methods.

3.29 BLASTING

A. Blasting is not permitted.

3.30 MATERIAL INVENTORIES

A. Contractors shall coordinate the delivery and storage on the jobsite of all significant materials.

B. Each Trade Contractor shall be responsible for the proper location, secure, and weather resistant storage as required of all materials. This includes placement of materials not to

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obstruct passage on site or within building structures or in any way which causes impediment or obstruction to other Trade Contractors.

C. All material inventories must be stored by the Trade Contractor to avoid excessive loads on building structure.

D. When directed by the Construction Manager, a Trade Contractor shall remove or relocate material inventories as required for the progress of the project.

3.31 DELIVERIES

A. All contractors are required to properly instruct material suppliers and vendors to address deliveries to them specifically by named responsible party at the jobsite and require advance notice.

B. All deliveries addressed to the project in general, the Owner, Architect or Construction Manager, will be refused and returned to shipper.

C. The Owner will not be responsible for receipt, handling, or loss of any materials which are shipped to the Owner in error and received unknowing of relationship to the project.

D. Contractor receiving materials at the jobsite shall be responsible for prevention of any mud or other deposits on public roadways or other areas outside project limit lines, which may result due to methods of material delivery. Trade Contractor shall instruct delivery conveyor to take appropriate measures to prevent depositing mud or other construction deposits outside of contract limit lines. Total responsibility of cleanup of mud or other construction deposit outside of contract limit lines will be the responsibility of the Trade Contractor receiving the delivery.

E. Each Contractor shall provide his superintendent with a telephone pager to enable locating the superintendent on and off site.

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3.32 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.
2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Construction Manager requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or not later than Substantial Completion. Complete

or, if necessary restore, permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the Trade Contractor. The Owner reserves the right to take possession of Project identification signs.

2. The Sitework Trade Contractor shall remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt, and other petrochemical compounds, and other substances which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances, as required by the governing authority.

3.33 SNOW REMOVAL

A. Snow removal for roads, building exterior, contractor parking, contractor office, staging, and Construction Manager's office area access will be performed by the Sitework Contractor.

B. The General Trades Contractor shall be responsible for snow removal from within the building, maintaining safe walkway, stair traffic areas and building corridors, using anti-skid methods for snow, mud and/or ice removal, to provide safe usage.

C. All snow and ice removal required to perform contractor specific tasks on floors, roof, work stages, etc., shall be performed by each Contractor.

END OF SECTION 015000

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SECTION 016000 - MATERIALS AND EQUIPMENT PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

1. Multiple Prime Contracts: Provisions of this Section apply to the construction activities of each prime contractor.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
2. Division 1 Section "Submittals" specifies requirements for submittal of the Contractor's Construction Schedule and the Submittal Schedule.
3. Division 1 Section "Substitutions" specifies administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, which is current as of the date of the Contract Documents.

b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

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3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 SUBMITTALS

A. Product List: A list of products required is included at the end of this Section. Prepare a schedule in tabular form showing each product listed. Include the manufacturer's name and proprietary product names for each item listed.

B. Product List: Prepare a list showing products specified in tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate product list with the Contractor's Construction Schedule and the Schedule of Submittals.
2. Form: Prepare product list with information on each item tabulated under the following column headings:

    a. Related Specification Section number.
    b. Generic name used in Contract Documents.
    c. Proprietary name, model number, and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date or time span of delivery period.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of an initial product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.

    a. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.

4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of the completed product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.

5. Architect's Action: The Architect will respond in writing to Contractor within 2 weeks of receipt of the completed product list. No response within this period constitutes no objection to listed manufacturers or products but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include a list of unacceptable product selections, containing a brief explanation of reasons for this action.

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1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each prime contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate contractors.
2. If a dispute arises between prime contractors over concurrently selectable, but incompatible products, the Architect will determine which products shall be retained and which are incompatible and must be replaced.

C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:

1. No available domestic product complies with the Contract Documents.
2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.

D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
   a. Name of product and manufacturer.
   b. Model and serial number.
   c. Capacity.
   d. Speed.
   e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where Specifications name only a single product or manufacturer, provide the product indicated. No substitutions will be permitted.
2. Semi proprietary Specification Requirements: Where Specifications name 2 or more products or manufacturers, provide 1 of the products indicated. No substitutions will be permitted.

a. Where Specifications specify products or manufacturers by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

3. Nonproprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly,

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listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated.
   a. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.

6. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.

7. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
   a. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.

8. Visual Selection: Where specified product requirements include the phrase "... as selected from manufacturer's standard colors, patterns, textures ..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern, and texture from the product line selected.

9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 1 for allowances that control product selection and for procedures required for processing such selections.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

   1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 016000

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SECTION 017000 – CONTRACT CLOSEOUT

1.1 RELATED SECTIONS

A. General and Supplementary Conditions.
B. Section 013300 - Submittal Procedures for closeout documents submittals.
C. Section 015000 - Construction Facilities and Temporary Controls: Progress cleaning.
D. Section 017500 - Starting of Systems: System start-up, testing, adjusting, and balancing.

1.2 CLOSEOUT PROCEDURES

A. Completion of the Work specified herein is a condition precedent to issuance of the Final Certificate of Payment by Construction Manager and Architect.

B. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect review.

C. Provide submittals to Architect through Construction Manager that is required by governing or other authorities.

D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

E. Owner will occupy portions of the site as specified in Section 013100.

1.3 HAZARDOUS-FREE MATERIALS CERTIFICATION

A. Upon completion of this project, the Contractor shall deliver to the Architect three (3) copies of a notarized letter addressed to the Owner certifying that to the best of the Contractor's knowledge all products provided by them for incorporation into this project do not contain any hazardous materials exceeding current EPA guidelines.

B. It is the responsibility of the Contractor to review "Manufacturer's Safety Data Sheets" (MSDS) on all products to ascertain compliance with EPA guidelines prior to shop drawing submission to the Architect. Incorporation of products into the project without the submission of shop drawings or samples to the Architect will indicate that the Contractor has ascertained that the products meet EPA limits.

C. It is the responsibility of the Contractor to notify the Architect in writing of the lack of compliance of a product with EPA guidelines prior to ordering or incorporating any products into this project.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit data on 8-1/2 x 11 inch text pages, bound in three D side ring binders with durable plastic covers.

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B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of Project.

C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed on white paper, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. Include for all mechanical and electrical equipment a compilation of the nameplate data for equipment; name, address and phone number of nearest distributor; name, address and phone number of nearest service organization.

2. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

   a. Significant design criteria.
   b. List of equipment.
   c. Parts list for each component.
   d. Operating instructions.
   e. Maintenance instructions for equipment and systems.
   f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents. Include videotapes of training sessions.
   g. (1) 8x10 photograph of each piece of equipment.
   h. Name and telephone number of service representative.
   i. Test results/reports.
   j. Certified performance curves.
   k. Re-order information.
   l. Catalog, model, serial number.
   m. Wiring diagrams.
   n. Assembly drawings.
   o. Schedule
   p. Charts
   q. Nameplate data.

3. Part 3: Project documents and certificates, including the following:

   a. Shop drawings and product data.
   b. Air and water balance reports.
   c. Certificates.
   d. Photocopies of warranties and bonds.

E. Submit 1 draft copy of completed volumes 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect/Engineer comments. Revise

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content of all document sets as required prior to final submission.

F. Submit three copies of revised final volumes, within 10 days after final inspection.

1.5 WARRANTIES

A. Provide triplicate notarized copies.

B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in three D side ring binder with durable plastic cover.

D. Submit prior to final Application for Payment.

E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.6 FINAL SUBMISSIONS

A. Submit Consent of Surety to Final Payment.

B. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

C. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and the list has been endorsed and dated by the Architect.

D. Affidavit of payment of all claims against the work.

1.7 PROJECT RECORD DOCUMENTS

A. Trade contractors shall maintain on site, one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Construction Manager and Owner.

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C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

   1. Measured depths of foundations in relation to finish floor.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract Drawings.

G. Remove Architect seal from all documents.

H. Submit documents to Architect with final Application for Payment.

I. Submit a final liquidated damages settlement statement.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed extra materials and parts as indicated within the respective specification sections; obtain receipt from Owner upon delivery and placement and prior to final payment.

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END OF SECTION 017000

SECTION 01 73 29 – CUTTING & PATCHING

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 procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 02 through 07 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety. Operating elements include the following: List below is an example only. Revise to suit Project's operating systems. With advice of counsel, delete below if Architect's approval is not required. If list is deleted, delete option in paragraph above.

1. Fire-suppression systems.
2. Mechanical systems piping and ducts.
3. Control systems.
4. Communication systems.
5. Conveying systems.
6. Electrical wiring systems.

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C. 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.

D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

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.

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C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied 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 or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
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.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even

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surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 73 29

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SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.

B. Salvage: Recovery of materials for on-site reuse, sale or donation to a third party.

C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Crushing or grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.

D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.

E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.

F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.

G. Approved Recycling Facility: Any of the following:

1. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.

2. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials.

1.3 SUBMITTALS

A. Contractor shall develop a Waste Management Plan: Submit 3 copies of plan within 14 days of date established for the **Notice to Proceed**.

B. Contractor shall provide Waste Management Report: Concurrent with each Application for Payment, submit **3** copies of report.

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1.4 PERFORMANCE REQUIREMENTS

A. General: Divert a minimum of **75%** CDL waste, by weight, from the landfill by one, or a combination of the following activities:

1. Salvage
2. Reuse
3. Source-Separated CDL Recycling
4. Co-mingled CDL Recycling

B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:

1. Acoustical ceiling tiles
2. Asphalt
3. Asphalt shingles
4. Cardboard packaging
5. Carpet and carpet pad
6. Concrete
7. Drywall
8. Fluorescent lights and ballasts
9. Land clearing debris (vegetation, stumpage, dirt)
10. Metals
11. Paint (through hazardous waste outlets)
12. Wood
13. Plastic film (sheeting, shrink wrap, packaging)
14. Window glass
15. Wood
16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.4 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.

B. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.

C. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.

1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.

a. Owner
b. Architect

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c. Contractor's superintendent
d. Major subcontractors
e. Waste Management Coordinator
f. Other concerned parties.

2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:

a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
b. Review requirements for documenting quantities of each type of waste and its disposition.
c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
e. Review waste management requirements for each trade.

3. Minutes: Record discussion. Distribute meeting minutes to all participants.
Note: If there is a Project Architect, they will perform this role.

1.5 WASTE MANAGEMENT PLAN – Contactor shall develop and document the following:

A. Develop a plan to meet the requirements listed in this section at a minimum. Plan shall consist of waste identification, waste reduction plan and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight throughout the plan.

B. Indicate anticipated types and quantities of demolition, site-cleaning and construction waste generated by the project. List all assumptions made for the quantities estimates.

C. List each type of waste and whether it will be salvaged, recycled, or disposed of in an landfill. The plan should included the following information:

1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.

2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:

a. Contracting with a deconstruction specialist to salvage materials generated,
b. Selective salvage as part of demolition contractor’s work,
c. Reuse of materials on-site or sale or donation to a third party.

3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:

a. Requiring subcontractors to take their CDL waste to a recycling facility;
b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility;

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c. Processing and reusing materials on-site;
d. Self-hauling to a recycling or material recovery facility.

4. Name of recycling or material recovery facility receiving the CDL wastes.

5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs, including cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

A. Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.

B. The collection containers for recyclable CDL waste must contain no more than 10% non-recyclable material, by volume.

C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.

D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.

E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.

F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

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A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible.

Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

REMOVAL OF CONSTRUCTION WASTE MATERIALS

A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.

B. Transport CDL waste materials off Owner's property and legally dispose of them.

C. Burning of CDL waste is not permitted.

END OF SECTION

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WASTE MANAGEMENT PROGRESS REPORT				
	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	**DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE**		
MATERIAL CATEGORY		Recycled	Salvaged	Reused
1. Acoustical Ceiling Tiles				
2. Asphalt				
3. Asphalt Shingles				
4. Cardboard Packaging				
5. Carpet and Carpet Pad				
6. Concrete				
7. Drywall				
8. Fluorescent Lights and Ballasts				
9. Land Clearing Debris (vegetation, stumpage, dirt)				
10. Metals				
11. Paint (through hazardous waste outlets)				
12. Wood				
13. Plastic Film (sheeting, shrink wrap, packaging)				
14. Window Glass				
15. Field Office Waste (office paper, aluminum cans, glass, plastic, and coffee cardboard)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL ABOVE VALUES – IN WEIGHT)		
		Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)	

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SECTION 017500 - FACILITY STARTUP/COMMISSIONING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Starting systems.

B. Demonstration and instructions.

1.2 RELATED SECTIONS

A. General and Supplementary Conditions.

B. Section 017000 - Contract Closeout: System operation and maintenance data and extra materials.

1.3 STARTING SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Construction Manager, Architect/Engineer and Owner seven (7) days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer=s representative and Contractors= personnel in accordance with manufacturers= instructions.

G. When specified in individual Specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

1.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner=s personnel no more than two (2) weeks prior to date of Substantial Completion.

B. Demonstrate Project equipment and instruct in a classroom environment located at site and instructed by a qualified manufacturers= representative who is knowledgeable about the Project.

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C. Contractor shall video tape the demonstration/instructions on format acceptable to Owner and provide two (2) copies of tape at Project closeout or at such time as directed by Construction Manager. Tape shall be clear in visual and audio recreation of demonstration and instructions. A professionally prepared training video produced by the manufacturer shall be an acceptable substitute to on-site video tape.

D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners= personnel in detail to explain all aspects of operation and maintenance.

F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment or designated location.

G. Prepare and insert additional data in operations and maintenance manuals when needed for additional data becomes apparent during construction.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 017500

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Record Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
3. Divisions 2 through 33 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 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. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
7. Complete startup testing of systems.
8. Submit test/adjust/balance records.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Advise Owner of changeover in heat and other utilities.

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11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
12. Complete final cleaning requirements, including touchup painting.
13. 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 on 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.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 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 list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

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2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Include space for sign off and acceptance of each item.

1.6 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect and Owner's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. 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 cannot be readily identified and recorded later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. Mark important additional information that was either shown schematically or omitted from original Drawings.
4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy 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.

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2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one (1) set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

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 Drawings, and Record Specifications, where applicable.

E. Miscellaneous Record Submittals: 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.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:

a. Emergency instructions and procedures.
b. System, subsystem, and equipment descriptions, including operating standards.
c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
d. Description of controls and sequence of operations.
e. Piping diagrams.

2. Maintenance Data:

a. Manufacturer's information, including list of spare parts.
b. Name, address, and telephone number of Installer or supplier.
c. Maintenance procedures.
d. Maintenance and service schedules for preventive and routine maintenance.
e. Maintenance record forms.
f. Sources of spare parts and maintenance materials.
g. Copies of maintenance service agreements.
h. Copies of warranties and bonds.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

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1.8 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. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of 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 (115-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.

D. 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 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors experienced in operation and maintenance procedures.
2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

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B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.2 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances. Cut lawn and field areas.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.

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l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

n. Replace parts subject to unusual operating conditions.

o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

q. Clean ducts, blowers, and coils if units were operated without filters during construction.

r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

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SECTION 017836 - WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Submittals" specifies procedures for submitting warranties.
2. Division 1 Section "Contract Closeout" specifies contract closeout procedures.
3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.
4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

D. Separate Prime Contracts: Each prime contractor is responsible for warranties related to its own contract.

1.3 DEFINITIONS

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

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B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

C. Forms for special warranties are included at the end of this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

1. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Form of Submittal: At Final Completion compile 2 copies of each required warranty properly

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executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

E. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the 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 the Installer.

2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.

3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 LIST OF WARRANTIES

A. Schedule: Provide warranties on products and installations as specified in individual specification sections.

END OF SECTION 017836

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Statement of Special Inspections

Project: *Sussex County Vocational Technical School District* – STHS WEST PAVILION & GREENHOUSE

Location: *17137 County Seat Highway Georgetown, Delaware 19947*

Owner: *Sussex County Vocational Technical School District*

Design Professional in Responsible Charge:

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project as well as the name of the Special Inspection Coordinator and the identity of other approved agencies to be retained for conducting these inspections and tests. This *Statement of Special Inspections* encompass the following disciplines:

☒ Structural ☐ Mechanical/Electrical/Plumbing
☐ Architectural ☐ Other: _____

The Special Inspection Coordinator shall keep records of all inspections and shall furnish inspection reports to the Building Official and the Registered Design Professional in Responsible Charge. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official and the Registered Design Professional in Responsible Charge.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Interim Report Frequency: or ☒ per attached schedule.

Prepared by:

Jim Baker, PE
(type or print name)

Signature Date

Design Professional Seal

Owner's Authorization:

Signature Date

Building Official's Acceptance:

Signature Date

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Schedule of Inspection and Testing Agencies

This Statement of Special Inspections / Quality Assurance Plan includes the following building systems:

- ☒ Soils and Foundations
- ☒ Cast-in-Place Concrete
- ☐ Precast Concrete
- ☒ Masonry
- ☒ Structural Steel
- ☒ Cold-Formed Steel Framing
- ☐ Spray Fire Resistant Material
- ☐ Wood Construction
- ☐ Exterior Insulation and Finish System
- ☐ Mechanical & Electrical Systems
- ☐ Architectural Systems
- ☐ Special Cases

Special Inspection Agencies	Firm	Address, Telephone, e-mail
1. **Special Inspection Coordinator**		
2. Inspector		
3. Inspector		
4. Testing Agency		
5. Testing Agency		
6. Other		

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Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

SPECIAL INSPECTIONS AND TESTS MATRIX

(Required by IBC 2012, Chapter 17)

Note: Refer to individual Technical Specification Sections for additional testing requirements.

Project: Sussex County Vocational Technical School District – STHS WEST PAVILION & GREENHOUSE

INSPECTION AND TESTING *("Continuous" & "Periodic" defined by the IBC 2009; refer to applicable Technical Specification Section for additional frequency requirements)*	REQUIRED *(Required if checked; Not Applicable if not checked)*	TECHNICAL SPECIFICATION SECTION	INSPECTION/ TESTING RESPONSIBILITY	CONTINUOUS	PERIODIC	REFERENCE STANDARD	IBC 2012 REFERENCE
A. Concrete Construction							
1. Inspection of reinforcing steel, including prestressing tendons, and placement.	☒	03 30 00	Owner's Testing Agency	☐	☒	ACI 318: 3.5, 7.1-7.7	1910.4
2. Inspection of reinforcing steel welding in accordance with Table 1705.2.2, Item 2b.	☒	03 30 00	Owner's Testing Agency	☐	☐	AWS D1.4; ACI 318: 3.5.2	-
3. Inspection of anchors cast in concrete where allowable loads have been increased or where strength design is used.	☒	03 30 00	Owner's Testing Agency	☐	☒	ACI 318: 8.1.3, 21.2.8	1908.5, 1909.1
4. Inspection of anchors installed in hardened concrete members	☒	03 30 00	Owner's Testing Agency	☐	☒	ACI 318: 3.8.6, 8.1.3, 21.2.8	1909.1
5. Verify use of required design mix.	☒	03 30 00	Owner's Testing Agency	☐	☒	ACI 318: Ch. 4, 5.2-5.4	1904.2, 1910.2, 1910.3
6. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	☒	03 30 00	Owner's Testing Agency	☒	☐	ASTM C 172, ASTM C 31; ACI 318: 5.6, 5.8	1910.10
7. Inspection of concrete and shotcrete placement for proper application techniques	☒	03 30 00	Owner's Testing Agency	☒	☐	ACI, 318: 5.9, 5.10	1910.6, 1910.7, 1910.8
8. Inspection for maintenance of specified curing temperature and techniques	☒	03 30 00	Owner's Testing Agency	☐	☒	ACI, 318: 5.11, 5.13	1910.9
9. Inspection of prestressed concrete:							
a. Application of prestressing forces.	☐		Owner's Testing Agency	☒	☐	ACI 318: 18.20	-
b. Grouting of bonded prestressing tendons in the seismic-force-resisting system.	☐		Owner's Testing Agency	☒	☐	ACI 318: 18.18.4	-
10. Erection of precast concrete members	☐		Owner's Testing Agency	☐	☒	ACI 318: Ch. 16	-
11. Verification of in-situ concrete strength, prior to stressing of tendons	☒	03 30 00	Owner's Testing Agency	☐	☒	ACI 318: 6.2	-

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INSPECTION AND TESTING *("Continuous" & "Periodic" defined by the IBC 2009; refer to applicable Technical Specification Section for additional frequency requirements)*	**REQUIRED** (*Required if checked; Not Applicable if not* checked)	**TECHNICAL SPECIFICATION SECTION**	**INSPECTION/ TESTING RESPONSIBILITY**	**CONTINUOUS**	**PERIODIC**	**REFERENCE STANDARD**	**IBC 2012 REFERENCE**
in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs							
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.	☒	03 31 00.00 10	Owner's Testing Agency	☐	☒	ACI 318: 6.1.1	-
B. Masonry Construction - Level 1							
1. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 1.5	-
2. Verification of f'_m and f'_{AAC} prior to construction except where specifically exempted by this code.	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 1.4B	-
3. Verification of slump flow and VSI as delivered to the site for self-consolidating grout.	☒	04 20 00	Owner's Testing Agency	☒	☐	TMS 602, ACI 530.1, ASCE 6[a], Art. 1.5.B.1.b.3	-
4. Verify to ensure compliance: a. Proportions of site prepared mortar	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 2.6A	-
b. Construction of mortar joints	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.3B	-
c. Location of reinforcement, connectors, prestressing tendons, anchorages	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.4, 3.6A	-
d. Prestressing technique	☐		Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.6B	-
e. Grade and size of prestressing tendons & anchorages	☐		Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 2.4B, 2.4H	-
5. Inspection shall verify: a. Size and location of structural elements	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.3F	-

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INSPECTION AND TESTING *("Continuous" & "Periodic" defined by the IBC 2009; refer to applicable Technical Specification Section for additional frequency requirements)*	REQUIRED (*Required if checked; Not Applicable if not* checked)	TECHNICAL SPECIFICATION SECTION	INSPECTION/ TESTING RESPONSIBILITY	CONTINUOUS	PERIODIC	REFERENCE STANDARD	IBC 2012 REFERENCE
b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 402, ACI 530, ASCE 5[a], Sec. 1.2.2(e), 1.16.1	-
c. Specified size, grade and type of reinforcement, anchor bolts, pre-stressing tendons and anchorages	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 402, ACI 530, ASCE 5[a], Sec.1.15, TMS 602, ACI 530.1, ASCE 6[a], Art. 2.4, 3.4	-
d. Welding of reinforcing bars	☒	04 20 00	Owner's Testing Agency	☒	☐	TMS 402, ACI 530, ASCE 5[a], Sec. 2.1.9.7.2, 3.3.3.4(b)	-
e. Cold (temperature below 40°F)/hot (temperature above 90°F) weather protection of masonry construction	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 1.8C, 1.8D	Sec.2104.3, 2104.4
f. Prestressing force measurement and application	☐	04 20 00	Owner's Testing Agency	☒	☐	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.6B	-
6. Prior to grouting, the following shall be verified to ensure compliance: a. Grout space is clean.	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.2D	-
b. Placement of reinforcement, connectors and anchorages.	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 402, ACI 530, ASCE 5[a], Sec. 1.13 TMS 602, ACI 530.1, ASCE 6[a], Art. 3.4	-
c. Proporations of site-prepared grout.	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 2.6B	-
d. Construction of mortar joints.	☒	04 20 00	Owner's Testing Agency	☐	☒	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.3B	-
7. Grout placement shall be verified to ensure compliance with code and construction document provisions.	☒	04 20 00	Owner's Testing Agency	☒	☐	TMS 602, ACI 530.1, ASCE 6[a], Art 3.5	-
a. Grouting of prestressing bonded tendons	☐	04 20 00	Owner's Testing Agency	☒	☐	TMS 602, ACI 530.1, ASCE 6[a], Art. 3.6C	-

NOT FOR BIDDING

INSPECTION AND TESTING *("Continuous" & "Periodic" defined by the IBC 2009; refer to applicable Technical Specification Section for additional frequency requirements)*	REQUIRED (*Required if checked; Not Applicable if not* checked)	TECHNICAL SPECIFICATION SECTION	INSPECTION/ TESTING RESPONSIBILITY	CONTINUOUS	PERIODIC	REFERENCE STANDARD	IBC 2012 REFERENCE
8. Preparation of grout specimens, mortar specimens and/or prisms	☒	04 20 00	Owner's Testing Agency	☒	☐	TMS 602, ACI 530.1, ASCE 6[a], Art 1.4	Sec. 2105.2.2, 2105.3
D. Steel Construction							
1. Material verification and high strength bolts, nuts, and washers:							
a. Identification markings to conform to ASTM standards specified in the approved construction documents	☒	05 12 00	Owner's Testing Agency	☐	☒	Applicable ASTM material specifications. AISC 360, Section A3.3	
b. Manufacturer's certificate of compliance required	☒	05 12 00	Owner's Testing Agency	☐	☒	-	
2.Inspection of high-strength bolting:							
a. Snug-tight joints	☐	05 12 00	Owner's Testing Agency	☐	☒	AISC 360, Section M2.5	1704.3.3
b. Pre-tensioned and slip-critical joints using turn-of-nut with match marking, twist-off bolt or direct tension indicator methods of installation.	☐	05 12 00	Owner's Testing Agency	☐	☒	AISC 360, Section M2.5	1704.3.3
c. Pre-tensioned and slip-critical using turn-of-nut without match marking or calibrated wrench methods of installation.	☐	05 12 00	Owner's Testing Agency	☒	☐	AISC 360, Section M2.5	1704.3.3
3. Material verification of structural steel:							
a. For structural steel, identification markings to conform to AISC 360.	☒	05 12 00	Owner's Testing Agency	☐	☒	AISC 360, Section M5.5	-
b. Identification markings to conform to ASTM standards specified in the approved construction documents.	☒	05 12 00	Owner's Testing Agency	☐	☒	Applicable ASTM material standards	-
c. Manufacturer's certified test reports.	☒	05 12 00	Owner's Testing Agency	☐	☒	-	-
4. Material verification of weld filler materials:							
a. Identification markings to conform to AWS specification in the approved construction documents.	☒	05 12 00	Owner's Testing Agency	☐	☒	AISC 360, Section A3.5 and applicable AWS A5 documents	-

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INSPECTION AND TESTING *("Continuous" & "Periodic" defined by the IBC 2009; refer to applicable Technical Specification Section for additional frequency requirements)*	REQUIRED (*Required if checked; Not Applicable if not checked*)	TECHNICAL SPECIFICATION SECTION	INSPECTION/ TESTING RESPONSIBILITY	CONTINUOUS	PERIODIC	REFERENCE STANDARD	IBC 2012 REFERENCE
b. Manufacturer's certificate of compliance required.	☒	05 12 00	Owner's Testing Agency	☐	☒	-	-
5. Inspection of welding: a. Structural steel and cold-formed steel deck:							
1. Complete and partial penetration groove welds.	☒	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.1	1704.3.1
2. Multipass fillet welds.	☒	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.1	1704.3.1
3. Single-pass fillet welds >5/16"	☒	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.1	1704.3.1
4. Plug and slot welds	☒	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.1	1704.3.1
5. Single-pass fillet welds ≤ 5/16"	☒	05 12 00	Owner's Testing Agency	☐	☒	AWS D1.1	1704.3.1
6. Floor and roof deck welds.	☒	05 12 00	Owner's Testing Agency	☐	☒	AWS D1.3	-
b. Reinforcing steel:							
1. Verification of weldability of reinforcing steel other than ASTM A 706.	☒	05 12 00	Owner's Testing Agency	☐	☒	AWS D1.4, ACI 318: Section 3.5.2	-
2. Reinforcing steel-resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls and shear reinforcement.	☐	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.4, ACI 318: Section 3.5.2	-
3. Shear reinforcement.	☒	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.4, ACI 318: Section 3.5.2	-
4. Other reinforcing steel.	☒	05 12 00	Owner's Testing Agency	☐	☒	AWS D1.4, ACI 318: Section 3.5.2	-
6. Inspection of steel frame joint details for compliance with approved construction documents:							
a. Details such as bracing and stiffening.	☐	05 12 00	Owner's Testing Agency	☐	☒	-	1704.3.2
b. Member locations.	☐	05 12 00	Owner's Testing Agency	☐	☒	-	1704.3.2
c. Application of joint details at each connection.	☐	05 12 00	Owner's Testing Agency	☐	☒	-	1704.3.2
E. STEEL CONSTRUCTION OTHER THAN STRUCTURAL STEEL							
1. Material verification of cold-formed steel deck:							

NOT FOR BIDDING

INSPECTION AND TESTING *("Continuous" & "Periodic" defined by the IBC 2009; refer to applicable Technical Specification Section for additional frequency requirements)*	REQUIRED *(Required if checked; Not Applicable if not checked)*	TECHNICAL SPECIFICATION SECTION	INSPECTION/ TESTING RESPONSIBILITY	CONTINUOUS	PERIODIC	REFERENCE STANDARD	IBC 2012 REFERENCE
a. Identification markings to conform to ASTM standards specified in the approved construction documents	☒	05 12 00	Owner's Testing Agency	☐	☒	Applicable ASTM material standards	
b. Manufacturer's certified test reports	☒	05 12 00	Owner's Testing Agency	☐	☒		
2.Inspection of welding:							
a. Cold-formed steel deck:							
1. Floor and roof deck welds.	☒	05 12 00	Owner's Testing Agency	☐	☒	AWS D1.3	
b. Reinforcing Steel:							
1) Verification of weldability of reinforcing steel other than ASTM A706.	☒	05 12 00	Owner's Testing Agency	☐	☒	AWS D1.4, ACI 318: Section 3.5.2	
2) Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special structural walls of concrete and shear reinforcement.	☒	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.4, ACI 318: Section 3.5.2	
3) Shear reinforcement.	☒	05 12 00	Owner's Testing Agency	☒	☐	AWS D1.4, ACI 318: Section 3.5.2	
4) Other reinforcing steel.	☒	05 12 00	Owner's Testing Agency	☐	☒	AWS D1.4, ACI 318: Section 3.5.2	
F. Soils							
1. Verify element materials below shallow foundations are adequate to achieve the design bearing capacity.	☒	31 00 00	Owner's Testing Agency	☐	☒		
2. Verify excavations are extended to proper depth and have reached proper material.	☒	31 00 00	Owner's Testing Agency	☐	☒		
3. Perform classification and testing of compacted fill materials.	☒	31 00 00	Owner's Testing Agency	☐	☒		
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	☒	31 00 00	Owner's Testing Agency	☒	☐		
5. Prior to placement of compacted fill, observe Subgrade and verify that site has been prepared properly.	☒	31 00 00	Owner's Testing Agency	☐	☒		

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“Special Inspections and Tests” Report Requirements:

1. Testing Agency to furnish reports to the appropriate authority and to the registered design professional. Reports to indicate that work inspected is in conformance with the contract documents. Discrepancies to be brought to the immediate attention of the contractor for correction, and reported to the registered design professional. If discrepancies are not corrected they are to be brought to the attention of the appropriate authority and to the registered design professional, prior to completion of that phase of the work. Final reports documenting the tests and inspections along with discrepancies and correction of discrepancies shall be furnished to the appropriate authority and to the registered design professional.

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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 "Electrical Commissioning Requirements" for specific requirements for commissioning electrical systems.
3. Division 01 Section "Plumbing System Commissioning Requirements" for specific requirements for commissioning Plumbing systems.
4. Division 01 Section "Contract Closeout" for specific requirements for closeout at substantial and final completion.
5. Division 01 Section "Contract Closeout" for Specific Requirements for training and demonstration of systems to Owner.
6. 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:

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1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. All contractor commissioning requirements and costs associated with commissioning the project shall be included in the base bid.
3. Representatives of the facility user and operation and maintenance personnel.
4. 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 and pre-testing of functional performance tests are complete and operational prior to scheduling performed testing by CxA. Submit completed functional performance test forms with data from pre-testing.
9. During functional performance testing, a representative from the mechanical contractor, controls contractor, and test/balance engineer must be present and participate in testing.

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. Pre-test all systems/equipment prior to engaging CxA for Functional Performance Testing.
2. Participate in commissioning and construction-phase coordination meetings.
3. Participate in maintenance orientation and inspection.
4. Participate in procedures meeting for testing.
5. Participate in final review at acceptance meeting.
6. 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.
7. Provide information to the CxA for developing construction-phase commissioning plan.

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8. Participate in training sessions for Owner's operation and maintenance personnel.
9. Provide updated Project Record Documents to the CxA on a daily basis.
10. 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."
11. 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.
12. The test/balance subcontractor, mechanical contractor, and automatic temperature controls subcontractor must be on-site and provide assistance during all functional performance testing.

D. Contractors and subcontractors must pre-inspect and pre-test all equipment and systems prior to requesting functional performance testing by the CxA. All pre-start/start-up checklists and functional performance test forms must be completed and submitted to Engineer prior to scheduling formal functional performance testing.

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

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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

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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

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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. Punch Lists.
8. Test/Balance Reports.
9. Listing of off-season test(s) not performed and a schedule for their completion.
10. All commissioning documents must be submitted to the building Owner within 90 days of the date of receipt of the Certificate of Occupancy.

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."

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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.

1.12. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

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.

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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

NOT FOR BIDDING

SECTION 019114– PLUMBING 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 plumbing 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. Backflow preventers.
2. Compressed air systems/equipment.
3. Condensate Neutralizers.
4. Domestic Hot Water Expansion Tanks.
5. Domestic hot water heaters.
6. Domestic hot water re-circulating system.
7. Domestic water meters (including interlock to ATC system).
8. Domestic water pumps.
9. Emergency eyewash/shower systems, mixing valves, alarms, and equipment.
10. Gas Pressure Regulators.
11. High/Low mixing valves.
12. Plumbing Fixtures.
13. Plumbing Pumps.
14. Roof Hydrants.
15. Shower head flow rates.
16. Thermostatic mixing valves below hand sinks/lavs.
17. Trap priming stations.

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 plumbing systems, electrical, communications, controls for plumbing 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.

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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.
3. Assist performing functional performance tests.

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.
3. Assist performing functional performance tests.
4. Assist testing flow rates of all plumbing fixtures and plumbing equipment.

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:
i. Accessibility of equipment and components required for TAB Work.
ii. Verify flush valve gallons per flush matches schedules/submittals.
iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
iv. 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.
v. Flow rates and aerations 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."
d. Assist performing functional performance tests.

2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation & Controls of HVAC & Plumbing Systems."

F. Electrical Contractor:

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

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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 plumbing 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 plumbing systems and equipment.
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. Certified Pipe Cleaning and Flushing Report: CxA shall certify that pipe cleaning, flushing, hydrostatic testing, and chemical treating have been completed.

F. 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.

G. Corrective Action Documents: CxA shall submit corrective action documents.

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

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1.7. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1. TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that plumbing 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 plumbing 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 plumbing 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 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. Backflow preventer cross connection tests.
    b. Air Compressor operation including refrigerated air dryers.
    c. Discharge temperatures of water heaters.
    d. Domestic water meter total volume in gallons.
    e. Flow rates for domestic re-circulating systems.
    f. Flow rates in gallons per minute for showerheads.
    g. Thermostatic mixing valve temperatures and water flow rates.
    h. Re-circ. pump and alarms pressures and flow rates.
    i. Roof hydrant operation and freeze protection.
    j. Temperature for emergency eyewash/shower systems.
    k. Trap priming station water discharge.
    l. Water heater temperatures and set points.

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

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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 plumbing 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 22 Sections.
13. Verify flow rates of all aerators.
14. Verify the operation and flow rates of all plumbing fixtures and plumbing equipment.

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. Operational modes include the following:

1. Occupied and unoccupied.
2. Emergency power supply.
3. Life-safety and safety systems.
4. Temporary upset of system operation.
5. Partial occupancy conditions.
6. Special cycles.
7. Alarm conditions.
8. All alarms.

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, Plumbing 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. A deviation of more than 10 percent.

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB

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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 Plumbing Contractor Testing:

1. Testing scope shall include entire plumbing installation, from central hot water heating equipment for heat generation through distribution systems to each fixture. 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.
3. Test all plumbing fixtures.
4. Test time to reach temperature and temperature of hot water at all fixtures with thermostatic mixing valves.
5. Test discharge of water at all trap priming stations.
6. Verify that all backflow preventers have been tested. Document in writing.
7. Test operation of all water meters.
8. Test domestic water heaters.
9. Test operation, set points, and safeties of water heaters.
10. Test discharge of water at all trap priming stations.
11. Test emergency fixtures including temperatures and alarms.

D. Detailed Testing Procedures: CxA, with Plumbing Contractor, TAB Subcontractor, and Plumbing Instrumentation and Control Contractor, shall prepare detailed testing plans, procedures, and checklists for plumbing 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, Plumbing Contractor, and the HVAC Instrumentation and Control Contractor shall collaborate to

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prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

F. Plumbing System Testing: Plumbing Contractor shall prepare a testing plan to verify performance of water heaters, emergency eyewash/shower systems, domestic re-circulating systems, backflow preventers, plumbing fixtures, trap priming stations, domestic pumps, domestic water meters, and thermostatic mixing valves. 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 section 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. Design and actual measurements for all equipment.

G. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the plumbing 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.

H. 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

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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 Flow Monitoring Stations.
2. Automatic Temperature Control System.
3. Carbon Dioxide Sensors.
4. Condensate overflow alarms.
5. Condensate pumps.
6. Dampers.
7. Demand Meter/ATC Interface.
8. Duct smoke detectors.
9. Ductless heat pump units.
10. Electric Duct Heater.
11. Electric Heaters/Radiant Heat Panels.
12. Electric Panel Monitoring and Control.
13. Energy recovery ventilators (Including variable frequency drives).
14. Energy Recovery Module.
15. Exhaust Fans and ventilation fans.
16. Gas Furnaces.
17. Gas Fired Radiant Heaters.
18. Greenhouse ventilation/heating systems.
19. High and low temperature alarms.
20. Hot Gas Reheat coils.
21. HVAC controls and sequences of operation.
22. Lighting interface to ATC system.
23. Plumbing load interface with ATC system.
24. Refrigerant Mitigation Controls.
25. Relative Humidity Sensors.
26. Static Pressure Sensors.
27. Temperature Sensors.
28. Unit Heaters.
29. Variable frequency drives.
30. Ventilation Fans.

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31. Water meter/ATC interface.

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.
3. Assist performing functional performance tests.

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.
3. Assist performing functional performance tests.

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. Assist with performing functional performance tests.

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:
i. Accessibility of equipment and components required for TAB Work.
ii. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
iv. 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.
v. Air flow rates have been specified and compared to central equipment output capacities.

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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."
d. Assist performing functional performance tests.

2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation & Controls of HVAC & Plumbing Systems."

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

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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.

1.7. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

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. All temperature alarms.
    b. Differential bypass valves and transmitters.

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c. Duct Smoke detectors operation and interlocks with fire alarm system.
d. Ductless heat pumps units with air flow rates and temperatures.
e. Electric heating equipment volts, amps, airflow rate, and temperature rise.
f. Electric Heat Tracing.
g. Electric Meter Monitoring of Energy (kWh) and Power (kW).
h. Electric Radiant Heat Panel Temperature Sensors.
i. Fire Fighters AHU emergency switch interface with equipment and ATC system.
j. Gas furnace and gas fired infrared heater operation, control, and leaving air temperature.
k. Greenhouse Heating and Ventilation Equipment.
l. Head pressure controls for air cooled heat pump units.
m. Energy recovery ventilation/energy module recovery unit operation, temperatures, and air flow rates.
n. Lighting interface and start/stop by ATC system.
o. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
p. Operation of heat pump units in both heating and cooling cycles.
q. Operation/Accuracy of air flow measuring stations at various flow rates.
r. Refrigeration mitigation controls, interlocks, and leak detection system operation.
s. Sequences of operation of all HVAC equipment.
t. Set point and operation of high temperature alarms.
u. Supply and return air flow rates for all HVAC equipment.
v. Supply and return flow rates for VAV and constant volume systems in each operational mode.
w. Supply, outside air, exhaust and return air flow rates for ERVs in each operating mode.
x. Test and calibrate all static pressure sensors.
y. Total exhaust airflow and total outdoor-air intake.
z. Unit heaters operation and control.
aa. Variable speed drive parameters at each operated mode.

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. Economizer cycle/relief air fan/damper operation.
5. Emergency power supply.

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6. Gas furnaces and gas fired infrared heaters in all modes of operation.
7. Electric heating coil safeties, air flow switches and overheat devices.
8. ERV/ERM Units in all modes of operation.
9. Life-safety and safety systems.
10. Duct detectors.
11. Fire safety.
12. Temporary upset of system operation.
13. Partial occupancy conditions.
14. Special cycles.
15. ERV Unit/ERV Module supply/exhaust air flow at partial CO2 levels.
16. Lead/lag/standby modes of operation where redundant equipment is indicated.
17. All alarms.
18. Condensate overflow safety switch shut-down and alarm.
19. Condensate pump operation.
20. Test operation and accuracy of air flow measuring stations.
21. Test refrigerant mitigation controls including fan interlocks and refrigerant leak detection sensors.

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.

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3.3. TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Contractors and subcontractors must pre-inspect and pre-test all equipment and systems prior to requesting functional performance testing by the CxA. All pre-start/start-up checklists and functional performance test forms must be completed and submitted to Engineer prior to scheduling formal functional performance testing.

C. 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.

D. 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.

E. 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.

F. 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.

G. Energy Supply System Testing: HVAC Contractor shall prepare a testing plan to verify performance of gas 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.

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H. Heat-Generation System Testing: HVAC Contractor shall prepare a testing plan to verify performance of heat pumps, energy recovery ventilators, unit heaters, radiant heat panels, gas furnaces, gas fired infrared heaters, and energy recovery modules. 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.

I. Refrigeration/Heat Rejection System Testing: HVAC Contractor shall prepare a testing plan to verify performance of heat pumps, refrigerant compressors, ductless units, 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.

J. HVAC Distribution System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air, air handling units, special exhaust ERV/ERM unit supply and exhaust, and other distribution systems. Include HVAC terminal equipment and unitary equipment. 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. Equipment, air flow rates, air temperatures, safeties, and demand controlled ventilation.

K. 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.

L. 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

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SECTION 030516 - UNDERSLAB VAPOR BARRIER - STEGO

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Sheet vapor barrier under concrete slabs on grade.

1.2. RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.3. REFERENCE STANDARDS

A. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2024.

B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products.

C. Samples: Submit samples of underslab vapor barrier to be used.

D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

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PART 2 PRODUCTS

2.1. MATERIALS

A. Underslab Vapor Barrier:
   1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m2 Pa)), maximum.
   2. Thickness: 15 mils (0.4 mm).
   3. Product:
      a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): www.stegoindustries.com/#sle.
      b. VaporBlock 15 by Raven Industries, Inc.
      c. Viper II by ISI Building Products
      d. Substitutions: Not permitted.

B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.2. INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.

B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.

C. Lap joints minimum 6 inches (150 mm).

D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.

E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.

F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

NOT FOR BIDDING

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.

B. Related Sections:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
3. Section 321313 "Concrete Paving" for concrete pavement and walks.
4. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

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1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar

diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint and Control Joint Layout: Indicate proposed construction and control joints required to construct the structure.

1. Location of construction and control joints is subject to approval of the Architect.

2. Contractor to coordinate construction /control joints with flooring manufacturer requirements and flooring joint layout as required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

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1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference: Conduct conference at Project site.

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1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete subcontractor.
    e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

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1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    c. Structural 1, B-B or better; mill oiled and edge sealed.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not

exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

E. Deformed-Steel Wire: ASTM A 496/A 496M.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

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2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

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1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
   b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
   c. Euclid Chemical Company (The), an RPM company; EUCON BCN.
   d. Grace Construction Products, W. R. Grace & Co.; DCI.
   e. Sika Corporation; Sika CNI.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
   b. Cortec Corporation; MCI- 2000.
   c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
   d. Sika Corporation; FerroGard 901.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. ChemMasters.
   b. Davis Colors.
   c. Dayton Superior Corporation.
   d. Hoover Color Corporation.
   e. Lambert Corporation.
   f. QC Construction Products.
   g. Rockwood Pigments NA, Inc.
   h. Scofield, L. M. Company.
   i. Solomon Colors, Inc.

2. Color: As selected by Architect from manufacturer's full range.

NOT FOR BIDDING

2.6 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Greenstreak.
   b. Williams Products, Inc.

2. Profile: As indicated.
3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick).

B. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. BoMetals, Inc.
   b. Greenstreak.
   c. Paul Murphy Plastics Company.
   d. Vinylex Corp.

2. Profile: As indicated.
3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick); nontapered.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
   b. CETCO; Volclay Waterstop-RX.
   c. Concrete Sealants Inc.; Conseal CS-231.
   d. Greenstreak; Swellstop.
   e. Henry Company, Sealants Division; Hydro-Flex.
   f. JP Specialties, Inc.; Earth Shield Type 20.

D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

NOT FOR BIDDING

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. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
   b. Greenstreak; Hydrotite.
   c. Vinylex Corp.; Swellseal.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: ***See Section 030516.***

2.8 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 4 (4.75-mm) sieve.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      a. Anti-Hydro International, Inc.; Emery.
      b. Dayton Superior Corporation; Emery Tuff Non-Slip.
      c. Lambert Corporation; EMAG-20.
      d. L&M Construction Chemicals, Inc.; Grip It.
      e. Metalcrete Industries; Metco Anti-Skid Aggregate.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      a. Anti-Hydro International, Inc.; A-H Alox.
      b. BASF Construction Chemicals - Building Systems; Frictex NS.
      c. L&M Construction Chemicals, Inc.; Grip It AO.

C. Emery Dry-Shake Floor Hardener: Pigmented , factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

   1. Color: As selected by Architect from manufacturer's full range.

D. Metallic Dry-Shake Floor Hardener: Pigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

   1. Color: As selected by Architect from manufacturer's full range.

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E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Maximent.
b. ChemMasters; ConColor.
c. Conspec by Dayton Superior; Conshake 500.
d. Dayton Superior Corporation; Quartz Tuff.
e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 250.
f. Euclid Chemical Company (The), an RPM company; Surflex.
g. Kaufman Products, Inc.; Tycron.
h. Lambert Corporation; Colorhard.
i. L&M Construction Chemicals, Inc.; Quartzplate FF.
j. Metalcrete Industries; Floor Quartz.
k. Scofield, L. M. Company; Lithochrome Color Hardener.
l. Symons by Dayton Superior; Hard Top.

F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Mastercron.
b. ChemMasters; ConColor.
c. Conspec by Dayton Superior; Conshake 600 Colortone.
d. Dayton Superior Corporation; Quartz Tuff.
e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 200 - 205.
f. Euclid Chemical Company (The), an RPM company; Surflex.
g. Kaufman Products, Inc.; Tycron.
h. Lambert Corporation; Colorhard.
i. L&M Construction Chemicals, Inc.; Quartz Plate FF.
j. Metalcrete Industries; Floor Quartz.
k. Scofield, L. M. Company; Lithochrome Color Hardener.
l. Symons by Dayton Superior; Color Hardener.

2. Color: As selected by Architect from manufacturer's full range.

2.9 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

NOT FOR BIDDING

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. ChemMasters; Chemisil Plus.
    b. ChemTec Int'l; ChemTec One.
    c. Conspec by Dayton Superior; Intraseal.
    d. Curecrete Distribution Inc.; Ashford Formula.
    e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
    f. Edoco by Dayton Superior; Titan Hard.
    g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
    h. Kaufman Products, Inc.; SureHard.
    i. L&M Construction Chemicals, Inc.; Seal Hard.
    j. Meadows, W. R., Inc.; LIQUI-HARD.
    k. Metalcrete Industries; Floorsaver.
    l. Nox-Crete Products Group; Duro-Nox.
    m. Symons by Dayton Superior; Buff Hard.
    n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
    o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

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. Advanced Floor Products; Retro-Plate 99.
    b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
    c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    b. BASF Construction Chemicals - Building Systems; Confilm.
    c. ChemMasters; SprayFilm.
    d. Conspec by Dayton Superior; Aquafilm.
    e. Dayton Superior Corporation; Sure Film (J-74).
    f. Edoco by Dayton Superior; BurkeFilm.
    g. Euclid Chemical Company (The), an RPM company; Eucobar.
    h. Kaufman Products, Inc.; Vapor-Aid.
    i. Lambert Corporation; LAMBCO Skin.
    j. L&M Construction Chemicals, Inc.; E-CON.
    k. Meadows, W. R., Inc.; EVAPRE.

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l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
b. BASF Construction Chemicals - Building Systems; Kure 200.
c. ChemMasters; Safe-Cure Clear.
d. Conspec by Dayton Superior; W.B. Resin Cure.
e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
f. Edoco by Dayton Superior; Res X Cure WB.
g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
h. Kaufman Products, Inc.; Thinfilm 420.
i. Lambert Corporation; AQUA KURE - CLEAR.
j. L&M Construction Chemicals, Inc.; L&M Cure R.
k. Meadows, W. R., Inc.; 1100-CLEAR.
l. Nox-Crete Products Group; Resin Cure E.
m. Right Pointe; Clear Water Resin.
n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; AH Clear Cure WB.
b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
c. ChemMasters; Safe-Cure & Seal 20.

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d. Conspec by Dayton Superior; Cure and Seal WB.
e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
g. Edoco by Dayton Superior; Spartan Cote WB II.
h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
j. Lambert Corporation; Glazecote Sealer-20.
k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
l. Meadows, W. R., Inc.; Vocomp-20.
m. Metalcrete Industries; Metcure.
n. Nox-Crete Products Group; Cure & Seal 150E.
o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
p. TK Products, Division of Sierra Corporation; TK-2519 WB.
q. Vexcon Chemicals, Inc.; Starseal 309.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
b. ChemMasters; Safe-Cure Clear.
c. Conspec by Dayton Superior; High Seal.
d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
f. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
g. Kaufman Products, Inc.; SureCure Emulsion.
h. Lambert Corporation; Glazecote Sealer-20.
i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
j. Meadows, W. R., Inc.; Vocomp-20.
k. Metalcrete Industries; Metcure 0800.
l. Nox-Crete Products Group; Cure & Seal 200E.
m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
n. Vexcon Chemicals, Inc.; Starseal 0800.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
b. ChemMasters; Spray-Cure & Seal Plus.
c. Conspec by Dayton Superior; Sealcure 1315.
d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
e. Edoco by Dayton Superior; Cureseal 1315.

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f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
g. Kaufman Products, Inc.; Sure Cure 25.
h. Lambert Corporation; UV Super Seal.
i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
j. Meadows, W. R., Inc.; CS-309/30.
k. Metalcrete Industries; Seal N Kure 30.
l. Right Pointe; Right Sheen 30.
m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure 1315.
b. ChemMasters; Polyseal WB.
c. Conspec by Dayton Superior; Sealcure 1315 WB.
d. Edoco by Dayton Superior; Cureseal 1315 WB.
e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
g. Lambert Corporation; UV Safe Seal.
h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
i. Meadows, W. R., Inc.; Vocomp-30.
j. Metalcrete Industries; Metcure 30.
k. Right Pointe; Right Sheen WB30.
l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

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B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

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2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.
2. Maximum Water-Cementitious Materials Ratio: As Indicated.
3. Slump Limit: As Indicated.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated.
2. Maximum Water-Cementitious Materials Ratio: As Indicated.
3. Slump Limit: As Indicated.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.
2. Minimum Cementitious Materials Content: As Indicated.
3. Slump Limit: As Indicated.
4. Air Content: **6** percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size at locations indicated.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated..
2. Minimum Cementitious Materials Content: As Indicated.
3. Slump Limit: As Indicated.

E. Building Frame Members: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.
2. Maximum Water-Cementitious Materials Ratio: As Indicated.
3. Slump Limit: As Indicated.

F. Building Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.
2. Maximum Water-Cementitious Materials Ratio: As Indicated.
3. Slump Limit: As Indicated.

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2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

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L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

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B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: ***Install in accordance with Section 030516.***

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

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1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

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B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

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1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match

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adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings, to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

b. Contractor to provide more stringent slab tolerance as specified by the architectural floor finish manufacturer if required.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed ~~1/8 inch (3.2 mm).~~ *the Floor Flatness and Floor Levelness indicated on Drawing S-002.*

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E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m) unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

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3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches ((100 mm)) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

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2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.
2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.

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3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
4. Control and dispose of waste products produced by grinding and polishing operations.
5. Neutralize and clean polished floor surfaces.

C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

NOT FOR BIDDING

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

NOT FOR BIDDING

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.
    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete;; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.
    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

NOT FOR BIDDING

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

NOT FOR BIDDING

SECTION 042000 - UNIT MASONRY

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Concrete masonry units (CMU).

B. Pre-finished architectural concrete block (Ground-face CMU) indicated as DCMU-1 and DCMU-2.

C. Mortar and grout.

D. Reinforcement and anchorage.

E. Flashings.

F. Lintels.

G. Accessories.

1.2. RELATED REQUIREMENTS

A. Section 033000 - Cast-in-Place Concrete: Installation of dovetail slots for masonry anchors.

B. Section 072100 - Thermal Insulation: Insulation for cavity spaces.

C. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.3. REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2025.

C. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).

D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement; 2022.

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

F. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.

G. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2025.

H. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2024.

J. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2024.

NOT FOR BIDDING

K. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025a.

L. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

M. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

N. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2024.

O. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.

P. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2024.

Q. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.

R. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2025).

S. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.

T. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

U. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.

V. BIA Technical Notes No. 28B - Brick Veneer/Cold-Formed Steel Framed Walls; 2025.

W. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.

X. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

Y. UL (FRD) - Fire Resistance Directory; Current Edition.

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.

D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

1.5. QUALITY ASSURANCE

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

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

NOT FOR BIDDING

1.6. DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1. CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.
2. Special Shapes: Provide nonstandard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
a. Provide bullnose units for outside corners.
3. Load-Bearing Units: ASTM C90, lightweight.
a. Hollow block, as indicated.
b. Exposed Faces: Manufacturer's standard color and texture.
4. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at time of manufacture.
a. Performance of Units with Integral Water Repellent:
1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
a) No water visible on back of wall above flashing at the end of 24 hours.
b) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.
c) No more than 25 percent of wall area above flashing visibly damp at end of test.
2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
b. Use only in combination with mortar that also has integral water repellent admixture.
c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

2.2. DECORATIVE CMU (DCMU)

A. Manufacturers:
1. Basis of Design Manufacturer: York Ground Face Gemstone series, to match existing building. Other manufacturers with similar color and finish range may submit for inclusion.

B. Products
1. Basis of Design:
a. DCMU-1: Graphite 771 Gemstone Ground Face by York
b. DCMU-2: Tundra 877 Gemstone Ground Face by York
2. Structural Requirements:.
a. Load-bearing CMU: Comply with ASTM
b. Non-load-bearing CMU: Comply with ASTM C129
c. Aggregates: Conform to ASTM C33
d. Sampling and Testing: Provide according to ASTM C140

2.3. MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.

B. Hydrated Lime: ASTM C207, Type S.

NOT FOR BIDDING

C. Grout Aggregate: ASTM C404.

D. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
1. Color(s): As selected by Architect from manufacturer's full range.

E. Water: Clean and potable.

F. Accelerating Admixture: Not permitted

G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
1. Use only in combination with masonry units manufactured with integral water repellent admixture.
2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
3. Meet or exceed performance specified for water repellent admixture used in masonry units.

H. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
1. Color: _____.

I. Packaged Dry Material for Mortar for Unit Masonry: Premixed masonry cement and mason sand; complying with ASTM C1714/C1714M and capable of producing mortar of specified strength in accordance with ASTM C270 with addition of water only.

J. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.

2.4. REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
1. Blok-Lok Limited; www.blok-lok.com/#sle.
2. Hohmann & Barnard, Inc; X-Seal Anchor: www.h-b.com/#sle.
3. WIRE-BOND; www.wirebond.com/#sle.

B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed billet bars; galvanized.

C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

D. Single Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Truss or ladder.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

E. Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Truss.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch (3.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods; width as required to provide not less than 5/8 inch (16 mm) of mortar coverage on each exposure.

F. Adjustable Multiple Wythe Joint Reinforcement: ASTM A951/A951M.
1. Type: Truss, with adjustable ties or tabs spaced at 16 in (406 mm) on center.

NOT FOR BIDDING

2. Material: ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M Class B.
3. Size: 0.1875 inch (4.8 mm) side rods with 0.1483 inch (3.8 mm) cross rods and adjustable components of 0.1875 inch (4.8 mm)wire, width of components as required to provide not less than 5/8 inch (16 mm) of mortar coverage from each masonry face.
4. Vertical adjustment: Not more than 1 1/4 inches (32 mm).
5. Insulation Clips: Provide clips at tabs or ties designed to secure insulation against outer face of inner wythe of masonry.

2.5. FLASHINGS

A. Combination No asphaltic Flashing Materials - Copper:
1. Copper/Polymer Film or Fabric Flashing: 3 oz/sq ft (0.915 kg/sq m) copper sheet laminated between two sheets of polyethylene film. Minimum Puncture Resistance of 780 psi (5.38 MPa), when measured in accordance with ASTM E154/E154M.
   a. Manufacturers:
   b. Hohmann & Barnard, Inc; Copper-Fabric NA: www.h-b.com/#sle.
   c. WIRE-BOND: www.wirebond.com/#sle.
   d. York Flashings; Multi-Flash 500 Series: www.yorkflashings.com/#sle.

B. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.

C. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

2.6. ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

B. Joint Filler: Closed cell polyvinyl chloride, oversized 50 percent to joint width; self expanding; in maximum lengths available.

C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.

D. Weeps:
1. Type: Polyester mesh.
2. Color(s): As selected by Architect from manufacturer's full range.

E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.7. MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type S.
2. Exterior, loadbearing masonry: Type N.
3. Exterior, non-loadbearing masonry: Type N.
4. Interior, loadbearing masonry: Type N.
5. Interior, non-loadbearing masonry: Type O.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

NOT FOR BIDDING

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2. PREPARATION

A. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3. COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

B. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.

C. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

3.4. COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
3. Mortar Joints: Concave.

D. Brick Units:

3.5. PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units with face shell bedding on head and bed joints.

C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.

NOT FOR BIDDING

D. Remove excess mortar and mortar smears as work progresses.

E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

F. Interlock intersections and external corners, except for units laid in stack bond.

G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

3.6. WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

3.7. CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.8. REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches (400 mm) on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches (400 mm) each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches (150 mm).

3.9. REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

A. Use individual metal ties installed in horizontal joints to bond wythes together. Provide ties spaced as indicated on drawings.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.

3.10. MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
   1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up flashing ends at least 1 inch (25.4 mm), minimum, to form watertight pan at non-masonry construction.
   2. Remove or cover protrusions or sharp edges that could puncture flashings.

NOT FOR BIDDING

3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Terminate flashing up 8 inches (203 mm) minimum on vertical surface of backing:
1. Install vertical leg of flashing behind water-resistive barrier sheet over backing.
2. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's directions.
3. Terminate vertical leg of flashing into bed joint in masonry or reglet in concrete.
4. Anchor vertical leg of flashing into backing with a termination bar and sealant.
5. Apply cap bead of sealant on top edge of self-adhered flashing.

C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

D. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

E. Extend metal flashings to within 1/2 inch (12 mm) of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.

F. Support flexible flashings across gaps and openings.

G. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

3.11. LINTELS

A. Install lintels over openings, refer to drawings.

3.12. GROUTED COMPONENTS

A. Reinforce bond beams as noted on drawings.

B. Lap splices minimum 24 bar diameters.

C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.

D. Place and consolidate grout fill without displacing reinforcing.

E. At bearing locations, fill masonry cores with grout for a minimum 12 inches (300 mm) either side of opening.

3.13. CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

D. Size control joints as indicated on drawings; if not indicated, 3/4 inch (19 mm) wide and deep.

E. Form expansion joint as detailed on drawings.

NOT FOR BIDDING

3.14. BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
1. Fill adjacent masonry cores with grout minimum 12 inches (300 mm) from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.15. TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

B. Maximum Variation from Alignment of Columns: 1/4 inch (6 mm).

C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).

D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/6 m) or more.

E. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.

F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).

G. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

3.16. CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.17. CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

NOT FOR BIDDING

3.18. PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

NOT FOR BIDDING

SECTION 047200 - CAST STONE MASONRY

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Architectural cast stone.

B. Units required are indicated on drawings as "cast stone".

C. Units required are:
1. Exterior wall units, including coping.

1.2. RELATED REQUIREMENTS

A. Section 040511 - Masonry Mortaring and Grouting: Mortar for setting cast stone.

B. Section 042000 - Unit Masonry: Installation of cast stone in conjunction with masonry.

C. Section 079200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.3. REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2025.

C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2024.

D. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2025.

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

G. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025a.

I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

J. ASTM C642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete; 2021.

K. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2025.

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

NOT FOR BIDDING

B. Product Data: Test results of cast stone components made previously by the manufacturer.

C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.

D. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

1.5. QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. A firm with a minimum of 5 years experience producing cast stone of types required for project.
2. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Architectural Cast Stone:
1. Any current producer member of the Architectural Precast Association.
2. Any current producer member of the Cast Stone Institute.

2.2. ARCHITECTURAL CAST STONE

A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural granite, complying with ASTM C1364.
1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
4. Color: Selected by Architect from manufacturer's full range.
5. Remove cement film from exposed surfaces before packaging for shipment.

B. Shapes: Provide shapes indicated on drawings (CS-1).
1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
2. Unless otherwise indicated on drawings, provide:
a. Wash or slope of 1:12 on exterior horizontal surfaces.
b. Drips on projecting components, wherever possible.
c. Raised fillets at back of sills and at ends to be built in.

C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.

2.3. MATERIALS

A. Portland Cement: ASTM C150/C150M.
1. For Mortar: Type I or II, except Type III may be used in cold weather.

B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.

C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.

D. Admixtures: ASTM C494/C494M.

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E. Water: Potable.

F. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed bars, galvanized.
1. Galvanized in accordance with ASTM A767/A767M, Class I.

G. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.

H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.

I. Mortar: Portland cement-lime, as specified in Section 040511 ; do not use masonry cement.

J. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.4. SOURCE QUALITY CONTROL

A. Test compressive strength and absorption of specimens selected at random from plant production.
1. Test in accordance with ASTM C642.
2. Select specimens at rate of 3 per 500 cubic feet (3 per 14 cubic m), with a minimum of 3 per production week.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

3.2. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cast stone components in conjunction with masonry, complying with requirements of Section 042000.

C. Mechanically anchor cast stone units indicated; set remainder in mortar.

D. Setting:
1. Drench cast stone components with clear, running water immediately before installation.
2. Set units in a full bed of mortar unless otherwise indicated.
3. Fill vertical joints with mortar.
4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.3. TOLERANCES

A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
1. Rake mortar joints 3/4 inch (19 mm) for pointing.
2. Remove excess mortar from face of stone before pointing joints.
3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.

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4. Leave the following joints open for sealant:
   a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
   b. Joints in projecting units.
   c. Joints between rigidly anchored units, including soffits, panels, and column covers.
   d. Joints below lugged sills and stair treads.
   e. Joints below ledge and relieving angles.
   f. Joints labeled "expansion joint".

B. Installation Tolerances:
   1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
   2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
   3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
   4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4. REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).

B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.

C. Repair methods and results subject to Architect 's approval.

3.5. CLEANING

A. Keep cast stone components clean as work progresses.

3.6. PROTECTION

A. Protect completed work from damage.

B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION

NOT FOR BIDDING

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.

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1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
2. Welded built-up members with plates thicker than 2 inches (50 mm).
3. Column base plates thicker than 2 inches (50 mm).

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data.

NOT FOR BIDDING

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

NOT FOR BIDDING

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD**.** If the fabricator does not have the AISC certification they can still bid the project but they are responsible to have a third party inspector inspect the fabrication process to ensure they are meeting AISC guidelines.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector. If the erector does not have the AISC certification they can still bid the project but must be in compliance with Chapter N of AISC’s Specification indicating quality control requirements.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

NOT FOR BIDDING

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of moment frame and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:

1. W-Shapes: 60 percent.
2. Channels, Angles, M , S-Shapes: 60 percent.
3. Plate and Bar: 25 percent.
4. Cold-Formed Hollow Structural Sections: 25 percent.
5. Steel Pipe: 25 percent.
6. All Other Steel Materials: 25 percent.

C. W-Shapes: As Indicated.

D. Channels, Angles, M , S-Shapes: As Indicated.

E. Plate and Bar: As Indicated.

F. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: As Indicated.

G. Cold-Formed Hollow Structural Sections: As Indicated.

H. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

I. Steel Pipe: As Indicated.

1. Weight Class: Standard.
2. Finish: Black except where indicated to be galvanized.

J. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

K. Steel Forgings: ASTM A 668/A 668M.

L. Welding Electrodes: Comply with AWS requirements.

NOT FOR BIDDING

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: As Indicated.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Plain.

G. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-]hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Plain.

H. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

K. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

L. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.

NOT FOR BIDDING

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Con-Serv, Inc.
    b. Fluorocarbon Company Limited.
    c. R.J. Watson Bridge & Structural Engineered Systems.

3. Mating Surfaces: PTFE and PTFE.
4. Coefficient of Friction: Not more than 0.05.
5. Design Load: Not less than 5,000 psi (34 MPa).
6. Total Movement Capability: 2 inches (50 mm).

2.4 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting.", Section 099600 "High-Performance Coatings.".

C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

D. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.

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3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned.

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B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

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1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

NOT FOR BIDDING

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

NOT FOR BIDDING

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

NOT FOR BIDDING

2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

NOT FOR BIDDING

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. Joist accessories.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

NOT FOR BIDDING

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications**."**

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

NOT FOR BIDDING

1. Use ASD; data are given at service-load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:
   a. Roof Joists: Vertical deflection of 1/360 of the span.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

F. Do not camber joists.

G. Camber joists according to SJI's "Specifications."

H. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.3 PRIMERS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

C. Primer: Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

NOT FOR BIDDING

2.4 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

D. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.

E. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

F. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface unless otherwise indicated.

G. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

H. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.

1. Finish: Plain.

I. Welding Electrodes: Comply with AWS standards.

J. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

K. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

NOT FOR BIDDING

D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

NOT FOR BIDDING

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709.
c. Ultrasonic Testing: ASTM E 164.
d. Radiographic Testing: ASTM E 94.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists**,** bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
2. Apply a compatible primer of same type as primer used on adjacent surfaces.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

NOT FOR BIDDING

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:
1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
3. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
4. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

NOT FOR BIDDING

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.

D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

NOT FOR BIDDING

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Deck Group.
5. Epic Metals Corporation.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Verco Manufacturing Co.
9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

   a. Color: Manufacturer's standard.
2. Deck Profile: As indicated.
3. Cellular Deck Profile: As indicated, with bottom plate.
4. Profile Depth: As indicated.
5. Design Uncoated-Steel Thickness: As indicated.
6. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
7. Span Condition: Triple span or more.
8. Side Laps: Overlapped.

NOT FOR BIDDING

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile indicated and recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and sloped recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: ASTM A 780.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

NOT FOR BIDDING

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

NOT FOR BIDDING

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (457 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

G. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

NOT FOR BIDDING

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

NOT FOR BIDDING

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Exterior non-load-bearing wall framing.
2. Ceiling joist framing.
3. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

NOT FOR BIDDING

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

NOT FOR BIDDING

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AllSteel & Gypsum Products, Inc.
2. ClarkWestern Building Systems, Inc.
3. Craco Mfg., Inc.
4. Dietrich Metal Framing; a Worthington Industries Company.
5. Formetal Co. Inc. (The).
6. MarinoWARE.
7. Nuconsteel; a Nucor Company.
8. Olmar Supply, Inc.
9. Quail Run Building Materials, Inc.
10. SCAFCO Corporation.
11. Steel Construction Systems.
12. Steel Network, Inc. (The).
13. Steel Structural Systems.
14. Super Stud Building Products, Inc.
15. United Metal Products, Inc.
16. United Steel Manufacturing.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Exterior Non-Load-Bearing Framing: Horizontal deflection As Indicated of the wall height.
   b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of 1/2 inch (13 mm).

NOT FOR BIDDING

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:

1. Floor and Roof Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

C. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180).

NOT FOR BIDDING

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard [bypass] [head] clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AllSteel & Gypsum Products, Inc.
b. ClarkWestern Building Systems, Inc.
c. Dietrich Metal Framing; a Worthington Industries company.
d. MarinoWARE.
e. SCAFCO Corporation.
f. Steel Network, Inc. (The).
g. Steeler, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0966 inch (2.45 mm).
2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0966 inch (2.45 mm)].
b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures] and 1 inch (25 mm) plus twice the design gap for other applications.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0966 inch (2.45 mm)].
b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch (25 mm).

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:

NOT FOR BIDDING

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

NOT FOR BIDDING

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-

ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

NOT FOR BIDDING

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

NOT FOR BIDDING

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

NOT FOR BIDDING

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As Indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

a. Install solid blocking at centers indicated on Shop Drawings.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

NOT FOR BIDDING

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

NOT FOR BIDDING

SECTION 055133 - METAL LADDERS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Shop-fabricated metal ladders.

1.2. RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Paint finish.

1.3. REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.

D. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

F. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings:
1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

NOT FOR BIDDING

1.5. QUALITY ASSURANCE

A. Design ladder under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.1. MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.2. FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints but tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3. FABRICATED LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
1. Side Rails: 3/8 by 2 inches (9 by 50 mm) members spaced at 20 inches (500 mm).
2. Rungs: One inch (25 mm) diameter solid round bar spaced 12 inches (300 mm) on center.
3. Space rings 7 inches (175 mm) from wall surface.

2.4. FINISHES - STEEL

A. Prime paint steel items.

B. Prime Painting: One coat.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2. PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3. INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

NOT FOR BIDDING

3.4. TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION

NOT FOR BIDDING

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Rooftop equipment bases and support curbs.
4. Wood blocking and nailers.
5. Wood furring.
6. Plywood backing panels.

B. Related Requirements:
1. Section 061600 "Sheathing."
2. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

NOT FOR BIDDING

1.3 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

C. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.
7. Metal framing anchors.

NOT FOR BIDDING

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship for the following:

1. Dimension lumber framing.
2. Laminated-veneer lumber.
3. Parallel-strand lumber.
4. Miscellaneous lumber.

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: [15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

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1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2, for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat **items indicated on Drawings, and the following:**

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load-bearing.
2. Species:

   a. Hem-fir (north); NLGA.
   b. Mixed southern pine; SPIB.
   c. Spruce-pine-fir; NLGA.

NOT FOR BIDDING

d. Hem-fir; WCLIB, or WWPA.
e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

B. Load-Bearing Partitions: No. 2 grade or as indicated on drawings.

1. Application: Exterior walls and interior load-bearing partitions.
2. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Mixed southern pine; SPIB.
e. Spruce-pine-fir; NLGA.
f. Douglas fir-south; WWPA.
g. Hem-fir; WCLIB or WWPA.
h. Douglas fir-larch (north); NLGA.
i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. Ceiling Joists: Construction or No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Douglas fir-larch (north); NLGA.
e. Mixed southern pine; SPIB.
f. Spruce-pine-fir; NLGA.
g. Hem-fir; WCLIB or WWPA.
h. Douglas fir-south; WWPA.
i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
j. Northern species; NLGA.

D. Joists, Rafters, and Other Framing Not Listed Above: No. 2 grade or as indicated on drawings.

1. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Mixed southern pine; SPIB.
e. Spruce-pine-fir; NLGA.
f. Douglas fir-south; WWPA.
g. Hem-fir; WCLIB or WWPA.
h. Douglas fir-larch (north); NLGA.
i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.4 ENGINEERED WOOD PRODUCTS

A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.

NOT FOR BIDDING

B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

C. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Boise Cascade Corporation.
b. Georgia-Pacific.
c. Louisiana-Pacific Corporation.
d. Roseburg Forest Products Co.
e. Weyerhaeuser Company.

2. Extreme Fiber Stress in Bending, Edgewise: See drawings.
3. Modulus of Elasticity, Edgewise: See drawings.

D. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Louisiana-Pacific Corporation.
b. Weyerhaeuser Company.

2. Extreme Fiber Stress in Bending, Edgewise: See drawings.
3. Modulus of Elasticity, Edgewise: See drawings.

NOT FOR BIDDING

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Furring.
5. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 and any of the following species:

1. Hem-fir (north); NLGA.

2. Mixed southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

NOT FOR BIDDING

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.7 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Simpson Strong-Tie Co., Inc.
2. USP Structural Connectors.

C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

D. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

E. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

F. Stainless-Steel Sheet: ASTM A 666, Type 316.

1. Use for exterior locations and where indicated.

G. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.

H. I-Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.

I. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.

J. Bridging: Rigid, V-section, nailless type, 0.050 inch (1.3 mm) thick, length to suit joist size and spacing.

NOT FOR BIDDING

K. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick.

L. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: As indicated.
2. Thickness: As indicated.
3. Length: As indicated.

M. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick.

N. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches (57 mm) wide by 0.062 inch (1.6 mm) thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

O. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.

1. Bolt Diameter: As indicated.
2. Width: As indicated.
3. Body Thickness: As indicated.
4. Base Reinforcement Thickness: As indicated.

P. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches (29 mm) wide by 9/16 inch (14 mm) deep by 0.034 inch (0.85 mm) thick with hemmed edges.

Q. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch (24 by 24 by 1 mm) thick with hemmed edges.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

D. Adhesives for Gluing to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

NOT FOR BIDDING

1. Adhesives shall have a VOC content of 70g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

F. Do not splice structural members between supports unless otherwise indicated.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.

NOT FOR BIDDING

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

I. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

J. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

M. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

NOT FOR BIDDING

C. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

D. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally and vertically at 24 inches (610 mm) o.c.

C. Furring to Receive Gypsum Board : Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide as indicated.
2. For interior partitions and walls, provide as indicated.
3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches (2438 mm) high, using members of 2-inch nominal (38-mm actual) thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.
2. For load-bearing walls, provide as indicated.

NOT FOR BIDDING

3.5 CEILING JOIST AND RAFTER FRAMING INSTALLATION

A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.
2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- (19-by-140-mm actual-) size boards between every third pair of rafters, but not more than 48 inches (1219 mm) o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.6 TIMBER FRAMING INSTALLATION

A. Install timber with crown edge up and provide not less than 4 inches (102 mm) of bearing on supports. Provide continuous members unless otherwise indicated; tie together over supports as indicated if not continuous.

B. Where beams or girders are framed into pockets of exterior concrete or masonry walls, provide 1/2-inch (13-mm) air space at sides and ends of wood members.

C. Install wood posts using metal anchors indicated.

D. Treat ends of timber beams and posts exposed to weather by dipping in water-repellent preservative for 15 minutes.

NOT FOR BIDDING

3.7 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

NOT FOR BIDDING

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 072500 "Weather Barriers" for water-resistive barrier applied over wall sheathing.

NOT FOR BIDDING

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-

accredited certification body. Include statement indicating cost for each certified wood product.

2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports for Credit IEQ 4: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

NOT FOR BIDDING

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Plywood.
2. Oriented strand board.
3. Fiberboard wall sheathing.
4. Particleboard underlayment.
5. Hardboard underlayment.

C. Plywood: DOC PS 1 or DOC PS 2 unless otherwise indicated.

D. Oriented Strand Board: DOC PS 2.

E. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

F. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground..

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: As indicated.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.

NOT FOR BIDDING

2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings.

2.5 WALL SHEATHING

A. Plywood Wall Sheathing: Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 24/16.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

C. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide as indicated on drawings.

2. Type and Thickness: As indicated.
3. Size: As indicated.

D. Cementitious Backer Units: ASTM C 1325, Type A.

1. Products: Subject to compliance with requirements, provide as indicated. Coordinate "Thickness" Subparagraph below with retained products. 1/2-inch (12.7-mm) thickness is available from all manufacturers listed. 5/8-inch (15.9-mm) thickness is available from USG.

2. Thickness: As indicated.

NOT FOR BIDDING

2.6 ROOF SHEATHING

A. Plywood Roof Sheathing: Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than as indicated.

B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than as indicated.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

G. Screws for Fastening Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

NOT FOR BIDDING

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

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3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
4. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent

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boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

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3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FIBERBOARD SHEATHING INSTALLATION

A. Comply with ASTM C 846 and with manufacturer's written instructions.

B. Fasten fiberboard sheathing panels to intermediate supports and then at edges and ends. Use galvanized roofing nails; comply with manufacturer's recommended spacing and referenced fastening schedule. Drive fasteners flush with surface of sheathing and locate perimeter fasteners at least 3/8 inch (9.5 mm) from edges and ends.

C. Install sheathing vertically with long edges parallel to, and centered over, studs. Install solid wood blocking where end joints do not occur over framing. Allow 1/8-inch (3-mm) open space between edges and ends of adjacent units. Stagger horizontal joints if any.

D. Cover sheathing as soon as practical after installation to prevent deterioration from wetting.

END OF SECTION 061600

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SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

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. Wood roof trusses.
2. Wood girder trusses.
3. Wood truss bracing.
4. Metal truss accessories.

B. Related Requirements:

1. Section 061600 "Sheathing" for roof sheathing and subflooring.

C. Allowances: Provide wood truss bracing under the Metal-Plate-Connected Truss Bracing Allowance as specified in Section 012100 "Allowances."

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1.3 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For wood-preservative-treated lumber, and fire-retardant-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that wood trusses comply with forest certification requirements. Include statement indicating cost for each certified wood product.

C. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.

D. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

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1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For metal connector-plate manufacturer.

B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.

D. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated lumber.
2. Fire-retardant-treated wood.
3. Metal-plate connectors.
4. Metal truss accessories.

1.6 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in TPI BCSI**,** "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.

B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

1. Design Loads: As indicated.
2. Maximum Deflection Under Design Loads:

    a. Roof Trusses: Vertical deflection of 1/240 of span.

C. Comply with applicable requirements and recommendations of the following publications:

1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."

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2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Certified Wood: For metal-plate-connected wood trusses and permanent bracing, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S.
4. Provide dry lumber with [**19**] [**15**] percent maximum moisture content at time of dressing.

C. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal (38 by 140 mm actual) for top chords and 2 by 6 inches nominal (38 by 140 mm actual) for bottom chords unless noted otherwise for insulation purposes.

D. Minimum Specific Gravity for Top Chords: As determined by truss designer.

E. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061000 "Rough Carpentry."

2.3 METAL CONNECTOR PLATES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpine Engineered Products, Inc.; an ITW company.
2. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc
3. Truswal Systems Corporation; an ITW company.

B. Source Limitations: Obtain metal connector plates from single manufacturer.

C. General: Fabricate connector plates to comply with TPI 1.

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D. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for interior locations unless otherwise indicated.

E. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

F. Stainless-Steel Sheet: ASTM A 666, Type 304, and not less than 0.035 inch (0.88 mm) thick.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
2. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

2.5 METAL FRAMING ANCHORS AND ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Simpson Strong-Tie Co., Inc.
2. USP Structural Connectors.

C. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

D. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

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E. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

F. Stainless-Steel Sheet: ASTM A 666, [**Type 304**] [**Type 316**].

1. Use for exterior locations and where indicated.

G. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. Tie fastens to one side of truss, top plates, and side of stud below.

H. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall studs below, 2-1/4 inches (57 mm) wide by 0.062 inch (1.6 mm) thick. Tie fits over top of truss and fastens to both sides of truss, top plates, and one side of stud below.

I. Truss Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening roof trusses to wall studs below, 2-1/2 inches (63 mm) wide by 0.062 inch (1.6 mm) thick. Tie fits over top of truss and fastens to both sides of truss, inside face of top plates, and both sides of stud below.

J. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick. Clip is fastened to truss through slotted holes to allow for truss deflection.

K. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches (38 mm) wide by 1 inch (25 mm) deep by 0.040 inch (1.0 mm) thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

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2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

2.7 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.8 SOURCE QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.

1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.

B. Correct deficiencies in Work that special inspections indicate does not comply with the Contract Documents.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.

1. Anchor trusses to girder trusses as indicated.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Section 061000 "Rough Carpentry."
2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

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J. Install wood trusses within installation tolerances in TPI 1.

K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

L. Replace wood trusses that are damaged or do not meet requirements.

1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

3.2 REPAIRS AND PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.

1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

END OF SECTION 061753

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SECTION 062000 - FINISH CARPENTRY

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Finish carpentry items.

B. Hardware.

1.2. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data:
1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.

PART 2 PRODUCTS

2.1. FINISH CARPENTRY ITEMS

A. Exterior Woodwork Items:
1. Enclosing Soffit Spaces: As detailed.
2. Aluminum wrapped fascia as detailed.

B. Interior Woodwork Items:
1. Window Sills: Solid Surface material as detailed.

2.2. FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

B. Fasteners for Exterior Applications: Stainless steel; length required to penetrate wood substrate 1-1/2 inch (38 mm) minimum.

2.3. ACCESSORIES

A. Aluminum Trim and Mouldings: Extruded, alloy 6063 T5.

B. Aluminum Edge Trim: Extruded convex shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; natural mill finish.

2.4. HARDWARE

A. Countertop Support Brackets: Fixed, L-shaped, corner reinforced, face-of-stud mounting.
1. Material: Steel.

2.5. FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

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B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify adequacy of backing and support framing.

3.2. INSTALLATION

A. Install factory-fabricated units in accordance with manufacturer's printed installation instructions.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

3.3. TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

END OF SECTION

NOT FOR BIDDING

SECTION 072100 - THERMAL INSULATION

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, and over roof sheathing.

B. Batt insulation and vapor retarder in exterior wall and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2. REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.

D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

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PART 2 PRODUCTS

2.1. APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.

C. Insulation in Wood Framed Walls: Batt insulation with integral vapor retarder.

2.2. FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.

2.3. MINERAL FIBER BLANKET INSULATION MATERIALS

A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
4. Facing: Aluminum foil, flame spread 25 rated; one side.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2. BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.3. BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.4. PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

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SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In masonry cavity walls.
   2. In exterior framed walls at West Pavilion.

1.2. REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2025.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

F. FM 4880 - Examination Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials; 2022.

G. NFPA 275 - Standard Method of Fire Tests for the Evaluation of Thermal Barriers; 2022.

H. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

I. UL 1040 - Standard for Safety Fire Test of Insulated Wall Construction; Current Edition, Including All Revisions.

J. UL 1715 - Standard for Safety Fire Test of Interior Finish Material; Current Edition, Including All Revisions.

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1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.

C. Certificates: Certify that products of this section meet or exceed specified requirements.

D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.

E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.4. QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

C. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.5. FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.1. MATERIALS

A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and fire protection requirements.
a. Fire Protection: Provide 15-minute thermal barrier of 1/2 inch (12.7 mm) gypsum board or equivalent material complying with NFPA 275 test method, or foamed-in-place insulation either exposed or with covering that complies with FM 4880, NFPA 286, UL 1040, or UL 1715.
2. Thermal Resistance: R-value (RSI-value) of 7.1 (1.25), minimum, per 1-inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature when tested in accordance with ASTM C518.
3. Water Vapor Permeance: Vapor retarder; 2 perms (115 ng/(Pa s sq m)), maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
4. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
5. Air Permeance: 0.04 cfm per square foot (0.2 L/(s/sq m)), maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf (75 Pa).
6. Closed Cell Content: At least 90 percent.
7. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
8. Products:
a. BASF Corporation; WALLTITE US: www.spf.basf.com/#sle.
b. Henry, a Carlisle Company: www.henry.com/#sle.
c. Johns Manville; JM IV HFO Closed-cell: www.jm.com/#sle.

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d. NCFI Polyurethanes; InsulStar 1.7 HFO 11-033: www.ncfi.com/#sle.
e. Preferred Solutions, Inc; Staycell 504 Closed Cell Spray Foam Insulation: www.preferredsolutions.net/#sle.

2.2. ACCESSORIES

A. Primer: As required by insulation manufacturer.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify work within construction spaces or crevices is complete before insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.2. PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

3.3. APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. Apply insulation by spray method, to a uniform monolithic density without voids.

C. Apply to a minimum cured thickness of 2-1/2 inch (63.5 mm).

D. Apply to achieve a thermal resistance ().

END OF SECTION

NOT FOR BIDDING

SECTION 074113 - METAL ROOF PANELS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Metal roof panel system of preformed aluminum panels.

B. Associated underlayment, metal trim, accessories, fasteners, insulation, and sealants.

C. Snow Guards

1.2. REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2025.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2025.

E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

F. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2025.

G. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference; 1995 (Reapproved 2024).

H. ICC-ES AC188 - Acceptance Criteria for Roof Underlayment’s; 2023.

I. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Current Edition, Including All Revisions.

NOT FOR BIDDING

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Storage and handling requirements and recommendations.
2. Installation methods.
3. Specimen warranty.

C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayment, and special conditions.
1. Show work to be field-fabricated or field-assembled.

D. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.

E. Test Reports: Indicate compliance of metal roofing system to specified requirements.

F. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.4. QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least five years of documented experience.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.6. FIELD CONDITIONS

A. Do not install metal roof panels, eave protection membrane or underlayment when surface, ambient air, or wind chill temperatures are below 45 degrees F (7 degrees C).

1.7. WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 35-year non-prorated manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

C. Special Warranty: Provide 5-year warranty for weathertightness of roofing system, including agreement to repair or replace metal roof panels that fail to keep out water commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

NOT FOR BIDDING

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Architectural Metal Roof Panel Manufacturers:
1. Petersen Aluminum Corporation; Tite-Loc Plus Panel: www.pac-clad.com/#sle; **Basis of Design,** to match existing building.
2. The products of other manufacturers are acceptable subject to conformance with the requirements of this Section and in matching Bid Pac B selected materials for color and style.

B. Metal Soffit Panels Manufacturers:
1. Petersen Aluminum Corporation; PAC-850 Soffit: www.pac-clad.com/#sle.

2.2. PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:

1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F (56 degrees C).

2.3. METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.
1. Aluminum Panels:
   a. Alloy and Temper: Aluminum complying with ASTM B209/B209M; temper as required for forming.
   b. Thickness: Minimum 20 gauge, 0.032 inch (0.81 mm).
2. Profile: Standing seam, with minimum 1-1/2-inch (38 mm) seam height; concealed fastener system for field seaming with special tool.
3. Texture: Smooth.
4. Length: Full length of roof slope, without lapped horizontal joints.
5. Width: Maximum panel coverage of 18 inches (457 mm).
6. Color: As selected from manufacturer's full line to match existing.

C. Metal Soffit Panels:
1. Profile: Style as indicated, with venting provided.
2. Material: Precoated aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness.
3. Color: As selected by Architect from manufacturer's standard line to match roof.

2.4. ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.5. FABRICATION

A. Panels: Provide factory fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.6. FINISHES

A. Top Side; Total dry film thickness of 0.95 to 1.25 mil to meet AAMA 621;

1. Prime Coat: film thickness of 0.25 to 0.30 mil

2. Finish Coat: 70 percent polyvinylidene fluoride; film thickness of 0.70 to 0.90 mil

B. Bottom Side: Primer dry film thickness of .25 mil;

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2.7. ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
1. Downspouts: Open face, rectangular profile.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

D. Underlayment: Self-adhering polymer modified asphalt sheet complying with ASTM D1970/D1970M, with strippable release film and top surface of woven polypropylene sheet.
1. Minimum Requirements: Comply with requirements of ICC-ES AC188 for non-self-adhesive sheet.
2. Sheet Thickness: 22 mils, 0.022 inch (0.55 mm), minimum.
3. Self Sealability: Nail sealability in accordance with ASTM D1970/D1970M.
4. Low Temperature Flexibility: Comply with ASTM D1970/D1970M.
5. Water Vapor Permeance: 0.1 perm (5.72 ng/Pa s sq m), maximum, when tested in accordance with ASTM E96/E96M using Desiccant Method (Method A).
6. Functional Temperature Range: Minus 45 degrees F (Minus 42.8 degrees C) to 250 degrees F (121 degrees C).
7. Products:
a. CertainTeed Roofing; WinterGuard HT - High Temperature Waterproofing Underlayment: www.certainteed.com/#sle.
b. GAF; FT Solutions Performance SA Leak Barrier: www.ftsolutionsroof.com/#sle.
c. Henry, a Carlisle Company; Blueskin RF200: www.henry.com/#sle.
d. Henry, a Carlisle Company; Blueskin PE200HT: www.henry.com/#sle.

E. Snow Guard.
1. Basis of Design Products:
2. SnoCleat RCT Standing Seam Roof manufactured by Action Manufacturing, LLC www.metalsnowguards.com
3. S-5! Cologuard 2.0 manufactured by S-5; www.S-5.com
4. Requirements:
a. Snow Guard with 4"" wide face and inside roof clamp
b. Material: Extruded 6063- T5 Aluminum with stainless steel threaded, cupped nose set screws.
c. Finish: Powder Coat to match metal roof color.

PART 3 EXECUTION

3.1. EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

NOT FOR BIDDING

3.2. PREPARATION

A. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.

B. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.

C. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.

D. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3. INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
   1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
   2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.

B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

3.4. CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.5. PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

NOT FOR BIDDING

SECTION 074213 - METAL WALL PANELS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels and sub-girt framing assembly, with related flashings and accessory components.

1.2. RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Wall panel substrate.

B. Section 072100 - Thermal Insulation.

C. Section 079200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.3. REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

D. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2025.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

D. Samples: Submit two samples of wall panel and soffit panel, 12 inches by 12 inches (305 mm by 305 mm) in size illustrating finish color, sheen, and texture.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

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G. Warranty Documentation for Installation of Building Rainscreen Assembly: Submit installer warranty and ensure that forms have been completed in Owner's name and registered with installer.

1.5. QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience and approved by manufacturer.

1.6. DELIVERY, STORAGE, AND HANDLING

A. See Section 017419 - Construction Waste Management and Disposal for packaging waste requirements.

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

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

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

1.7. FIELD CONDITIONS

A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

1.8. WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide 15-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

NOT FOR BIDDING

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Metal Wall Panels - Concealed Fasteners:
1. ATAS International, Inc: www.atas.com/#sle.
2. MBCI, a Cornerstone Building Brands Company: www.mbci.com/#sle.
3. Petersen Aluminum Corporation: www.pac-clad.com/#sle.

2.2. METAL WALL PANEL SYSTEM

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
1. Provide exterior wall panels and sub-girt framing assembly.
2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
3. Design Pressure: In accordance with applicable codes.
4. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
5. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to

seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.

6. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
7. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
8. Corners: Factory-fabricated in one continuous piece with minimum 2-inch (51 mm) returns.

B. Exterior Wall Panels:
1. Profile: Vertical1 1/2" Deep rib with 7.2" spacing style.
2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
3. Material: Precoated aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness.
4. Panel Width: 36 inches
5. Color: As selected by Architect to match Bid Pac B selection from manufacturer's full line

C. Sub-girt Framing Assembly:
1. 16 gauge, 0.0598 inch (1.52 mm) thick formed non-precoated steel sheet.
2. Profile as indicated; to attach panel system to building.

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

E. Expansion Joints: Same material, thickness and finish as exterior sheets; ___ gauge, ___ inch (___ mm) thick; manufacturer's standard brake formed type, of profile to suit system.

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

G. Anchors: Galvanized steel.

2.3. MATERIALS

A. Precoated Aluminum Sheet: ASTM B209/B209M, 3105 alloy, O temper, with smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.4. ACCESSORIES

A. Support for Cladding and Continuous Insulation: Thermal clips.
1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
2. Fasteners: As recommended by clip manufacturer.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that building framing members are ready to receive panels.

3.2. PREPARATION

A. Install sub-girts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.

B. Protect surrounding areas and adjacent surfaces from damage during execution of this work.

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3.3. INSTALLATION

A. Install panels on walls in accordance with manufacturer's instructions.

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

C. Locate joints over supports.

D. Use concealed fasteners unless otherwise indicated by Architect.

3.4. TOLERANCES

A. Offset From True Alignment Between Adjacent Members Abutting or In Line: 1/16 inch (1.6 mm), maximum.

B. Variation from Plane or Location As Indicated on Drawings: 1/4 inch (6.4 mm), maximum.

3.5. CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Remove site cuttings from finish surfaces.

C. Remove protective material from wall panel surfaces.

3.6. PROTECTION

A. Protect metal wall panels until completion of project.

B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

END OF SECTION

NOT FOR BIDDING

SECTION 075300 - ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Elastomeric roofing membrane application.

B. Insulation, flat and tapered.

C. Vapor retarder.

1.2. RELATED REQUIREMENTS

A. Section 053100 - Steel Decking: Placement of acoustical insulation for deck flutes.

1.3. REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.

B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

C. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015, with Editorial Revision (2022).

D. FM (AG) - FM Approval Guide; Current Edition.

E. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2025).

F. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

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

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PART 2 PRODUCTS

2.1. MANUFACTURERS

A. EPDM Membrane Materials:
1. Carlisle SynTec Systems: www.carlisle-syntec.com/#sle.
2. GenFlex Roofing Systems, LLC: www.genflex.com/#sle.
3. Versico Roofing Systems; VersiGard EPDM: www.versico.com/#sle.

2.2. ROOFING - UNBALLASTED APPLICATIONS

A. Elastomeric Membrane Roofing: One ply membrane, fully adhered, over vapor retarder and insulation.

B. Roofing Assembly Requirements:
1. Roof Covering External Fire Resistance Classification: UL (DIR) certified Class A.
2. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.

C. Acceptable Insulation Types - Constant Thickness Application:
1. Minimum 2 layers of polyisocyanurate board.

D. Acceptable Insulation Types - Tapered Application:
1. Uniform thickness composite board covered with tapered polyisocyanurate board.

2.3. ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane: Ethylene-propylene-diene-monomer (EPDM); internally reinforced with fabric or scrim; complying with minimum properties of ASTM D4637/D4637M.
1. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
2. Sheet Width: 120 inches (3,048 mm), minimum; factory fabricate into widest possible sheets.
3. Solar Reflectance: 0.75, minimum, initial, and 0.64, minimum, 3-year, certified by Cool Roof Rating Council.
4. Thermal Emittance: 0.84, minimum, initial, and 0.87, minimum, 3-year, certified by Cool Roof Rating Council.
5. Color: White.
6. Tensile Strength: 1200 psi (____ MPa), minimum, measured in accordance with ASTM D412.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Membrane Fasteners: As recommended by and approved by membrane manufacturer.

D. Vapor Retarder: Reinforced Kraft paper laminate, complying with requirements of fire rating classification; compatible with roofing and insulation materials.
1. Fire-retardant adhesive.

E. Flexible Flashing Material: Same material as membrane.

2.4. INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
1. Classifications:
a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
2) Compressive Strength: Classes 1-2-3, Grade 2 - 20 psi (138 kPa), minimum.
3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inches (38 mm) thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F (24 degrees C).
2. Board Size: 48 by 96 inches (1220 by 2440 mm).
3. Board Thickness: 1.5 inch (37.5 mm).
4. Board Edges: Square.

2.5. ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.

B. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches (152 mm) wide; self adhering.

C. Insulation Fasteners: Appropriate for purpose intended.

D. Membrane Adhesive: As recommended by membrane manufacturer.

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E. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.

F. Insulation Adhesive: As recommended by insulation manufacturer.

G. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
1. Composition: Asphaltic with mineral granule surface.
2. Size: As indicated on drawings.
3. Surface Color: White.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.2. PREPARATION - METAL DECK

A. Mechanically fasten sheathing to roof deck in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
1. Over entire roof area, fasten sheathing using six fasteners with washers per sheathing board.

3.3. INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
1. Extend vapor retarder under cant strips and blocking to deck edge.
2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.

B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.

C. Attachment of Insulation:
1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.

D. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.

E. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.

F. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

G. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

H. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.

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I. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches (457 mm).

J. Do not apply more insulation than can be covered with membrane in same day.

3.4. INSTALLATION - MEMBRANE

A. Install elastomeric membrane roofing system in accordance with manufacturer's recommendations and NRCA (WM) applicable requirements.

B. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.

C. Shingle joints on sloped substrate in direction of drainage.

D. Fully Adhered Application: Apply adhesive to substrate at rate required by manufacturer. Fully embed membrane in adhesive except in areas directly over or within 3 inches (76 mm) of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.

E. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (76 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

F. At intersections with vertical surfaces:
1. Extend membrane over cant strips and up a minimum of 4 inches (102 mm) onto vertical surfaces.
2. Fully adhere flexible flashing over membrane and up to nailing strips.

G. Around roof penetrations, seal flanges and flashings with flexible flashing.

H. Coordinate installation of roof drains and sumps and related flashings.

3.5. CLEANING

A. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.

B. Repair or replace defaced or damaged finishes caused by work of this section.

3.6. PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

NOT FOR BIDDING

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, exterior penetrations, and other items indicated in Schedule.

B. Precast concrete splash pads.

1.2. REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

C. CDA A4050 - Copper in Architecture - Handbook; Current Edition.

D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3. SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.4. QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1. SHEET MATERIALS

A. Anodized Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 0.032 inch (0.81 mm) thick; clear anodized finish.

NOT FOR BIDDING

2.2. PREFINISHED ALUMINUM SHEETS

A. Description: Factory-applied topcoat systems applied to aluminum flat sheet substrates prior to fabrication by coil coating; topcoat systems consist of primers and organic topcoats on exposed side and backing coats on unexposed side.

B. Aluminum Sheet Substrates: ASTM B209/B209M, alloy and temper as recommended by manufacturer for application.

C. High-Performance Organic Coating System: Comply with AAMA 2604 for aluminum preparation, pretreatment, primer and finish coat system; provide thermally cured, 50-percent PVDF or silicone-modified polyester systems; tested for weathering for 5 years with 5 delta units color change maximum.

2.3. FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.4. GUTTERS AND DOWNSPOUTS

A. Gutters: SMACNA (ASMM) Rectangular profile.

B. Downspouts: Profile as indicated.

C. Gutters and Downspouts: Size indicated on drawings.

D. Accessories: Profiled to suit gutters and downspouts.
1. Gutter Supports: Brackets.
2. Downspout Supports: Brackets.

E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.

F. Overflow Scupper: Aluminum with all welded seams as indicated on drawings.

G. Seal metal joints.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

NOT FOR BIDDING

3.2. INSTALLATION

A. Comply with drawing details.

B. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.

C. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

D. Apply plastic cement compound between metal flashings and felt flashings.

E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

F. Secure gutters and downspouts in place with concealed fasteners.

G. Connect downspouts to downspout boots, and grout connection watertight.

H. Set splash pads under downspouts.

END OF SECTION

NOT FOR BIDDING

SECTION 077200 - ROOF ACCESSORIES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Roof curbs.

B. Roof hatches.

PART 2 PRODUCTS

2.1. ROOF CURBS

A. Roof Curbs Manufacturers:
1. AES Industries Inc; _____: www.aescurb.com/#sle.
2. The Pate Company; _____: www.patecurbs.com/#sle.
3. LMCurbs; Roof Curbs: www.lmcurbs.com/#sle.
4. MKT Metal Manufacturing: www.mktduct.com/#sle.

B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
1. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation .
2. Sheet Metal Material:
a. Aluminum: 0.080 inch (2.03 mm) minimum thickness, with 3003 alloy, and H14 temper.

2.2. ROOF HATCHES AND VENTS

A. Roof Hatch Manufacturers:
1. Babcock-Davis; Personnel: www.babcockdavis.com/#sle.
2. Bilco Company: Type E (ladder access, 3 ft square, solid cover): thermally broken; www.bilco.com/#sle.basis of design
3. LMCurbs; Roof Hatch: www.lmcurbs.com/#sle.

B. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.

PART 3 EXECUTION

3.1. EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

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3.2. PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.3. INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.4. CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean installed work to like-new condition.

3.5. PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

NOT FOR BIDDING

SECTION 078413 - HVAC & PLUMBING PENETRATION FIRESTOPPING

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. Section includes:

1. Through-penetration firestopping in fire rated construction.
2. Through-penetration smoke-stopping in smoke partitions.

C. Related items:

1. Fire dampers and manufactured devices: Refer to Division 23 Section HVAC Air Distribution.

1.2. 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:

C. ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.3. 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.

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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.

1.4. 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.
2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations.

1.5. SUBMITTALS

A. Submit in accordance with Division 01 Section Submittal Procedures, 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.

C. Shop drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable UL system number, or UL classified devices.
2. Manufacturer or manufacturer's representative shall provide qualified engineering judgment and drawings relating to non-standard applications as needed.

D. Quality control submittals:

1. Statement of qualifications.

E. Applicators' qualifications statement:

1. List past projects indicating required experience.

1.6. QUALITY ASSURANCE

A. Installer's qualifications: Fire experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, State or local authority where applicable.
2. At least 2 years experience with systems.
3. Successfully completed at least 5 comparable scale projects using this system.

B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.

C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

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1.7. 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.

1.8. PROJECT CONDITIONS

A. Existing condition:

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.

1.9. WARRANTY

A. Submit copies of written warranty agreeing to repair or replace joint sealers which fail 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 warranty period shall be two (2) years from date of substantial completion unless otherwise noted.

PART 2 PRODUCTS

2.1. 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, penetrant 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 3.6 of this section.

3. All firestopping products must be from a single manufacturer. All trades shall use products

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from the same manufacturer unless otherwise noted.

2.2. SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in The Systems and Applications Schedule in Part 3.6 of this section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

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.

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.

B. Coordinate an inspection of all Mechanical Firestopping systems with the Fire Marshal prior to installation of ceilings, walls, etc.

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 pipes, ducts, or other items, close unused portions of opening with firestopping materials tested for the application. See UL Fire Resistance Directory or Section 3.6 of this document.

1. Install smoke stopping as specified for firestopping.

3.4. FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

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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.

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 CP25WB+ 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 MPS2+ 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 Metallic Pipe	CAJ5001 CP 25N/S, CP 25S/L, CP 25WB+ CAJ5002 FS-195+ CAJ5003 FS-195+ CAJ5005 MPS-2+ CAJ5009 2000+, 2003 CAJ5017 FS-195+, CP 25 CAJ5022 FS-195+ CAJ5024 FS-195+ CAJ5030 CS-195+, FS-195+ CAJ5041 2000, 2000+, 2003 CAJ5060 CP 25WB+ CAJ5074 2000+ CBJ5002 CP 25 CBJ5003 FS-195+ FA5001 FS-195+, CP 25WB+	WL5001 FS-195+ WL5002 FS-195+ WL5009 FS-195+ WL5010 FS-195+ WL5011 CP 25WB+ WL5032 2000+ WL5038 CP 25WB+ WL5039 CP 25WB+ WL5040 CP 25WB+ WL5045 CP 25WB+ WL5053 2000+	FC5002 FS-195+ FC5008 FS-195+
Miscellaneous Mechanical HVAC Ducts	CAJ7001 CP 25N/S CP 25S/L CAJ7003 CP 25WB+ CAJ7009 DUCT WRAP, BULK PUTTY		FC7001 CP 25S/L, CP 25N/S
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+	

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*Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

1.2. REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).

C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.

G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Backing material recommended by sealant manufacturer.
   4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   5. Substrates the product should not be used on.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

E. Executed warranty.

1.4. QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

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

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience and approved by manufacturer.

D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
1. Adhesion Testing: In accordance with ASTM C794.
2. Compatibility Testing: In accordance with ASTM C1087.
3. Allow sufficient time for testing to avoid delaying the work.
4. Deliver sufficient samples to manufacturer for testing.
5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

1.5. WARRANTY

A. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Nonsag Sealants:
1. Dow: www.dow.com/#sle.
2. Pecora Corporation: www.pecora.com/#sle.
3. Sika Corporation: usa.sika.com/#sle.
4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.2. JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints:
a. Do not seal exterior joints unless indicated on drawings as sealed.
b. Seal open joints except open joints indicated on drawings as not sealed.
c. Seal the following joints:
1) Wall expansion and control joints.
2) Joints between doors, windows, and other frames or adjacent construction.
2. Interior Joints:
a. Do not seal interior joints indicated on drawings as not sealed.
b. Do not seal gaps and openings in gypsum board and suspended ceilings
c. Seal open joints except specific open joints indicated on drawings as not sealed.
d. Seal the following joints:
1) Joints between door frames and window frames and adjacent construction.
2) Joints at floor to wall as indicated.

B. Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, noncuring.

C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.

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2.3. JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

B. Colors: As seelcted from full range

2.4. NONSAG JOINT SEALANTS

A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M, A, G, and O; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
5. Color: To be selected by Architect from manufacturer's standard range.
6. Products:
   a. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
   b. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
   c. Sika Corporation; Sikasil WS-290: usa.sika.com/#sle.
   d. Tremco Commercial Sealants & Waterproofing; Tremsil 200: www.tremcosealants.com/#sle.

B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 35 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.
3. Products:
   a. Pecora Corporation; DynaTrol II: www.pecora.com/#sle.
   b. Sika Corporation; Sikaflex-15 LM: usa.sika.com/#sle.
   c. Tremco Commercial Sealants & Waterproofing; Dymonic 100: www.tremcosealants.com/#sle.

C. Type ___ - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.

D. Type ___ - Noncuring Butyl Sealant: Solvent-based, single component, nonsag, nonskinning, nonhardening, nonbleeding; nonvapor permeable; intended for fully concealed applications.

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PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.2. PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3. INSTALLATION

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install bond breaker backing tape where backer rod cannot be used.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

NOT FOR BIDDING

SECTION 080671 – DOOR HARDWARE SCHEDULE (GREENHOUSE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware”.
2. Division 28 Section “Access Control”.
3. Division 28 Section “Integrated Access Control Hardware Devices”.

D. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

NOT FOR BIDDING

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service

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representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

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PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a

hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1. Section 08 71 00 – Door Hardware.
2. Section 28 13 00 – Access Control.
3. Section 28 15 00 – Access Control Hardware Devices.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. SA - SARGENT
6. RF - Rixson
7. NO - Norton
8. OT - Other

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Hardware Sets

Set: 1.0

Doors: 100/1, 100/2

2	Continuous Hinge	CFM__HD1 PT - DOOR HEIGHT		PE	087100	
2	Electric Power Transfer	EL-CEPT	630	SU	087100	⚡
1	Mullion	L980	PC	SA	087100	
1	Rim Exit Device, Exit Only	55 8810 EO	US32D	SA	087100	⚡
1	Rim Exit Device, Storeroom (CRsn) - By Division 28	DG164 56-SN200-8804 862	US32D	SA	087100	⚡

1	Cylinder (mullion)	DG164 980C1	US26D	SA	087100
2	Permanent Core	DG1 6300	US15	SA	087100
2	Surface Closer	CLP7500T	689	NO	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	5110BL		PE	087100
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100
2	Sweep	3452CNB		PE	087100
1	Threshold	272A MSES25SS		PE	087100
2	Frame Harness	QC-C1500P		MK	087100
2	Door Harness	QC-C___ - LENGTH TO SUIT		MK	087100
2	Door Contact Switch	BY SECURITY - PREP DOOR/FRAME		OT	281300
1	Power Supply	AQL4-R8E1		SU	087100

Notes: When door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 2.0

Doors: 109/1

1	Continuous Hinge	CFM__HD1 PT - DOOR HEIGHT		PE	087100
1	Electric Power Transfer	EL-CEPT	630	SU	087100
1	Rim Exit Device, Storeroom (CRsn) - By Division 28	DG164 56-SN200-8804 862	US32D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100
1	Surface Closer	CPS7500	689	NO	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100
1	Sweep	3452CNB		PE	087100
1	Threshold	272A MSES25SS		PE	087100
1	Frame Harness	QC-C1500P		MK	087100
1	Door Harness	QC-C___ - LENGTH TO SUIT		MK	087100
1	Door Contact Switch	BY SECURITY - PREP DOOR/FRAME		OT	281530
1	Power Supply	AQL4-R8E1		SU	087100

Notes: When door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting

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door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 3.0

Doors:110/1

1	Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE	087100	
1	Continuous Hinge	CFM__HD1 PT - DOOR HEIGHT		PE	087100	
1	Electric Power Transfer	EL-CEPT	630	SU	087100	⚡
1	Dust Proof Strike	570	US26D	RO	087100	
2	Flush Bolt (manual)	555 (or) 557	US26D	RO	087100	
1	Fail Secure Lock (CRsn) - By Division 28	DG164 SN200-82271-24V BIPS-0E LNL	US26D	SA	281500	⚡
1	Permanent Core	DG1 6300	US15	SA	087100	
1	Surf Overhead Stop	8-X36	630	RF	087100	
1	Surface Closer	CPS7500	689	NO	087100	
2	Astragal	297AS		PE	087100	
1	Rain Guard	346C		PE	087100	
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100	
2	Sweep	3452CNB		PE	087100	
1	Threshold	272A MSES25SS		PE	087100	
1	Frame Harness	QC-C1500P		MK	087100	⚡
1	Door Harness	QC-C___ - LENGTH TO SUIT		MK	087100	⚡
2	Door Contact Switch	BY SECURITY - PREP DOOR/FRAME		OT	281300	
1	Power Supply	AQL4-R8E1		SU	087100	⚡

Notes: Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 4.0

Doors: 112/1, 110/3

2	Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE	087100
1	Dust Proof Strike	570	US26D	RO	087100
2	Flush Bolt (manual)	555 (or) 557	US26D	RO	087100
1	Storeroom/Closet Lock	DG164 8204 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100

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2	Surf Overhead Stop	8-X36	630	RF	087100
2	Astragal	297AS		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100
2	Sweep	3452CNB		PE	087100
1	Threshold	272A MSES25SS		PE	087100

Set: 5.0

Doors: 101/1

1	Continuous Hinge	CFM__HD1 PT - DOOR HEIGHT		PE	087100	
1	Electric Power Transfer	EL-CEPT	630	SU	087100	⚡
1	Fail Secure Lock (CRsn) - By Division 28	DG164 SN200-82271-24V BIPS-0E LNL	US26D	SA	281500	⚡
1	Permanent Core	DG1 6300	US15	SA	087100	
1	Surface Closer	CPS7500T	689	NO	087100	
1	Rain Guard	346C		PE	087100	
1	Gasketing	ACP112BL/2		PE	087100	
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100	
1	Sweep	3452CNB		PE	087100	
1	Threshold	272A MSES25SS		PE	087100	
1	Frame Harness	QC-C1500P		MK	087100	⚡
1	Door Harness	QC-C___ - LENGTH TO SUIT		MK	087100	⚡
1	Power Supply	AQL4-R8E1		SU	087100	⚡

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

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Set: 6.0

Doors: 106/2

2	Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE	087100
1	Dust Proof Strike	570	US26D	RO	087100
2	Flush Bolt (manual)	555 (or) 557	US26D	RO	087100
1	Classroom Lock	DG164 8237 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100

1	Surf Overhead Hold Open	8-326	630	RF	087100
1	Surface Closer	CPS7500T	689	NO	087100
2	Astragal	297AS		PE	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100
2	Sweep	3452CNB		PE	087100
1	Threshold	272A MSES25SS		PE	087100

Set: 7.0

Doors: 102/1

6	Hinge, Full Mortise	TA2714	US26D	MK	087100
1	Dust Proof Strike	570	US26D	RO	087100
2	Flush Bolt (manual)	555 (or) 557	US26D	RO	087100
1	Storeroom/Closet Lock	DG164 8204 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100
2	Conc Overhead Stop	2-X36	630	RF	087100
2	Silencer	608 (or) 609		RO	087100

Set: 8.0

Doors: 104/1

3	Hinge, Full Mortise	TA2714	US26D	MK	087100
1	Storeroom/Closet Lock	DG164 8204 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100
1	Wall Stop	409	US32D	RO	087100
3	Silencer	608 (or) 609		RO	087100

Set: 9.0

Doors: 101/2, 108/1

3	Hinge, Full Mortise	TA2714	US26D	MK	087100	
1	Electric Power Transfer	EL-CEPT	630	SU	087100	⚡
1	Fail Secure Lock (CRsn) - By Division 28	DG164 SN200-82271-24V BIPS-0E LNL	US26D	SA	281500	⚡
1	Permanent Core	DG1 6300	US15	SA	087100	
1	Surface Closer	R7500 (or) PR7500	689	NO	087100	
1	Wall Stop	409	US32D	RO	087100	
3	Silencer	608 (or) 609		RO	087100	
1	Frame Harness	QC-C1500P		MK	087100	⚡

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1	Door Harness	QC-C___ - LENGTH TO SUIT		MK	087100
1	Power Supply	AQL4-R8E1		SU	087100

Notes: Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

Set: 10.0

Doors: 115/1

6	Hinge, Full Mortise	TA2714	US26D	MK	087100
1	Dust Proof Strike	570	US26D	RO	087100
2	Flush Bolt (manual)	555 (or) 557	US26D	RO	087100
1	Classroom Lock	DG164 8237 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100
2	Conc Overhead Stop	2-X36	630	RF	087100
2	Silencer	608 (or) 609		RO	087100

Set: 11.0

Doors: 103/2

6	Hinge, Full Mortise	TA2714	US26D	MK	087100
1	Dust Proof Strike	570	US26D	RO	087100
2	Flush Bolt (manual)	555 (or) 557	US26D	RO	087100
1	Classroom Lock	DG164 8237 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100
2	Surf Overhead Hold Open	8-326	630	RF	087100
1	Surface Closer	R7500 (or) PR7500	689	NO	087100
2	Silencer	608 (or) 609		RO	087100

Set: 12.0

Doors: 105/1, 106/1

3	Hinge, Full Mortise	TA2714	US26D	MK	087100
1	Classroom Lock	DG164 8237 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100
1	Wall Stop	409	US32D	RO	087100

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3 Silencer	608 (or) 609		RO	087100

Set: 13.0

Doors: 107/1

3 Hinge, Full Mortise	TA2714	US26D	MK	087100
1 Privacy Lock	V21 8265 LNL	US26D	SA	087100
1 Surface Closer	R7500 (or) PR7500	689	NO	087100
1 Wall Stop	409	US32D	RO	087100
3 Silencer	608 (or) 609		RO	087100

Set: 14.0

Doors: 101/3, 103/1, 103/3, 105/2, 110/2, 110/4, 110/5

1 Permanent Core	DG1 6300	US15	SA	087100
1 Cylinder	As Required x Temp Core DG1	US32D	SA	087100

Notes: Balance of hardware by assembly manufacturer.

END OF SECTION 080671

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SECTION 080671 – DOOR HARDWARE SCHEDULE (WEST PAVILION)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware”.
2. Division 28 Section “Integrated Access Control Hardware Devices”.

D. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

NOT FOR BIDDING

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service

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representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

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PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a

hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1. Section 08 71 00 – Door Hardware.
2. Section 28 15 00 – Access Control Hardware Devices.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. SA - SARGENT
5. RF - Rixson
6. NO - Norton
7. RO - Rockwood

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Hardware Sets

Set: 1.0

Doors: 100/1

1	Continuous Hinge	CFM__HD1 PT - DOOR HEIGHT		PE	087100	
1	Electric Power Transfer	EL-CEPT	630	SU	087100	⚡
1	Fail Secure Lock (CRsn) - By Division 28	DG164 SN200-82271-24V BIPS-0E LNL	US26D	SA	281500	⚡
1	Permanent Core	DG1 6300	US15	SA	087100	
1	Surface Closer	CPS7500	689	NO	087100	
1	Rain Guard	346C		PE	087100	
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100	

1	Sweep	3452CNB		PE	087100
1	Threshold	272A MSES25SS		PE	087100
1	Frame Harness	QC-C1500P		MK	087100
1	Door Harness	QC-C___ - LENGTH TO SUIT		MK	087100
1	Power Supply	AQL4-R8E1		SU	087100

Notes: When door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Set: 2.0

Doors: 102/1, 104/1, 105/1, 107/1

2	Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE	087100
1	Mullion	L980	PC	SA	087100
1	Rim Exit Device, Storeroom	DG164 16 8804 862	US32D	SA	087100
1	Rim Exit Device, Dummy	DG164 16 8810 862	US32D	SA	087100
1	Cylinder (mullion)	DG164 980C1	US26D	SA	087100
4	Permanent Core	DG1 6300	US15	SA	087100
2	Surface Closer	CPS7500	689	NO	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	5110BL		PE	087100
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100
2	Sweep	3452CNB		PE	087100

Set: 3.0

Doors: 108/1

1	Continuous Hinge	CFM__HD1 - DOOR HEIGHT		PE	087100
1	Dormitory/Exit Lock	DG164 8225 LNL	US26D	SA	087100
1	Permanent Core	DG1 6300	US15	SA	087100
1	Surface Closer	CPS7500	689	NO	087100
1	Rain Guard	346C		PE	087100
1	Gasketing	290APK x 2891APK (Head & Jamb)		PE	087100
1	Sweep	3452CNB		PE	087100
1	Threshold	272A MSES25SS		PE	087100

Set: 4.0

Doors: 101/1, 109/1

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3	Hinge, Full Mortise	TA2714	US26D	MK 087100
1	Rim Exit Device, Storeroom	DG164 8804 ETL	US32D	SA 087100
1	Permanent Core	DG1 6300	US15	SA 087100
1	Surface Closer	CLP7500	689	NO 087100
3	Silencer	608 (or) 609		RO 087100

Set: 7.0

Doors: 103A/1, 106A/1

3	Hinge, Full Mortise	TA2714	US26D	MK 087100
1	Storeroom/Closet Lock	DG164 8204 LNL	US26D	SA 087100
1	Permanent Core	DG1 6300	US15	SA 087100
1	Surf Overhead Stop	10-X36	652	RF 087100
3	Silencer	608 (or) 609		RO 087100

Set: 11.0

Doors: 100/2, 108/2, 108/3

1	Permanent Core	DG1 6300	US15	SA 087100
1	Cylinder	As Required x Temp Core - DG1	US32D	SA 087100

END OF SECTION 080671

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1. SECTION INCLUDES

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

B. Thermally insulated hollow metal doors with frames.

C. Hollow metal borrowed lites glazing frames.

1.2. RELATED REQUIREMENTS

A. Section 087100 - Door Hardware.

B. Section 088000 - Glazing: Glass for doors and borrowed lites.

C. Section 099113 - Exterior Painting: Field painting.

D. Section 099123 - Interior Painting: Field painting.

1.3. ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. HMMA: Hollow Metal Manufacturers Association.

C. NAAMM: National Association of Architectural Metal Manufacturers.

D. NFPA: National Fire Protection Association.

E. SDI: Steel Door Institute.

F. UL: Underwriters Laboratories.

1.4. REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.

D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2025.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

NOT FOR BIDDING

G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2025.

H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2025.

I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

L. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

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

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

O. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.

P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

Q. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Hollow Metal Doors and Frames:
1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. Curries, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
3. Republic Doors, an Allegion brand; ____: www.republicdoor.com/#sle.
4. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.

2.2. PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Door Edge Profile: Beveled, both sides.
4. Typical Door Face Sheets: Flush.
5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
7. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

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

2.3. HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 3 - Extra Heavy-duty.
   b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
   e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
   a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
3. Door Thermal Resistance: R-Value of 8.7, minimum, for installed thickness of polyurethane.
4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
5. Door Finish: Factory primed and field finished.

C. Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 3 - Extra Heavy-duty.
   b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 1 - Full Flush.
   d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
   e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
4. Door Face Sheets: Flush.
5. Door Finish: Factory primed and field finished.

NOT FOR BIDDING

2.4. HOLLOW METAL FRAMES

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

B. Frame Finish: Factory primed and field finished.

C. Exterior Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
2. Frame Metal Thickness: 14 gauge, 0.067 inch (1.7 mm), minimum.
3. Frame Finish: Factory primed and field finished.
4. Weatherstripping: Separate, see Section 087100.

D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
2. Frame Finish: Factory primed and field finished.

E. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

F. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

G. Frames in Masonry Walls: Size to suit masonry coursing with head member 2 inches high to fill opening without cutting masonry units.

2.5. FINISHES

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

2.6. ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components ; factory-installed.

B. Glazing: Clear tempered sheet glass, 1/4 inch (6 mm) thick, factory installed.

C. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.

D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

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

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

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

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

NOT FOR BIDDING

3.2. PREPARATION

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

3.3. INSTALLATION

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

B. Coordinate frame anchor placement with wall construction.

C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

D. Install door hardware as specified in Section 087100.

1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

E. Coordinate installation of electrical connections to electrical hardware items.

3.4. TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.5. ADJUSTING

A. Adjust for smooth and balanced door movement.

3.6. SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

NOT FOR BIDDING

SECTION 083313 - COILING COUNTER DOORS - CHI OVERHEAD DOORS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Manual Coiling Counter doors.

1.2. REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

B. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish.

C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.

D. Manufacturer's Instructions: Indicate installation sequence, adjustment, and alignment procedures.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

1.4. QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with minimum 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified, with minimum 5 years of documented experience.

1.5. WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 5-year manufacturer warranty for defects in materials and workmanship. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. C.H.I. Overhead Doors, LLC: www.chiohd.com/#sle.

NOT FOR BIDDING

B. Cookson: www.cooksondoor.com

C. Cornell: www.cornelliron.com

D. Clopay: www.clopaydoor.com

2.2. COILING COUNTER DOORS

A. Non-Fire-Rated: Galvanized steel slat curtain.
1. Mounting: Interior face mounted.
2. Slat Profile: Flat.
3. Nominal Slat Size: 1-1/2 inches (38.1 mm).
a. Material Finish: ASTM A 653 galvanized base coating with baked on polyester coat, min. 2.5 - 3.5 mils cured film thickness; equivalent to Cornell's SpectraShiled Ultra finish..
b. Color: As selected by Architect.
4. Guides: Clear anodized.
a. Color: As indicated on drawings.
5. Hood Enclosure: Manufacturer's standard; primed steel.
a. Color: To match Slats.
6. Bottom Bar: Factory powder coated.
7. Weather Seal: Rubber hood baffle, jamb and header brush.
8. Operation: Manual push up.
9. Locking Mechanism: Handle throw cylinder lock.
10. Products: Cornell Model ESC10 or equivalent.

2.3. COMPONENTS

A. Metal Curtain:
1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.

B. Guide: Continuous, of profile to retain door in place, with mounting brackets of same metal.

C. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain; capable of holding position at mid-travel; adjustable spring tension; requiring 25 lb (10 kg) nominal force to operate.

NOT FOR BIDDING

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify adjacent construction meets manufacturer’s requirements for door installation.

B. Verify door opening is plumb, header is level, and dimensions are correct.

C. Notify Architect of conditions or varying dimensions that do not meet manufacturer’s requirements.

D. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.2. INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install fire-rated doors in accordance with NFPA 80.

C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

E. Fit and align assembly, including hardware, level and plumb to provide smooth operation.

3.3. TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation from Plumb: 1/16 inch (1.5 mm).

C. Maximum Variation from Level: 1/16 inch (1.5 mm).

3.4. ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.5. CLEANING

A. See Section 017000 - Execution and Closeout Requirements for additional requirements.

B. Clean installed components.

C. Remove labels and visible markings.

3.6. PROTECTION

A. Protect installed coiling doors from subsequent construction operations.

END OF SECTION

NOT FOR BIDDING

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Exterior coiling doors.

1.2. RELATED REQUIREMENTS

A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.3. REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

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

F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

G. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; Current Edition, Including All Revisions.

NOT FOR BIDDING

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide general construction and component connections and details.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

D. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

E. Manufacturer's qualification statement.

F. Installer's qualification statement.

G. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.5. QUALITY ASSURANCE

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Overhead Coiling Metal Doors:
1. Clopay: www.clopaydoor.com/#sle.
2. Cornell Iron Works, Inc; ESD30 Thermiser Max; Basis of Design: www.cornelliron.com/#sle.
3. Overhead Door Corporation; Model 626 RapidSlat Stormtite Insulated Rolling Service Door : www.overheaddoor.com/#sle.
4. Raynor Garage Doors; DuraCoil, Model ___: www.raynor.com/#sle.
5. Wayne-Dalton, a Division of Overhead Door Corporation; Model 900 Rolling Service Door: www.wayne-dalton.com/#sle.

2.2. COILING DOORS

A. Exterior Coiling Doors: Steel slat curtain.
1. Capable of withstanding positive and negative wind loads of 20 psf (940 Pa) without undue deflection or damage to components.
2. Sandwich Slats: Manufacturer's standard, with core of foamed-in-place polyurethane insulation; minimum R-value of 8.1 (RSI-value of 1.43).
3. Nominal Slat Size: 2 inches (50 mm) wide by required length.
4. Finish: Factory painted ASTM A653/A653M glavanized base coating treated with dual process rinsing agents in preparation of a chemical bonding, baked-on polyester base coat and a baked-on polyester finish coat, color as selectd from full range of RAlL colors.
5. Manual hand chain lift operation.

2.3. MATERIALS

A. Metal Curtain Construction: Interlocking slats.
1. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
3. Steel Slats: Minimum thickness, 20 gauge, 0.8 mm thivk; ASTM A653/A653M galvanized steel sheet.

B. Guide Construction: Continuous, of profile to retain door in place with snap-on trim, mounting brackets of same metal.

C. Lock Hardware:
1. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.
2. Manual Chain Lift: Provide padlockable chain keeper on guide.

D. Roller Shaft Counterbalance: Steel pipe and helical steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb (10 kg) nominal force to operate.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that adjacent construction is suitable for door installation.

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B. Verify that electrical services have been installed and are accessible.

C. Verify that door opening is plumb, header is level, and dimensions are correct.

D. Notify Architect of any unacceptable conditions or varying dimensions.

E. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.2. INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.3. TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch (1.6 mm).

C. Maximum Variation From Level: 1/16 inch (1.6 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet (3.2 mm per 3 m) straight edge.

3.4. ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.5. CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

END OF SECTION

NOT FOR BIDDING

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

1.2. RELATED REQUIREMENTS

A. Section 042000 Unit Masonry: Preparation of adjacent work to receive work of this section.

B. Section 072500 - Weather Barriers: Sealing framing to water-resistive barrier installed on adjacent construction.

1.3. REFERENCE STANDARDS

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

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2025.

C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.

E. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

F. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

G. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

J. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

1.4. ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

NOT FOR BIDDING

1.5. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

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

C. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

1.6. QUALITY ASSURANCE

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

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

1.7. DELIVERY, STORAGE, AND HANDLING

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

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

1.8. FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.9. WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

NOT FOR BIDDING

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Aluminum-Framed Storefronts:
1. Kawneer North America; _____: www.kawneer.com/#sle.
2. Oldcastle BuildingEnvelope; _____: www.oldcastlebe.com/#sle.
3. YKK AP America, Inc; _____: www.ykkap.com/commercial/#sle.

2.2. BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Front-Set Style, Wind-Borne-Debris Resistance Tested:
1. Basis of Design: Kawneer 451T Storefront.

2.3. ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Unitized, shop assembly.
2. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
3. Glazing Position: Centered (front to back).
4. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).
5. Finish: Class II natural anodized.
a. Factory finish all surfaces that will be exposed in completed assemblies.
6. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
7. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
8. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
9. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
10. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Design Wind Loads: Comply with requirements of ASCE 7.
b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

2.4. COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Glazing Stops: Flush.

2.5. MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

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

2.6. FINISHES

A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils (0.01 mm) thick.

NOT FOR BIDDING

PART 3 EXECUTION

3.1. EXAMINATION

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

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.2. INSTALLATION

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

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

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

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

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

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

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

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

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

3.3. TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.4. CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

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

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.5. PROTECTION

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

END OF SECTION

NOT FOR BIDDING

SECTION 092116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Metal stud wall framing.

B. Metal channel ceiling framing.

C. Gypsum wallboard.

D. Joint treatment and accessories.

1.2. REFERENCE STANDARDS

A. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2025.

F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2025.

H. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

I. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2024.

J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

K. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019 (Reapproved 2024).

L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

M. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

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

NOT FOR BIDDING

1.4. QUALITY ASSURANCE

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

1.5. DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.1. GYPSUM BOARD ASSEMBLIES

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

B. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:

2.2. METAL FRAMING MATERIALS

A. Material and Product Requirements: AISI S201 and AISI S220.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

C. Manufacturers - Metal Framing, Connectors, and Accessories:
1. ClarkDietrich; ____: www.clarkdietrich.com/#sle.
2. MarinoWARE; ____: www.marinoware.com/#sle.
3. Phillips Manufacturing Co; ____: www.phillipsmfg.com/#sle.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
1. Studs: C-shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.

E. Nonstructural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

2.3. BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. CertainTeed Corporation; ____: www.certainteed.com/#sle.
2. Georgia-Pacific Gypsum; ____: www.gpgypsum.com/#sle.
3. Gold Bond Building Products, LLC provided by National Gypsum Company; ____: www.goldbondbuilding.com/#sle.
4. USG Corporation; ____: www.usg.com/#sle.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.

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2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
3. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
4. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   a. Mold resistant board is required at all locations.
5. Thickness:
   a. Vertical Surfaces: 5/8 inch (16 mm).
   b. Ceilings: 5/8 inch (16 mm).
6. Mold-Resistant, Paper-Faced Products:
   a. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
   b. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
   d. USG Corporation; Sheetrock Brand Mold Tough Firecode SCX Panels 5/8 in. (15.9 mm): www.usg.com/#sle.

2.4. GYPSUM BOARD ACCESSORIES

A. Finishing Accessories:
   1. Types: As detailed or required for finished appearance.
   2. Materials: 6063-T5 extruded aluminum alloy and G40 (Z120) galvanized steel sheet in accordance with ASTM A653/A653M.

B. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.

PART 3 EXECUTION

3.1. EXAMINATION

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

3.2. FRAMING INSTALLATION

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

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

C. Studs: Space studs at 16 inches on center (at 406 mm on center).
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

3.3. BOARD INSTALLATION

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

3.4. INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated on drawings.

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

3.5. JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

3.6. TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

NOT FOR BIDDING

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes resinous flooring systems.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.

C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
   1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
   2. Contractor shall have completed at least 10 projects of similar size and complexity.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, waterproofing membranes, hardening agents, grouting coats, broadcast aggregates and topcoats through one source from a single manufacturer, with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

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C. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.

1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.

D. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.

a. Include 48-inch (1200-mm) length of integral cove base.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Pre-installation Conference:

1. General contractor shall arrange a meeting not less than thirty days prior to starting work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

C. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

1. Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

D. Type 1 concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. If a vapor barrier is not present, please consult with your Stonhard technical representative.

1.7 WARRANTY

NOT FOR BIDDING

A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation or provide a joint and several warranties signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

B. Substitutions: All substitutions shall be submitted to Architect for review no later than ten (10) days prior to bidding in accordance with bidding requirements.

2.3 RESINOUS FLOORING SYSTEM

A. Resinous Flooring System (**RES-1**): Basis-of-Design: Stontec QBF as manufactured by Stonhard, Inc., Maple Shade, NJ, is a 1/16”/1.5 mm thick system comprised of a two-component, 100 solids flexible urethane undercoat with ¼” brightly colored flake broadcast and one coat of a high gloss clear epoxy sealer.

1. System Characteristics:

a. Color and Pattern: Select from Manufacturer’s standards to match existing High School.
b. Wearing Surface: Clear, high gloss epoxy sealer.
c. Integral Cove Base: 4” (inches).
d. Overall System Thickness: Nominal1.5 mm/1/16” thick.

2. System Components: Manufacturer's standard components that are compatible with each other and as follows:

a. Undercoat(s):
1) Material Basis: Stonproof ME7
2) Resin: Urethane
3) Elongation: 200 percent
4) Type: Pigmented
5) Formulation Description: 100% high solids.

b. Broadcast Aggregate:
1) Multi-color vinyl flakes broadcast ¼” size
2) Number of broadcasts: To refusal.

c. Topcoats:
1) Material Basis: Stonkote CE4
2) Resin: Epoxy
3) Formulation Description: 100% high solids.
4) Type: Clear gloss
5) Number of Coats: Standard one.

3. System Physical Properties: Provide resinous flooring system with the following minimum physical

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property requirements when tested according to test methods indicated:

a. Abrasion Resistance: 0.52 gm max. weight loss per ASTM D-4060, CS-17.
b. Tensile Strength: 5,900 psi per ASTM D-638.
c. .Flammability: Class 1 per ASTM E-648.
d. Hardness: 80 to 84, Shore D per ASTM D 2240.

2.4 ACCESSORY MATERIALS

A. Primer: Type recommended by manufacturer for substrate and body coats indicated. Formulation Description: Stonhard Standard Primer, 100% solids.

B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated. Formulation Description Only if application above grade Stonproof ME7. Optional.

E. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated. Resinous based materials only. Cementitious or single component products not accepted.

F. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 - EXECUTION

3.0 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Mechanically prepare substrates as follows:
   a. Includes use of a scabbler, scarifier or shot blast machine for removal of bond inhibiting materials such as curing compounds or laitance.
   b. Hand diamond grind near walls and obstructions.
   c. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
3. Verify that concrete substrates are dry.

   a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 85 percent.

   b. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

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4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.1 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.

a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.

C: Integral Cove Base: Stontec TRF urethane mortar. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners.

1. Integral Cove Base: 4" (inches) high.

D: Apply Urethane primer with quartz aggregate broadcast to floor and let cure.

E. Apply base coats and topcoats in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.2 FIELD QUALITY CONTROL

A: Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

NOT FOR BIDDING

3.3 CLEANING, PROTECTING, AND CURING

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.

C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer

END OF SECTION 096723

NOT FOR BIDDING

SECTION 099113 - EXTERIOR PAINTING

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.2. RELATED REQUIREMENTS

A. Section 099123 - Interior Painting.

B. Section 099600 - High-Performance Coatings.

1.3. REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; Current Edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.

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

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

E. SSPC-SP 2 - Hand Tool Cleaning; 2024.

F. SSPC-SP 3 - Power Tool Cleaning; 2024.

G. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:

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1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
2. MPI product number (e.g. MPI #47).
3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.

1.5. QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years experience and approved by manufacturer.

1.6. DELIVERY, STORAGE, AND HANDLING

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

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

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.7. FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

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

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

NOT FOR BIDDING

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

B. Paints:
1. Behr Paint Company; _____: www.behr.com/#sle.
2. Pittsburgh Paints: www.pittsburghpaintsco.com/#sle.
3. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

2.2. PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
b. Architectural coatings VOC limits of Delaware.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.3. PAINT SYSTEMS - EXTERIOR

A. Paint ME-OP-3A - Ferrous Metals, Unprimed, Alkyd, 3 Coat:
1. One coat of alkyd primer.
2. Semi-gloss: Two coats of alkyd enamel; ____.

B. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
2. Semi-gloss: Two coats of alkyd enamel; ____.

C. Paint MgE-OP-3A - Galvanized Metals, Alkyd, 3 Coat:
1. One coat galvanize primer.
2. Semi-gloss: Two coats of alkyd enamel; ____.

2.4. PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
2. Water Based Primer for Galvanized Metal; MPI #134.
3. Rust-Inhibitive Water Based Primer; MPI #107.

NOT FOR BIDDING

2.5. ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1. EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

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

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

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

3.2. PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

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

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

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

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Prepare surface according to SSPC-SP 2.

G. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

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

3.3. APPLICATION

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

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

C. Apply each coat to uniform appearance.

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

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4. CLEANING

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

3.5. PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.6. SCHEDULE - PAINT SYSTEMS

A. Steel Fabrications: Finish surfaces exposed to view and concealed surfaces where required to conform to performance requirements and resist corrosion.

B. Galvanized Steel: Finish surfaces exposed to view.

C. Shop-Primed Metal Items: Finish surfaces exposed to view.

END OF SECTION

NOT FOR BIDDING

SECTION 099123 - INTERIOR PAINTING

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

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

D. Do Not Paint or Finish the Following Items:
1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
5. Floors, unless specifically indicated.
6. Glass.
7. Concealed pipes, ducts, and conduits.

1.2. REFERENCE STANDARDS

A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

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

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

D. SSPC-SP 2 - Hand Tool Cleaning; 2024.

E. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

NOT FOR BIDDING

PART 2 PRODUCTS

2.1. MANUFACTURERS

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

B. Paints:
1. Behr Paint Company: www.behr.com/#sle.
2. Pittsburgh Paints: www.pittsburghpaintsco.com/#sle.
3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.2. PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.

2.3. PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.
1. Two top coats and one coat primer.
2. Top Coat(s): High Performance Architectural Interior Latex; MPI # 139.
   a. Products:
      1) Behr Ultra Scuff Defense Interior Eggshell [No.2750]. (MPI #139)
      2) Pittsburgh Paints Prominence Interior Latex, 84-3410 Series, Satin. (MPI #139)
      3) Sherwin-Williams ProMar 200 HP Series, Eg-Shel. (MPI #139)
3. Primer: As recommended by top coat manufacturer for specific substrate.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
2. Two top coats and one coat primer.
3. Top Coat(s): Interior Alkyd, Water Based; MPI #157, 167, 168, or 169.
4. Top Coat Sheen:
   a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

NOT FOR BIDDING

PART 3 EXECUTION

3.1. PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

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

C. Remove or repair existing paints or finishes that exhibit surface defects.

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

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

F. Concrete:

G. Masonry:

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

I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

J. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

K. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Prepare surface according to SSPC-SP 2.

L. Ferrous Metal:
1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

M. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

N. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

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

3.2. APPLICATION

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

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

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

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

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

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.3. CLEANING

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

NOT FOR BIDDING

3.4. PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.5. SCHEDULE - PAINT SYSTEMS

A. Gypsum Board: Finish surfaces exposed to view.
   1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.

B. Steel Doors and Frames: Finish surfaces exposed to view; MI-OP-3A, seim-gloss.

C. Steel Fabrications: Finish surfaces exposed to view and to concealed surfaces where required to conform to performance requirements and resist corrosion.
   1. Interior: MI-OP-3L, gloss.

D. Galvanized Steel: Finish surfaces exposed to view.
   1. Interior: MgI-OP-3L.

END OF SECTION

NOT FOR BIDDING

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. High performance coatings.

B. Surface preparation.

1.2. REFERENCE STANDARDS

A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

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

C. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.

C. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors available for selection.

1.4. QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.

1.5. DELIVERY, STORAGE, AND HANDLING

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

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

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

NOT FOR BIDDING

1.6. FIELD CONDITIONS

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

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.

C. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).

D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

E. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

F. Restrict traffic from area where coating is being applied or is curing.

1.7. WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Only materials (primers, coatings, etc.) listed in the latest edition of the MPI (APL) are acceptable for use on this project.

B. Provide high performance coating products from the same manufacturer.

C. High-Performance Coatings:
1. Pittsburgh Paints: www.pittsburghpaintsco.com/#sle.
2. Sherwin-Williams Company: www.protective.sherwin-williams.com/industries/#sle.
3. Tnemec Company, Inc: www.tnemec.com/#sle.

2.2. HIGH-PERFORMANCE COATINGS

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

B. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
2. NFPA 101, Class A rated.

2.3. TOP COAT MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.

B. High-Build Epoxy Coating for CMU:
1. Number of Coats: Two.

NOT FOR BIDDING

2. Top Coat(s): Epoxy, High-Build; MPI #98, #108, #120.
   a. Sheen: Gloss.
   b. Products:
      1) Sherwin-Williams; Pro Industrial High Performance Epoxy: www.protective.sherwin-williams.com/#sle. (MPI #98)
      2) or equivalent.

C. Shellac: Pure, white type.

2.4. PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.
1. Block Filler, Latex; MPI #4.
   a. Products:
      1) Pittsburgh Paints; Speedhide Masonry Hi Fill Latex Block Filler, 6-15XI: www.pittsburghpaintsco.com/#sle. (MPI #4)
      2) Sherwin-Williams; Heavy Duty Block Filler: www.protective.sherwin-williams.com/#sle. (MPI #4)

2.5. ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

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

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

3.2. PREPARATION

A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

B. Clean surfaces of loose foreign matter.

C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

D. Remove finish hardware, fixture covers, and accessories and store.

E. Masonry:
1. Prepare surface as recommended by coating manufacturer.

NOT FOR BIDDING

3.3. PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

B. Concrete Masonry: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils (0.8 mm).

3.4. COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.5. CLEANING

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

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.6. PROTECTION

A. Protect finished work from damage.

3.7. SCHEDULE

A. Color: As indicated on Finish Schedule.

END OF SECTION

NOT FOR BIDDING

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 2 PRODUCTS

1.1. MANUFACTURERS

A. Dimensional Letter Signs:
1. APCOs: www.apcosigns.com/#sle.
2. Gemini Signage; _____: www.geminimade.com/#sle.
3. Inpro Corporation; _____: www.inprocorp.com/#sle.
4. Takeform: www.takeform.net/#sle.

1.2. DIMENSIONAL LETTERS

A. Metal Letters:
1. Material: Aluminum sheet, flat.
2. Thickness: Manufacturer's standard for letter size.
3. Letter Height: As indicated on drawings.
4. Text and Typeface:
   a. Character Font: Times or other serif font.
   b. Character Case: Upper case only.
5. Finish: Brushed, satin.
6. Color: As selected.
7. Mounting: Projected mount with collars.

1.3. ACCESSORIES

A. Concealed Screws: Noncorroding metal: stainless steel, galvanized steel, chrome plated, or other.

PART 3 EXECUTION

2.1. EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

2.2. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

END OF SECTION

NOT FOR BIDDING

SECTION 101423 - PANEL SIGNAGE

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Panel signage.

1.2. REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

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

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
   b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   c. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.

F. Manufacturer's qualification statement.

1.4. QUALITY ASSURANCE

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

1.5. DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

NOT FOR BIDDING

C. Store under cover and elevated above grade.

D. Store tape adhesive at normal room temperature.

PART 2 PRODUCTS

2.1. REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.2. PANEL SIGNAGE

A. Panel Signage:
1. Application: Room and door signs.
2. Description: Flat signs with engraved panel media, tactile characters.
3. Sign Size: As indicated on drawings.
4. Total Thickness: 1/8 inch (3 mm).
5. Sign Edges: Squared.
6. Letter Edges: Squared.
7. Corners: Radiused.
8. Color and Font, unless otherwise indicated:
   a. Character Font: Helvetica, Arial, or other sans serif font.
   b. Character Case: Upper and lower case (title case).
   c. Background Color: as selected from manufacturer's full range.
   d. Character Color: Contrasting color.
9. Material: Laminated colored plastic engraved through face to expose core as background color.
10. Profile: Flat panel without frame.
11. Tactile Letters: Raised 1/32 inch minimum.
12. Braille: Grade II, ADA compliant.

NOT FOR BIDDING

2.3. SIGNAGE APPLICATIONS

A. Room and Door Signs:
1. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
2. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", and braille.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.2. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

END OF SECTION

NOT FOR BIDDING

SECTION 101423 - PANEL SIGNAGE

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Panel signage.

1.2. REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

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

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
   a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
   b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
   c. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.

F. Manufacturer's qualification statement.

1.4. QUALITY ASSURANCE

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

1.5. DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

NOT FOR BIDDING

C. Store under cover and elevated above grade.

D. Store tape adhesive at normal room temperature.

PART 2 PRODUCTS

2.1. REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.2. PANEL SIGNAGE

A. Panel Signage:
1. Application: Room and door signs.
2. Description: Flat signs with engraved panel media, tactile characters.
3. Sign Size: As indicated on drawings.
4. Total Thickness: 1/8 inch (3 mm).
5. Sign Edges: Squared.
6. Letter Edges: Squared.
7. Corners: Radiused.
8. Color and Font, unless otherwise indicated:
   a. Character Font: Helvetica, Arial, or other sans serif font.
   b. Character Case: Upper and lower case (title case).
   c. Background Color: as selected from manufacturer's full range.
   d. Character Color: Contrasting color.
9. Material: Laminated colored plastic engraved through face to expose core as background color.
10. Profile: Flat panel without frame.
11. Tactile Letters: Raised 1/32 inch minimum.
12. Braille: Grade II, ADA compliant.

NOT FOR BIDDING

2.3. SIGNAGE APPLICATIONS

A. Room and Door Signs:
1. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
2. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", and braille.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.2. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

END OF SECTION

NOT FOR BIDDING

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Solid plastic toilet compartments.

1.2. RELATED REQUIREMENTS

A. Section 061000 - Rough Carpentry: Blocking and supports.

B. Section 102800 - Toilet, Bath, and Laundry Accessories.

1.3. REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

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

D. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

NOT FOR BIDDING

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Solid Plastic Toilet Compartments:
1. All American Metal Corp - AAMCO: www.allamericanmetal.com/#sle.
2. ASI Accurate Partitions: www.asi-accuratepartitions.com/#sle.
3. Metpar Corporation: www.metpar.com/#sle.
4. Scranton Products: www.scrantonproducts.com/#sle. ***Basis of Design***

2.2. DESIGN CRITERIA

A. Accessibility: Comply with ICC A117.1 and ADA Standards.

B. Fire Performance: Pass when tested in accordance with NFPA 286.

2.3. SOLID PLASTIC TOILET COMPARTMENTS

A. General Description: Factory-fabricated doors, pilasters, and divider panels made of solid, molded, high-density polyethylene (HDPE); floor-mounted, headrail-braced.

B. Color: As selected by Architect.

C. Doors:
1. Thickness: 1 inch (25 mm).

2. Width: 24 inches (610 mm).
3. Width for Handicapped Use: 36 inches (915 mm), outswinging.
4. Height: 66 inches (1676 mm).

D. Panels:
1. Thickness: 1 inch (25 mm).
2. Height: 66 inches (1676 mm).

E. Pilasters:
1. Thickness: 1 inch (25 mm).
2. Width: As required to fit space; minimum 3 inches (76 mm).

F. Urinal Screens: Without doors; to match compartments; mounted to wall with continuous panel brackets.

2.4. FABRICATION

A. Fabricate toilet compartment components to sizes indicated in shop drawings.

B. Coordinate requirements and provide cutouts for through-partition toilet accessories.

2.5. MATERIALS

A. High-Density Polyethylene (HDPE):
1. Composition: Formed from waterproof, nonabsorbent, HDPE resins.
2. Properties: Mark-resistant, self-lubricating surface.
3. Material Fire Ratings: ICC (IBC), Class B.

2.6. ACCESSORIES

A. Pilaster Shoes: Stainless steel, satin finish, 3 inches (76 mm) high; concealing floor fastenings.
1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Wall and Pilaster Brackets: Stainless steel; manufacturer's standard type for conditions indicated on drawings.

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

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify dimensions, tolerances, and interfaces with other work.

B. Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

C. Verify spacing of and between plumbing fixtures.

D. Verify substrate and site conditions for product installation are installed in accordance with manufacturer's written instructions.

3.2. INSTALLATION

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

NOT FOR BIDDING

B. Maintain 3/8-to-1/2-inch (10 to 12 mm) space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate headrail joints at pilaster center lines.

3.3. TOLERANCES

A. Maximum Variation from True Position: 1/4 inch (6 mm).

END OF SECTION

NOT FOR BIDDING

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Commercial toilet accessories.

B. Under-lavatory pipe supply covers.

C. Utility room accessories.

1.2. RELATED REQUIREMENTS

A. Section 102113.19 - Plastic Toilet Compartments.

B. Section 224000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.3. REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2025.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.

D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

E. ASTM C1036 - Standard Specification for Flat Glass; 2025.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.

1.4. SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. American Specialties, Inc: www.americanspecialties.com/#sle.
   2. Bradley Corporation: www.bradleycorp.com/#sle.
   3. Bobrick: www.bobrick.com/#sle.
   4. Fixtures and Accessories not specified but shown shall be Owner provided and Contractor installed..

NOT FOR BIDDING

2.2. MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
1. Grind welded joints smooth.
2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Stainless Steel Sheet: ASTM A666/A666M, Type 304.

C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

F. Adhesive: Two component epoxy type, waterproof.

G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.3. FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

B. Powder-Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.

2.4. COMMERCIAL TOILET ACCESSORIES

A. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick laminated glass mirror.
1. Size: As indicated on drawings.
2. Products:
a. Bobrick B-290 series, as manufactured by Bobrick or equivalent.

B. Grab Bars: Stainless steel, smooth surface.
1. Standard Duty Grab Bars:
a. Push and Pull Point Load: Minimum 250 lbf (1112 N).
b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 18-gauge, 0.05-inch (1.02 mm) steel thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
c. Finish: Satin.
d. Length and Configuration: As indicated on drawings.
e. Products:
1) Bobrick Series B-5806 or equivalent.

C. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
1. Products:
a. Bobrick B-270 series or equivalent

2.5. UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
1. Drying rod: Stainless steel, 1/4 inch (6 mm) diameter.

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2. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
3. Length: Manufacturer's standard length for number of holders/hooks.
4. Products:
   a. Bobrick B-239 or equivalent.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.2. PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3. INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.4. PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

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SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

1.2. REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2026.

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide extinguisher operational features and extinguisher ratings and classifications.

1.4. FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature causes freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Fire Extinguishers:
1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
2. Larsens Manufacturing Co. ; MP5: www.larsensmfg.com/#sle. ***Basis of Design***
3. Potter-Roemer: www.potterroemer.com/#sle.

B. Fire Extinguisher Cabinets and Accessories:
1. Activar Construction Products Group, Inc. - JL Industries; Ambassador Series: www.activarcpg.com/#sle.
2. Larsen's Manufacturing Co; SS-2409-5R, Vertical Duo Door glazing: www.larsensmfg.com/#sle. ***Basis of Design***

C. AED Cabinet:
1. Larsen Manufacturing Co. Model SS1414-RK or equivalent product at locations shown on drawings.

2.2. FIRE EXTINGUISHERS

A. General Requirements: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

B. Multipurpose Dry-Chemical-Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
1. Class: A:B:C.

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2. Size: 5 lb (2.27 kg).
3. Finish: Baked polyester powder coat; color as selected by Architect.
4. Temperature Range: Minus 65 to 120 degrees F (Minus 54 to 49 degrees C).

2.3. FIRE EXTINGUISHER CABINETS

A. Cabinet Construction: Non-fire rated.
1. Formed primed steel sheet; 20-gauge, 0.036-inch (0.9 mm) thick base metal.

B. Cabinet Configuration: Semi-recessed type.
1. Projected Trim: Returned to wall surface, with 1-1/2-inch (38.1 mm) projection, and 2-inch (51 mm) wide face.

C. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape, and set in resilient channel glazing gasket.

D. Cabinet Mounting Hardware: Appropriate to cabinet, with predrilled holes for placement of anchors.

E. Fabrication: Weld, fill, and grind components smooth.

F. Finish of Cabinet Exterior Trim and Door: Satin chrome.

G. Finish of Cabinet Interior: White colored enamel.

2.4. ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

END OF SECTION

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SECTION 105113 - METAL LOCKERS

1.1. SECTION INCLUDES

A. Metal lockers.

B. Locker benches.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Metal Lockers:
1. ASI Storage Solutions; _____: www.asi-storage.com/#sle.
2. Lyon Workspace Products; ____: www.lyonworkspace.com/#sle.
3. Penco Products, Inc; ____: www.pencoproducts.com/#sle.

2.2. LOCKER APPLICATIONS

A. Athletic Lockers: Metal lockers, free-standing with matching closed base.
1. Configuration: Single tier.
2. Fittings: Size and configuration as indicated on drawings.
a. Upper shelf.
b. Hooks: One single prong.
3. Ventilation: Perforated side panels and doors.
4. Locking: Padlock hasps, for padlocks provided by Owner.
5. Color: To be selected from manufacturer's full range by Architect.

2.3. METAL LOCKERS

A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.

B. Locker Case Construction:
1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.

C. Latches and Door Handles: Manufacturer's standard.

D. Coat Hooks: Stainless steel or zinc-plated steel.

E. Number Plates: Provide oval shaped aluminum plates. Form numbers ____ inch (____ mm) high of block font style with ADA designation, in contrasting color.

F. Locks: Locker manufacturer's standard type indicated in Applications article above.

2.4. LOCKER BENCHES

A. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals.
1. Accessibility: Comply with ICC A117.1 and ADA Standards.

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PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases and embedded anchors are properly sized.

3.2. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Install fittings if not factory installed.

E. Replace components that do not operate smoothly.

3.3. CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION

NOT FOR BIDDING

SECTION 107316.13 - METAL CANOPIES

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Freestanding metal canopies.

B. Attached hanger rod aluminum canopies with custom fascia.

1.2. REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.

D. ASTM E2950 - Standard Specification for Metal Canopy Systems; 2014 (Reapproved 2020).

E. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2024.

F. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.

G. ITS (DIR) - Directory of Listed Products; Current Edition.

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

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

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1.3. QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
   1. Comply with applicable code for submission of design calculations as required for acquiring permits.

B. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
   1. Not less than three years of documented experience.

C. Erector Qualifications: Company specializing in performing the work of this section.
   1. Not less than three years of documented experience and approved by canopy manufacturer.

1.4. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site ready for erection.

B. Package using methods that prevent damage during shipping and storage on site.

C. Store materials under cover and elevated above grade.

1.5. WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Metal Canopies: Correct defective work within a two year period after Date of Substantial Completion.

C. Finish Warranty: Provide manufacturer's ten year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Metal Canopies:
1. Austin Canvas and Awning,: www.austincanvas.com/#sle.
2. Mapes Industries; Super Lumideck: https://mapes.com/#sle. Basis of Design
3. Peachtree Protective Covers: www.peachtreecovers.com.

2.2. METAL CANOPIES

A. Shop Fabricated Aluminum Canopy Type: Hanger Rod Style. and Column supported canopy as indicated on drawings.

B. Configuration: Layout and dimensions, canopy clearance, fascia profile, and roof covering design as indicated on drawings.
1. Fascia: Custom Fascia profile as indicated on drawings. at Hanger Rod Canopies
2. Column Anchorage: Column embedded in concrete footing.
3. Drainage Concept: Water collected in decking conducted into perimeter drain beams and discharged through columns.

C. Performance Requirements:
1. Design and fabricate metal canopy system to resist wind, snow, live, and seismic loads without failure, damage, or permanent deflection in accordance with ASCE 7:
   a. Loads: As indicated on drawings.
2. Thermal Movement: Design canopy system to accommodate thermal movement caused by ambient temperature range of 120 degrees F (49 degrees C) and surface temperature range of 180 degrees F (82 degrees C) without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
3. Electrical Components, Devices, and Accessories: Listed and labeled by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction and installed in compliance with NFPA 70, and marked for intended application.

2.3. SHOP FABRICATION

A. Provide a complete system ready for erection at project site.

B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.

C. Fabricate connections for bolt, nut, and washer connectors.

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2.4. FINISHES

A. Structural Steel Framing:
1. Shop Primer: Rust-inhibitive red oxide.

B. Aluminum Framing and Decking:
1. High Performance Organic Coatings: AAMA 2604, multiple coats, thermally cured, fluoropolymer system.

C. Fascia: Fluoropolymer finish; color Black.

2.5. ACCESSORIES

A. Structural Bolts: ASTM F3125/F3125M, Grade A325, minimum 3/4 inch (19 mm) diameter.

B. Fasteners, Non-Structural: ASTM F593 stainless steel or ASTM A307 carbon steel.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine substrates and site area for conditions that might prevent satisfactory installation.

B. Verify that bearing surfaces are ready to receive this work.

C. Do not proceed with installation until all conditions are satisfactory.

3.2. INSTALLATION - CANOPY COVERING

A. Install in accordance with manufacturer's instructions.

B. Fasten metal decking to metal support members, aligned level and plumb.

C. Install fascia panels, trim, and flashing.

D. Separate dissimilar metals using concealed bituminous paint.

E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.3. TOLERANCES

A. Maximum Variation from Level: Plus/Minus 1/8 inch (3.175 mm).

3.4. CLEANING

A. Clean surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.5. PROTECTION

A. Protect canopy after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION

NOT FOR BIDDING

SECTION 123600 - COUNTERTOPS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Stainless Steel Countertops for service areas

1.2. REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

1.3. SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

1.4. QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

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PART 2 PRODUCTS

2.1. COUNTERTOPS

A. Stainless Steel Countertops: , Type 304, stainless steel sheet; 16 gauge, 0.0625 inch (1.59 mm) nominal sheet thickness.
   1. Manufacturers:
      a. OnePointe Solutions LLC; Stainless Steel Countertops: www.onepointesolutions.com/#sle.
      b. Or Equivalent custom manufacturer.
   2. Finish: 4B satin brushed finish.
   3. Size and layout: As indicated on drawings.
   4. Exposed Edge Shape: Straight turndown with return; 1-1/2 inch (38 mm) high face, 1/2 inch (12 mm) return to face of case ; reinforced with hardwood or steel.

2.2. ACCESSORIES

A. Fixed Top-Mounted Countertop Support Brackets:

2.3. FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Stainless Steel: Fabricate tops up to 144 inches (3,657 mm) long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
   1. Weld joints; grind smooth and polish to match.
   2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
   3. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.

PART 3 EXECUTION

3.1. EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.2. PREPARATION

A. Clean surfaces thoroughly prior to installation.

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

3.3. INSTALLATION

A. Attach stainless steel countertops using stainless steel fasteners and clips.

B. Seal joint between back/end splashes and vertical surfaces.

3.4. TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.5. CLEANING

A. Clean countertops surfaces thoroughly.

NOT FOR BIDDING

3.6. PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

NOT FOR BIDDING

SECTION 133413.13 - GREENHOUSES

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 greenhouse construction and associated materials.

B. Related Sections include the following:

1. Division 3 Section for concrete.
2. Division 4 Section for masonry base and cast stone
3. Division 8 Section for Hardware to be installed under this section.
4. Division 22 Sections for water service.
5. Division 23 Section for heaters.
6. Division 26 Sections for electrical service.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements

1. Structural Members: Of sufficient sizes to support design loads as prescribed by governing building codes.
2. Water Penetration: No water penetration shall occur when the system is tested in accordance with ASTM E331 using a differential static pressure of 20% of the inward acting design wind load pressure, but not less than 12psf. Water penetration is defined as the appearance of uncontrolled water other than condensation on the interior surface of any part of the greenhouse.
    a. Drain water penetrating at joints, as well as condensation occurring within the system to exterior face of the work.
4. Thermal Movement: Provide for such expansion and contraction of component materials as will be caused by a surface temperature range of +/-90 F without causing buckling, stress on glass, failure of seals, undue stress on structural elements, reduction of performance of other detrimental effects.
5. Where permitted by code, a 1/3 increase in allowable stress for wind or seismic load shall be acceptable, but not in combination with any reduction applied to combined loads. In no case shall allowable values exceed the yield stress.
6. The greenhouse framing is designed to be self-supporting between the support construction. The greenhouse will impose reactions to the support construction. All adjacent and support construction must support the transfer of all loads including horizontal and vertical, exerted by the greenhouse. Design or structural engineering services for the supporting structure or building components not included in the greenhouse scope are not included under this section.

1.4 PERFORMANCE DESIGN CRITERIA

A. Exposure: C
B. Importance Factor: 1.10
C. Wind Load: 130 mph
D. Snow Load: 25 Lbs.

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1.5 SUBMITTALS

A. Submit one PDF copy of shop drawings showing plans, elevations, sections and details as required to fully describe the greenhouse construction for the Architect's approval prior to starting fabrication. Provide all flashing details and details of attachment to structure.
B. Submit structural calculations prepared by an engineer licensed in the State of Delaware.
C. Submit (2) sets of as-built drawings and cleaning and maintenance manuals upon completion of greenhouse installation.

1.6 QUALITY ASSURANCE

A. Work of this Section, including design, engineering, fabrication, finishing, preparation at the job site, erection and glazing of the greenhouse system shall be the responsibility of the greenhouse manufacturer. The manufacturer shall be regularly engaged in all phases of construction of greenhouses and able to demonstrate that he has performed successfully on comparably sized projects and of comparable design complexity over at least the previous ten years.

1.7 WARRANTY

A. Submit manufacturer's warranty certifying that greenhouse work was furnished and installed in accordance with the Contract Documents.
B. Certify that Greenhouse frame is free of defects in design, materials, and construction for a period of -10-years from the Date of Greenhouse Completion.
C. Warrant glass against defective materials, delimitation, seal failure, and defects in manufacturer per the glass manufacturer's standard warranties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Atlas Greenhouse, LLC. www.atlasgreenhouse.com; Grand Peak Series

1. Other manufacturers must pre-qualify to bid not less than ten (10) days prior to the bid closing date.
2. Prospective manufacturers submit notarized certification that they can meet all specified criteria and they have successfully performed in the phase of design, manufacture and installation of greenhouse projects comparable in nature over at least the previous ten (10) years and provide a list of 10 references with contacts and phone numbers.

2.2 MATERIALS

A. Framework

1. Truss and Column spacing will be 12'-0" unless specified otherwise by manufacturer.
2. All steel members shall comply with ASTM A500 dimensional tolerances.
3. All steel framing members to be galvanized. Framing members, including columns, rafters, truss members and roof purlins to have minimum yield strength of 50,000 PSI.
4. Column base plates to be 10" x 10" x ½" thick galvanized and welded to column members.

B. Covering Material

1. Greenhouse covering to be 8mm, Clear, Twin wall polycarbonate. Material will encompass roof, sides, and ends, including wall vent. Manufacturer to provide all extrusions and necessary hardware to properly install the greenhouse covering material. Ridge Base and Cap for Greenhouse must follow ASTM B308/B308M-20 standard specifications for 6061-T6 aluminum alloy. All other aluminum extrusions to fall within 6063-T5 or 6063-T6 categories.
2. Covering will be provided with a 10-year warranty

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C. Accessories

1. Doors and Door Frames: Provided quantity of doors and frames as indicated on drawings. Doors to be provided with polystyrene core with 20-gauge galvanized steel panels and adhere to ASTM A924 and A653. Panic hardware and lockset included.
2. Ventilation Equipment:
    a. Horizontal Air Flow Fans: Provide (2) two 18" fan with pre-wired cord and hanging bracket with swiveling capability.
    b. Quietaire GCS 24" exhaust fans with single speed 1/3 HP motors. Quantity; 4
    c. Quietaire 24" gable fan with single speed 1/3 HP motors. Quantity; 1
    d. Cooling System shutters: 36" motorized shutters with Belimo motors. Quantity: 10
3. Heating Equipment:
    a. Provide (1) one 250,000 BTU PTP Modine heater, Greenhouse manufacturer to provide all necessary hardware to mount the heater.
4. Cooling Equipment:
    a. Quietaire evaporative cooling system with PVC trough to be provided. Quantity: 2 – 3x15'
5. Environmental Controls:
    a. Provide controller to operate exhaust fans, cooling system, heater, and HAF fans.
    b. Controller must offer 4 stages of cooling and 2 stages of heating.
    c. Environmental controller to provide capability of temperature settings in DIF, DAY, and NITE stages; with ability to provide remote access capability. Controller to have touch screen interface and be UL listed.
6. Greenhouse Hanger basket rails:
    a. Manufacturer to provide 8 runs of hanging basket runs per bay. 6 runs to be for hanging baskets while the other two are for irrigation support.
7. Retractable Shade system:
    a. Provide interior retractable shade system that is fully automated. Wadsworth slope/flat/slope profile is basis of design.
8. Greenhouse Benches:
    a. Provide (16) - 4'x10' portable benches, framed aluminum extrusions and galvanized steel tubing on the main frame. Bench tops to be Durra Bench Ultra plastic tops.
9. Irrigation System:
    a. Provide full irrigation kit that includes misters for bench top space and drippers for hanging basket runs. Kit to include solenoid valves, pressure regulator, backflow preventer, and fertilizer injectors. Provide Rainbird controller per zone with minimum 7 zone capacity.

2.3 FABRICATION

A. Construct greenhouse in accordance with manufacturer's requirements and directions..
B. Construct greenhouse as a continuous structurally contiguous unit..
C. Insofar as practicable, fit and assemble work in the manufacturer's shop based on field verified dimensions. Work which cannot be permanently assembled shall be shop-assembled, marked, and disassembled before shipment to the job site.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to fabrication or release for fabrication contractor is to field verify all dimensions adjacent associated structure/substrate.
B. Upon arrival to the job site for installation of the specified work, the manufacturer's erector is to examine structure and substrate to determine that they are properly prepared, dimensionally accurate, and ready to receive the greenhouse work included herein. Report any discrepancies to the General Contractor. Correction of faulty work to be at the expense of the responsible party(s). The greenhouse manufacturer is not responsible for faulty structure or substrate.
C. Greenhouse manufacturer is to coordinate the installation of all reglets into masonry walls at all applicable locations.

NOT FOR BIDDING

3.2 PREPARATION

A. Prior to installation, manufacturer shall confirm all existing materials and other work impacting the Greenhouse are acceptable.

3.3 INSTALLATION

A. Install greenhouse frame, glazing and accessory items as needed in accordance with manufacturers instructions.
B. Install greenhouse system under the direction of the greenhouse manufacturer's designated erection supervisor.
C. Erect system plumb and true, in proper alignment and relation to established lines and grades as shown on approved shop drawings.
D. Anchor greenhouse to structure in strict accordance with approved shop drawings.
E. Furnishing of temporary covering and weatherproofing of the greenhouse openings, if required by the Installer, and removal of the protective measures during and after the greenhouse installation is the installer's responsibility.

3.4 TOLERANCES

A. All parts of the work, when completed, shall be within the following tolerances:

1. Maximum variation from plane or location shown on approved shop drawings: 1/8"per 12' length, or 1/4" in total length.
2. Maximum offset from true alignment between two members abutting end-to-end, edge-to-edge in line or separated by less than 3": 1/32".

3.5 FIELD QUALITY CONTROL

A. Water Leakage: Field check in accordance with AAMA 501.2 in appropriate and proportionate areas. There shall be no uncontrolled water leakage as defined in AAMA 501.2. Water supply to the greenhouse, with adequate water pressure, is to be furnished by the General Contractor. Tests are to be conducted upon completion of the installation with no remobilization or down time included to accommodate either water supply availability or witness personnel schedules. Testing is to be performed by the manufacturer's authorized personnel. Manufacturer to provide training to owner for all systems provided.

3.6 CLEANING

A. Clean frames and glazing materials and accessory items after installation so materials are prepared for their intended purpose, clean and free of debris.

3.7 PROTECTION

A. Protect installation until turnover to the owner.

END OF SECTION 133413.13

NOT FOR BIDDING

SECTION 133418 - POST FRAME BUILDING SYSTEMS

PART 1 GENERAL

1.1. SECTION INCLUDES

A. Provide pre-engineered building systems, including but not limited to primary and secondary structural framing systems, roofing, siding, roof and wall insulation, personnel doors, and accessories.

1.2. REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

D. ASTM C991 - Standard Specification for Flexible Fibrous Glass Insulation for Metal Buildings; 2025a.

E. ASTM C1036 - Standard Specification for Flat Glass; 2025.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.

G. ASTM D523 - Standard Test Method for Specular Gloss; 2025.

H. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test; 2022.

I. ASTM D4145 - Standard Test Method for Coating Flexibility of Prepainted Sheet; 2010 (Reapproved 2022).

J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

1.3. RELATED SECTIONS

A. Section 087100 - Door Hardware.

1.4. REFERENCES

A. ASTM International (ASTM):
1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
4. ASTM C523 - Method of Test for Light Reflectance of Acoustical Materials by the Integrating Sphere Reflectometer.
5. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
6. ASTM C991 - Standard Specification for Flexible Glass Fiber Insulation for Metal Buildings.
7. ASTM C1036 - Standard Specification for Flat Glass.
8. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

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9. ASTM D523 - Standard Test Method for Specular Gloss.
10. ASTM D3363 - Standard Test Method for Film Hardness by Pencil Test.
11. ASTM D3462 - Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules.
12. ASTM D3841 - Standard Specification for Glass-Fiber-Reinforced Polyester Plastic Panels.
13. ASTM D4145 - Standard Test Method for Coating Flexibility of Prepainted Sheet.
14. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
15. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

1.5. SYSTEM DESCRIPTION

A. Structural Frame Design:
1. Design shall be based on the building framing and enclosure as indicated on the drawings and pursuant to manufacturer's standards:
2. Type: Clear span roof truss framing with no interior column lines.
a. Maximum Width: 33 feet (1005.84 cm).
b. Maximum Clear Height: 12 feet (365.76 cm) 0 inches (0 mm).
c. Columns: Embedded in ground or bolted to foundation.
d. Purlins: Recessed between trusses in galvanized steel joist hangers.

B. Dimensions and Roof Slope:
1. As shown on drawings.

C. Structural Requirements:
1. Building Code: International building Code (IBC) and ASCE 7, current edition.
2. Design Loads:
a. Wind Exposure: Maximum Considered Earthquake 0.2 Second Spectral Response Acceleration.
b. Maximum Considered Earthquake 1.0 Second Spectral Response Acceleration.
c. Collateral Loads: Additional loads imposed by contract documents other than weight of building systems specified in this section.
d. Combination Loads: Comply with Building Code.
3. Structural Design:
a. Perform calculations using diaphragm and/or frame analysis. Incorporate bracing as required.
b. Comply with AF&PA "National Design Specification for Wood Construction (NDS)."
c. Trusses:
1) Limit deflection for live or snow loads to L/240 for trusses supporting steel ceilings and to L/180 for overhangs and trusses not supporting ceilings.
2) Limit deflection for live or snow loads to L/360 for trusses supporting GWB or plaster ceilings and to L/180 for overhangs and trusses not supporting ceilings.
3) Comply with appropriate NDS and Truss Plate Institute (TPI) standards.
d. Metal Wall and Roof Panels:
1) Design in accordance with AISI "Specifications for the Design of Light-Gauge, Cold-Formed Steel Structural Members" and in accordance with sound engineering methods and practices.
e. Plywood or Oriented Strand Board Sheathing: Comply with APA "Plywood Design Specification."
f. Expansion / Contraction Provisions: Design roof attachment system to allow for expansion and contraction of metal roofing, due to seasonal temperature variations, without detrimental effect to the roof panels.

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1.6. SUBMITTALS

A. Submit under provisions of Section 013300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Manufacturer's specifications and installation instructions for building components and accessories.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.

C. Shop Drawings: Showing roof framing, cross sections, roof and wall covering and trim details and accessory and component details clearly indicating proper assembly.

D. Structural Engineer Certification: Letter signed by a Professional/Structural Engineer, registered to practice in the jurisdiction of the project, verifying compliance with all Design Requirements. Letter shall reference specific dead loads, live loads, wind loads, tributary area load reductions (if applicable) collateral loads, seismic loads, end use categories, and governing building code including edition and load applications.

E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (152.4 mm) square, representing actual product, color, and patterns.

1.7. QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum ten years experience in producing pre-engineered wood buildings of the type specified.

B. Installer Qualifications: Installer Qualifications: Minimum three years experience in erection of pre-engineered wood buildings of the type specified.

C. Structural Engineer's Qualifications: Minimum of three years designing post frame structures; registered in the jurisdiction of the project.

1.8. DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation. Follow manufacturer's recommended storage procedures. Do not allow steel siding and roofing to contact the ground.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.9. PROJECT CONDITIONS

A. Anticipate environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10. WARRANTY

A. Structural Design - Lifetime: Manufacturer warrants that the building designed by Lester will not experience an occurrence of structural failure or an occurrence of structural damage due to improper structural design (excepting ventilation systems) on account of weather conditions, such as wind, ice, and

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snow, as indicated on the Lester Sales Agreement, "Building Description Section". The foregoing warranty is limited to 50 years with respect to any Owner which is not an individual.

B. Preservative Treated Materials: 50 years. Preservative treated lumber, including structural columns, are warranted by the original materials manufacturer against failures due to fungal decay and termite infestation.

C. Roofing and Siding Finish, steel panel: Warranted by the original materials manufacturer for 40 years from the date of shipment. Refer to Warranty document for complete details.

D. Individual Building Products: Manufacturer's standard warranty.

E. Installation Warranty: One-year general installation warranty, five years against roof leaks.

PART 2 - PRODUCTS

2.1. MANUFACTURERS

A. Acceptable Manufacturers include but are not limited to the following:
1. Lester Building Systems, 1111 2nd Ave. S.; Lester Prairie, MN 55354; Toll Free Tel: 800-826-4439; Tel: 320-395-2531; Fax: 320-395-2969; Email:request info (sbeste@lesterbuildings.com); Web:www.lesterbuildings.com
2. Apex Structures, LLC, P.O. Box 173, New Holland, PA 17557; Toll Free Tel: 800-449-9079; Email:request info (info@apexstructures.com); Web:www.apexstructuresllc.com
3. Delmarva Buildings; 317 N. Layton Ave., Wyoming, DE 19934; Toll Free Tel: 866-734-4811; Web:www.ilovepolebuildings.com

B. Manufacturers must meet all specification requirements or request aa substitution prior to bid.

2.2. STRUCTURAL FRAMING

A. Footings:
1. Embedded Column Footings:
   a. Precast 4 by 17 inch (431.8 mm) diameter 4000 psi (27579.04 kPa) concrete footing pad.
   b. PrecastPlus augmented footing consisting of 4 by 17 inch (431.8 mm) diameter 4000 psi (27579.04 kPa) concrete footing pad resting on dry concrete mix of diameter and thickness specified in the shop drawings.
   c. Cast in place concrete footing of 3500 psi (24131.66 kPa) ready-mix concrete of size and thickness specified in the shop drawings.
2. Column Foundation, Above Grade:
   a. Monolithic floating slab. Sized and reinforced as specified in the shop drawings.
   b. Pier and Beam. Sized and reinforced as specified in the shop drawings.
   c. Cast in place trenched wall foundation. Sized and reinforced as specified in the shop drawings.
   d. Cast in place frost wall and foundation. Sized and reinforced as specified in the shop drawings.

B. Primary Framing:
1. Columns:
   a. Treated Lumber Section:
      1) Lumber: No. 1 or Better Southern Yellow Pine, pressure treated with Chromated Copper Arsenate, Type III, to a retention of 0.6 pcf (9.6 kg/m3) and kiln dried after treating to 19 percent maximum moisture content.

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2) Fabrication: Laminate individual pieces using ring shank feed nails per manufacturer's engineered nailing pattern. Fasteners shall have ASTM A153 galvanizing.

b. Untreated Lumber Section:
1) Lumber: Lumber: No. 1 or Better Southern Yellow Pine or Douglas Fir-Larch or other equivalent NDS approved species/grade kiln dried to 19 percent maximum moisture content.
2) Fabrication: Laminate individual pieces using ring shank feed nails per manufacturer's engineered nailing pattern.
3) Grade and size shall be selected to support imposed loads within deflection limits.

c. End Joint Connection of Treated and Untreated Sections: Factory fabricated finger joint.

d. Configuration:
1) Sidewall and Endwall Columns: 3 ply or 4 ply combining 2x4, 2x6, 2x8, or 2x10 (50x150, 50x200, 50x250 mm) dimension lumber as required by "Structural Design" requirements specified herein.
2) Corner Columns: 2 ply or 3 ply 2x4, 2x6 or 2x8 (50x150, 50x200 mm) dimension lumber as required by "Structural Design" requirements specified herein.

e. Embedded Column Anchorage:
1) Anchor blocks factory adhered to column base.
2) Concrete collar pinned to column base with steel reinforcing rods.

f. Column on Concrete Foundation:
1) Provide screw in concrete anchors.
2) Provide cast-in-place anchors per shop drawings.

2. Trusses: Comply with "Structural Design" and "Quality Assurance" requirements as specified herein.
a. Comply with TPI "Design Specification for Metal Plate Connected Wood Trusses" and "Quality Standard for Metal Plate Connected Wood Trusses."
b. Manufacturer shall have a third party inspection program to verify compliance with requirements of TPI.
c. Coordinate mechanical system unit support.
d. Stamp trusses with inspection agency identification.

C. Secondary Framing:
1. Purlins and Girts:
a. Lumber: No. 2 or Better dimension lumber kiln dried to 19 percent maximum moisture content.
b. Configuration: 2x4 or 2x6 or 2x8 (50x100, 50x150, 50x200 mm) as required by "Structural Design" requirements specified herein.
1) Girts: Size, grade and spacing to meet wind and deflection criterion.
a) Face mounted to exterior side of column.
b) Precision cut to fit between columns. Flush to exterior and interior faces.
2) Purlins: Precision cut to fit between trusses flush with top of top chord. Provide 20 gauge galvanized purlin saddle hangers.
3) Purlins: Factory drilled and dadoed to accept 3/16 inch (4.76 mm) diameter x 6 inch (152.4 mm) screw fastener and ensure building modularity.
c. Spacing: As required by "Structural Design" requirements specified herein.
2. Splashplank:
a. Lumber: No. 2 or Better Southern Yellow Pine, preservative treated, to a retention of 14 pcf (2.2 kg/m3) of micronized copper azole.
b. Configuration: 2x6 or 2x8 (50x 150 or 50x200 mm) dimension lumber. Milled S4S for single row and milled T&G for multiple rows.
3. Sill Plate:

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a. Lumber: No. 2 or Better Southern Yellow Pine, preservative treated, to a retention of 0.17 pcf (B2O3) borate (0.25 pcf disodium octaborate tetrahydrate DOT) and kiln dried after treating to 19 percent maximum moisture content.
b. Configuration: 2x4 or 2x6 or 2x8 or 2x10 (50x100 or 50x150 or 50x200 or 50x250 mm) dimension lumber as required by "Structural Design" requirements specified herein.

4. Bracing, Wall and Lateral Truss Type (where required by "Structural Design"):
   a. Lumber: No. 2 or Better dimension lumber.
   b. Configuration:
      1) 2x4 or 2x6 (50x100, 50x150 mm) as required by "Structural Design" requirements specified herein.

2.3. EXPOSED FASTENER, LAP-SEAM, METAL ROOF PANELS

A. Metal Roofing: UNI-RIB panel as manufactured by Lester Building Systems.
   1. Material and Finish: 28 Gauge, ASTM A 653 (A 653 M), Structural Quality, Grade 80 (550) (formerly Grade E), AZ50 (Z180) zinc coating both sides, Triple Spot Test.
      a. Exterior Surface Finish:
         1) Bonderize and provide baked on primer and Valspar Weather-XL (silicone modified polyester) finish coat, 0.9 mil (0.02286 mm) minimum dry film thickness.
         2) Gloss (60 Degrees): ASTM D523, 20 to 80.
         3) Pencil Hardness: ASTM D3363, F to 2H.
         4) T-Bend: ASTM D4145: 2T to 4T.
         5) Color: Custom.
         6) * Meets Energy Star reflectivity standards.
   2. Configuration:
      a. Roll-formed; 36 inch (914.4 mm) coverage width. Provide panels covering up to 35 foot (1066.8 cm)
      b. 11.48 yard (10.5 meter) lengths in single pieces.
      c. Four major corrugations, 7/8 inch (22.22 mm) high, spaced 12 inches (304.8 mm) on center with 3 minor corrugations, 1/8 inch (3.18 mm) high, spaced 3 inches (76.2 mm) on center between each major corrugation.
      d. Form one outboard corrugation as overlapping corrugation.
      e. Form opposite outboard corrugation as underneath corrugation with full return leg to support side lap and a continuous anti-siphon drain channel.
      f. Factory cut to required length.
   3. Material and Finish: As shown on Erection Drawings, except as specified herein.
   4. Fasteners: Color coated No. 10 piercing screws with 1/4 inch (6.35 mm) hex head pre-assembled to 1/2 inch (12.7 mm) O.D. dome seal or bond seal galvanized steel and EPDM washers.

B. Basis of Design: Eclipse panel as manufactured by Lester Building Systems. Metal roof panels with side edges lapping adjacent panels. Secured to supports using fasteners through the major ribs.
   1. Configuration:
      a. Roll-formed; 36 inch (914.4 mm) coverage width. Provide panels covering up to 35 foot (1066.8 cm) lengths in single pieces.
      b. Three major corrugations, 7/8 inch (22.22 mm) high, spaced 18 inches (457.2 mm) on center with 3 minor corrugations, 1/8 inch (3.18 mm) high, spaced 3 inches (76.2 mm) on center between each major corrugation.
      c. Form one outboard corrugation as overlapping corrugation.
      d. Form opposite outboard corrugation as underneath corrugation with full return leg to support side lap and a continuous anti-siphon drain channel.
      e. Factory cut to required length.
   2. Material and Finish: 26 gauge steel, ASTM A 792 Class AZ50 Galvalume, coated both sides, 0.0187 inches (0.47 mm) thick.

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a. Exterior Surface Finish: Bonderize and provide baked-on primer and Valspar Weather-XL (silicone modified polyester) finish coat, 0.7 - 0.8 mil (0.02032 mm) minimum dry film thickness.
b. Exterior Surface Finish: Bonderize and provide baked-on primer and factory applied baked-on 70 percent Kynar 500 or Hylar 5000 PVDF fluropolymer resin based paint coating manufactured by Valspar, with a minimum dry film thickness of 0.7 - 0.8 mil (0.02032 mm)..
1) Color: As selected by Architect.
2) * Meets Energy Star reflectivity standards.

3. Fasteners: DS2000 coated No. 14 piercing screws with 3/8 inch (9.52 mm) hex head pre-assembled to 1/2 inch (12.7 mm) O.D. dome seal or bond seal galvanized steel and EPDM washers.

2.4. ROOFING ACCESSORLES

A. Steel Ridge Cap:
1. The cap materials and construction shall match the roof steel materials and construction.

B. Vents: Ridge vent, and/or low profile ridge ventilator as shown on Drawings.

C. Eave Overhang Fascia Flashing:
1. Size: 12 inches (304.8 mm) nominal.

D. End Overhang Fascia Flashing:
1. Size: 12 inches (304.8 mm) nominal.

E. Gutters and Downspouts: Provide manufacturer's standard gutters and downspouts as shown on Drawings.

F. Closure Strips: Closed cell, 2 pcf density polyethylene foam, premolded to match configuration of panels.

2.5. SIDING

A. Siding: UNI-RIB panel as manufactured by Lester Building Systems.
1. Material and Finish: 26 Gauge, ASTM A 653 (A 653 M), Structural Quality, Grade 80 (550) (formerly Grade E), AZ50 (Z180) zinc coating both sides, Triple Spot Test.
a. Exterior Surface Finish:
1) Bonderize and provide baked on primer and factory applied, baked-on 70% Kynar 500 or Hylar 5000 PVDF fluoropolymer resin based Fluropon paint coating as manufactured by Valspar, 0.9 mil (0.02286 mm) minimum dry film thickness.
2) Gloss (60 Degrees): ASTM D523, 20 to 80.
3) Pencil Hardness: ASTM D3363, F to 2H.
4) T-Bend: ASTM D4145: 2T to 4T.
5) Color: As selected by Architect
6) * Meets Energy Star reflectivity standards.
2. Configuration:
a. Roll-formed; 36 inch (914.4 mm) coverage width. Provide panels covering up to 35 foot (1066.8 cm) lengths in single pieces.
b. Four major corrugations, 7/8 inch (22.22 mm) high, spaced 12 inches (304.8 mm) on center with 3 minor corrugations, 1/8 inch (3.18 mm) high, spaced 3 inches (76.2 mm) on center between each major corrugation.
c. Form one outboard corrugation as overlapping corrugation.
d. Form opposite outboard corrugation as underneath corrugation with full return leg to support side lap and a continuous anti-siphon drain channel.
e. Factory cut to required length.

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f. Factory miter cut gable ends.
g. Material and Finish: As shown on Erection Drawings, except as specified herein.
h. Fasteners: Color coated No. 10 piercing screws with 1/4 inch (6.35 mm) hex head pre-assembled to 1/2 inch (12.7 mm) O.D. dome seal or bond seal galvanized steel and EPDM washers.

B. Siding Accessories:
1. Wall Trim and Flashings: Manufacturer's standard wall trim and flashings.
2. Louvers: Manufacturer's standard sheet metal unit with 1/2 inch (12.7 mm) hardware cloth screen, pre-finished enamel in color selected from Lester standard colors, 18 x 24 inch (457 x 610 mm) size.
3. Closure Strips: Closed cell, 2 pcf (32 kg/m3) density polyethylene foam, premolded to match configuration of panels.
4. Material and Finish: As shown on Erection Drawings, except as specified herein.
5. Weather Barrier: Provide weather barrier as indicated on drawings equivalent to HardieWrap

2.6. INSULATION

A. Blanket Insulation: ASTM C991, Type II, Preformed Poly-Scrim-Kraft-Faced Fiberglass Blanket, located between framing and exterior sheathing:
1. Thermal Resistance: As indicated on drawings.
2. Facing: 0.0015 inch white polypropylene film, fiberglass scrim reinforcement, and 12 lb. craft paper. 3 mil (0.0762 mm) cross laminated high density polyethylene.
3. Physical Properties:
a. Flame Spread, ASTM E84: Less than 25
b. Smoke Developed, ASTM E84: Less than 50
c. Water Vapor Transmission, ASTM E 96: 0.02 Perms (1.15 ng/(Pa*s*m^2).
d. Light Reflectivity, ASTM C 523, illuminant D-6500: 87 percent.

2.7. INTERIOR FINISH - WALLS AND CEILINGS

A. Steel Panel:
1. Type: Flat panel - 16 Gauge, Stainless Steel Sheets - Grade 304 as indicated on drawings

2.8. PERSONNEL DOORS

A. Steel Frame, Steel Clad, Hinged Doors: See Door Schedule and Hardware Schedule.

2.9. OVERHEAD SECTIONAL DOORS

A. Equivalent to ThermaCore AP Door System by Overhead Door Company; U factor 0.07

B. Model 850 door as indicated on drawing with thermal lights

2.10. WINDOW

A. Equivalent to Andersen 100 Series, single hung window, color Black

2.11. JOINT SEALANT MATERIAL

A. Sealant: Manus 75-A for applications that will not be painted, contains no solvents or isocyanates, non-yellowing.
1. Color: Manus Clear.

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B. Sealant: Manus 75-AM for applications that will be painted, contains no solvents or isocyanates, non-yellowing. Use white or bronze color for nearest match to adjacent substrate.
   1. Color: Manus Clear.

C. Tape Sealant: Manus-Bond 64-A Polysul Grip tape.

PART 3 EXECUTION

3.1. EXAMINATION

A. Verify that site conditions are acceptable for erection/installation of pre-engineered wood building system.

B. Coordinate with responsible entity to perform corrective work on unsatisfactory conditions.

C. Commencement of work by erector/installer is acceptance of site conditions.

3.2. ERECTION- STRUCTURAL FRAMING

A. Erect in accordance with manufacturer's instructions and approved shop drawings.

B. Provide temporary erection and wind load bracing to maintain structure plumb and in alignment until installation of permanent bracing and/or roofing and wall coverings are completed.

C. Do not field cut or alter structural members without approval of Architect and manufacturer.

3.3. INSTALLATION

A. Erect building per manufacturer's instructions and sequencing.

B. Metal Roofing:
   1. General: Install in accordance with manufacturer's instructions. Secure to structural framing aligned, level and plumb. Space fasteners as shown on Erection Drawings.
   2. Sidelap: Minimum one full corrugation.
   3. Endlap: 8 inches (203.2 mm) for slopes 4 inch (101.6 mm) 12 to 5 inch (127 mm) 12. Secure together over and to structural members.
   4. Endlap: 12 inches (304.8 mm) for slopes 2 inch (50.8 mm) 12 to 4 inch (101.6 mm) 12. Secure together over and to structural members.
   5. Accessories: Install as shown on Erection Drawings.

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END OF SECTION

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1. SUMMARY

A. All work under Division 22 is subject to the Division 01, General Requirements, the General Conditions and Supplementary Conditions.

B. Provide all labor, materials, equipment, and services necessary for and incidental to the complete installation and operation of all plumbing 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, 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, 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 22 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. All plumbing systems in the greenhouse and fieldhouse must be installed to be completely drainable. Install drain valves, trap plugs, and Schraeder air fittings with ball valves so that all plumbing equipment, plumbing fixtures, domestic water pipes, and sanitary pipes can be completely drained in the winter.

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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 22 shall be fully qualified and acceptable to the Architect 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

A. Specifications, Codes and Standards listed below are included as part of this specification, latest

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edition.

B. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers

C. ASME - American Society of Mechanical Engineers

D. ASPE - American Society of Plumbing Engineers

E. ASTM - American Society for Testing and Materials

F. AWWA - American Water Works Association

G. CS - Commercial Standard

H. CSD Control and Safety Devices

I. DNREC - Delaware Department of Natural Resources and Environmental Control

J. FM - Factory Mutual

K. IBC - International Building Code

L. IEEE - Institute of Electrical and Electronics Engineers

M. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry

N. NEC - National Electrical Code

O. NEMA - National Electrical Manufacturers Association

P. NFPA 54 - National Fuel Gas Code, 2024 Edition

Q. NSF - National Sanitation Foundation

R. UL - Underwriters' Laboratories

S. All plumbing 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.

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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 six (6) 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.

I. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.9. SHOP DRAWINGS

A. Prepare and submit shop drawings for all plumbing 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

1. Access Doors/Panels including layout and location
2. Automatic Temperature Control System and Equipment as it relates to plumbing system
3. Backflow Preventers
4. Backwater Valves
5. Bubblers
6. Compressed Air Filters
7. Compressed Air Regulators
8. Compressed Air Drain Traps

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9. Compressed Air Quick Disconnects
10. Compressed Air Hose Reels
11. Coordinated Drawings
12. Condensate Neutralizers
13. Direct Buried Piping
14. Domestic Water Expansion Tanks
15. Domestic Water Heaters
16. Drain Valves
17. Drip Pans
18. Downspout Shoes/Boots
19. Emergency Fixtures, Alarms, & Thermostatic Mixing Valves
20. Equipment Rails
21. Exterior Equipment/Piping Supports
22. Exterior Pipe Roller Support
23. Fire Stopping - Methods and Materials
24. Floor and Roof Drains
25. Gas Fired Domestic Water Heaters
26. Gas Pressure Regulating Valves
27. Gauges
28. Hose Bibbs and Wall Hydrants
29. Identification System
30. In-Line Circulators
31. Interceptors
32. Material and Equipment List
33. Operations and Maintenance Manuals
34. Pipe Enclosures
35. Pipe Guides and Anchors.
36. Pipe Materials Including Itemized Schedule
37. Plumbing Fixtures & Trim
38. Preliminary Testing and Balancing Report
39. Pressure/Temperature Relief Valves
40. Pumps
41. Refrigerated Air Dryers (for compressed air systems)
42. Roof Curbs
43. Roof Drains
44. Schrader Fittings with Ball Valves
45. Screenshots of ATC System Graphics
46. Shock Absorbers
47. Strainers
48. Test Certificates
49. Thermal Insulation Materials Include Table Summary
50. Thermometers and Gauges
51. Thermostatic Mixing Valves
52. Trap Priming Station/Valves
53. Vacuum Breakers
54. Valves
55. Vibration Isolation Materials
56. Weatherproof Assembly Components
57. Water Filters
58. 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.

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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, equipment, and other work performed under Division 22.

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 22 with that under Division 26. Coordinate all work under Division 22 with work under all other Divisions.

E. Supply services of an experienced (10 years 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 22. 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 work¬manlike 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 plumbing vents or other 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, and vent assemblies 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,

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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 founda¬tions, supports, pads, and other items required under Division 22. 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 of 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.

D. Paint perimeter of all housekeeping pads safety yellow.

1.14. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. Unless otherwise noted on the drawings, where existing plumbing work is removed all pipes, valves, 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 22 connects to existing equipment, piping, 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 22, or under other Divisions, requires relocation of existing equipment, piping, 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.

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1.15. EXCAVATION AND BACKFILLING

A. GENERAL

1. Perform all necessary excavation, or installation of work under Division 22, in whatever materials or conditions encountered, using suitable methods and equipment.
2. Accurately establish required lines and grades and properly locate the work.
3. Determine the locations of all existing utilities before commencing the work.

B. Excavation: (Refer also to other portions of the specifications)

1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.

3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling: (Refer also to other portions of the specifications)

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

1.16. VIBRATION ISOLATION

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

1.17. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

1.18. 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. Concealed means hidden from sight in chases, formed spaces, shafts, hung ceilings, or embedded in construction.

F. Exposed means not installed underground or concealed as defined above.

G. Invert Elevation means the elevation of the inside bottom of pipe.

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. 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.

J. ECM: Electronically Commutating Motor.

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K. Building Line: Exterior wall of building.

1.19. MINIMUM EFFICIENCY REQUIREMENTS

A. All plumbing equipment shall be manufactured to provide the minimum efficiency requirements as specified in ASHRAE Standard 90.1, latest edition.

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

E. Department of Energy (DOE) compliance: Pump manufacturers shall comply with US Department of Energy (DOE) energy conservation standard for "clean water pumps" 1-200 horse power, less than 459 feet of head and greater than 25 gpm. These pumps shall be evaluated using the Pump Energy Index (PEI) of equal to or lesser than 1.0. The PEI number shall appear on the pump name plate and available for the record at http://er.pumps.org.

F. Where Energy Star certification exists for equipment utilized on this project, the equipment must be Energy Star certified. Provide Energy Star certification with submittals.

1.20. FUTURE ADDITIONS

A. Where future additions are indicated, install all piping to account for future additions. Furnish and install shut-off valve in ceiling adjacent to future additions. Provide cap at the end of the piping. Arrange so that in the future the cap can be removed and shut-off valve opened to serve future addition without draining system. Install bypass with balance valve and shut-off valve on domestic recirc system. Balance to future flow rate and then shut the bypass balance valve.

1.21. SYSTEM INTEGRATION

A. For all plumbing 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. Plumbing equipment submittals requiring system integration as defined above must identify all required system integration points.

C. Plumbing 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 plumbing equipment manufacturer and the ATC Subcontractor. This portion of systems integration must occur prior to plumbing equipment being delivered to the project.

E. Once the plumbing 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 plumbing equipment manufacturer's representative familiar with system integration and the ATC subcontractor familiar with programming must be present.

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F. A final system integrations meeting shall occur once all equipment is in place and ready for operation. The Mechanical Contractor, the plumbing 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.

1.22. LEAD FREE REQUIREMENTS

A. All plumbing fixtures, equipment, and devices that contact potable water must be lead free per the State requirements. Potable water systems shall also comply with NSF 61 – Annex G and NSF-372.

1.23. COORDINATION WITH SUSSEX TECHNICAL SCHOOL DISTRICT I.T. DEPARTMENT

A. All equipment that interfaces with the internet shall be coordinated with the Sussex Technical School District I.T. Department to verify that the same is suitable for use on the Sussex Technical School District IT infrastructure. Coordinate with the Sussex Technical School District I.T. Department regarding the allowable frequency bands to avoid interference with the Sussex Technical School District I.T. infrastructure.

1.24. EXTRA MATERIALS

A. Provide one set of seals for each type and model of pump provided on the project.

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 22 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 22. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 22.

B. All electrical work performed under Division 22 shall conform to the applicable requirements of Division 26 and conforming to the National Electrical Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA & International Building Code.

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

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number, service factor, power factor and efficiency.

G. Motors located in exterior locations, wet air streams 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.

K. Where a motor disconnect is indicated downstream of a variable frequency drive (VFD) provide interlock wiring from the auxiliary contacts on the disconnect to the VFD to de-energize when the disconnect is turned “off”.

L. Where equipment under this Division is specified with integral disconnecting means, the same shall be a single disconnecting means for disconnecting all ungrounded main power supply conductors that is capable of being locked in the open (“off”) position in accordance with the National Electrical Code and the local electrical inspector.

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 l.

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 WR2 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.

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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 plumbing equipment. 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
2HP	86.5 percent	85 percent
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent
7½ HP	91 percent	86 percent
10HP	91.7 percent	85 percent
15HP	93.0 percent	85 percent
20HP	93.0 percent	86 percent
25HP	93.6 percent	85 percent
50HP	94.5 percent	88 percent
60 HP	95.0 percent	90 percent
75HP	95.0 percent	90 percent
100 HP	95.4 percent	90 percent

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125 HP	95.8 percent	95 percent
150 HP and above	96.0 percent	95 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.

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 plumbing items of equipment to electrical contractor and ATC subcontractor for coordination.

2.5. ENCLOSURES

A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:

1. Dry Interior Locations: NEMA 1.
2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.
3. Corrosive Locations, Including Janitor's Closets, and Similar Space = NEMA 4X.

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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 the 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 plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

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.

G. Do not install equipment or piping over electrical gear, electrical panels, motor controllers, and similar electrical equipment. Install equipment and piping to maintain clear space above and in front of all electrical components per the National Electric Code.

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.

C. Concrete housekeeping pads and foundations shall be not less than 4 inches high and shall extend a minimum of 6 inches beyond equipment bases. Provide wire-mesh reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

3.3. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record demonstration and training video recordings. Record each training module separately.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show

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area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

3.4. PROVISIONS FOR ACCESS

A. The contractor shall provide access panels and doors for all concealed equipment, valves, strainers, dampers, filters, controls, control devices, cleanouts, 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 minimum of 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 20 inches x 30 inches for full body access where required. Review locations and sizes with Architect prior to fabrication. 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, Acudor Products, Babcock-Davis, Nystrom, 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. 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.

F. Where access doors are installed in wet locations (i.e. shower rooms, toilet rooms, kitchen rooms, kitchens, barns, headhouse, fieldhouse, and similar spaces, etc.) provide aluminum access doors/frame.

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

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shall be baked enamel with proper pretreatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 22 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, piping and building surfaces. Do not paint manufacturer's labels or tags.

G. All exposed piping, equipment, etc. shall be painted. Colors shall be as stated in this division or as selected by the Architect and conform to ANSI Standards.

H. All exterior roof mounted equipment, piping and vents shall be painted to match roof in color as selected by Architect.

I. All exposed piping, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

J. All exposed piping, equipment, etc., in Mechanical Rooms, Penthouses, Mezzanines, and Storage where PVC jacketed shall not require painting. Label and identify and color code as specified.

3.6. 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. 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.

E. Leave systems clean, and in complete running order.

3.7. 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.

3.8. 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.

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B. Cover temporary openings in piping 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.

3.9. 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 plumbing systems for temporary services or temporary conditioning during construction. Refer to Division 01 section "Temporary Facilities and Controls" for temporary plumbing during construction.

E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items such as filters.

3.10. 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 and disconnects 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). Equipment identification and room name or area served shall be on each panel.

D. Provide six (6) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Operations and Maintenance Manuals as hereinafter specified.

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E. All lines piping installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and service. Refer to Division 22 Section, Plumbing Piping, Fittings, Valves, Etc. 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 plumbing identification. Submit samples of equipment identification cards, piping labels, labels, and valve tags to Engineer for review prior to installation.

G. Provide at least 8 hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner. Additional instruction time for the automatic temperature control (ATC) system is specified in Division 23 Section, Instrumentation and Controls of HVAC and Plumbing Systems.

H. Contractor shall demonstrate Sequences of Operation of all plumbing equipment in presence of Owner's representative, Engineer, and ATC subcontractor.

3.11. WALL AND FLOOR PENETRATION

A. All penetrations of partitions, ceilings, roofs and floors by piping or conduit under Division 22 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 07 Section, "Fire Protection, HVAC and Plumbing Penetration Firestopping".

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 and 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 for sleeved pipes 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. Extend all floor sleeves through floor at least 2-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.

3.12. RECORD DRAWINGS

A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect one complete set of prints of the mechanical 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 to Architect.

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3.13. WARRANTY

A. Contractor's attention is directed to warranty obligations contained in the General Conditions and Supplementary 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 (2) 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.

3.14. 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 Operations and Maintenance Manuals.

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.

3.15. OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared six (6) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals and deliver these copies of the manuals to the Owner. The manuals shall be as specified herein. The manuals must be approved and will not be accepted as final until so stamped.

B. The manuals 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 Sussex County School District – Sussex Technical High School – Bid Pack C – Plumbing Systems. 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. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of Volume 1 (if applicable) of hard copies of the manual.

D. Provide the following data in the booklet:

1. As first entry, an approved letter indicating the starting/ending time of Contractor's

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warranty period.

2. Catalog data on each piece of plumbing equipment furnished.
3. Maintenance, operation, and lubrication instructions on each piece of plumbing equipment furnished.
4. Complete catalog data on each piece of plumbing equipment furnished including approved shop drawing.
5. Manufacturer's extended limited warranties on equipment.
6. Chart form indicating frequency and type of routine maintenance for all plumbing equipment. The chart shall also indicate model number of equipment, location and service.
7. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
8. Provide supplier and subcontractor’s names, address, and phone number.
9. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.
10. 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. .
11. Copy of the approved balancing report for plumbing equipment/system.
12. Access panel charts with index illustrating the location and purpose of access panels.
13. Approved Health Department, Plumbing, and Electrical Certificates.
14. Start-up reports for equipment.
15. Insert color graphic with embedded parameters for ATC system into Record and Information Booklet.
16. Winterization instructions.
17. Pipe pressure testing test forms.

E. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of volume 1 (if applicable) of hard copies of the manual.

F. Submit Operations and Maintenance Manuals prior to the anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Operations and Maintenance Manuals are reviewed and approved.

3.16. INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following:

1. Complete Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with lights, electrical equipment, HVAC equipment and structural amenities.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, and piping in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manu¬facturer’s literature showing internal wiring.

3.17. PIPING SYSTEMS TESTING

A. The entire new plumbing piping systems shall be tested hydrostatically before insulation covering

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is applied and proven tight under the following gauge pressures for a duration of twenty-four (24) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Domestic Water & Coil Drain Piping	100 psig
Sanitary Water Piping	As specified below
Compressed Air Piping	150 psig
Emergency Fixtures, Tempered Water	100 psig

B. All gas piping shall be pressure tested in accordance with NFPA-54, and NFPA-58. Gas piping systems shall be proven tight under the following gauge pressures for a duration of four (4) hours:

SYSTEM	TEST PRESSURE
Gas Piping	100 psig

C. All waste, vent and water piping shall be tested by the Contractor and approved by the Engineer before acceptance. All storm, soil, and waste piping, located underground, shall be tested before backfilling. The costs of all equipment required for tests are to be included in the contract price.

D. The entire new drainage system and venting system shall have all necessary openings plugged and filled with water to the level of the highest stack above or at the roof. The system shall hold this water for thirty (30) minutes without showing a drop greater than 1inch. Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except a vertical stack 10 feet above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. The pressure shall be maintained for thirty (30) minutes. All testing shall be in accordance with the local Plumbing Code and witnessed by the Plumbing Inspector or authority having jurisdiction.

E. Upon completion of roughing-in and before setting equipment and fixtures, the entire new water piping system shall be tested at a hydrostatic pressure of not less than one hundred (100) pounds per square inch gauge and proven tight at this pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system.

F. 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.

3.18. 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.

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3.19. 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 this Section, to Owner for approval.

3.20. WINTERIZATION OF ALL WATER CONTAINING PIPING SYSTEMS

A. Contractor to install all drain valves, plugs, and Schrader valves to allow proper winterization.

B. Contractor to include in scope and bid all costs, material, and labor for winterizing the of the greenhouse and fieldhouse in preparation for the first winter.

C. A detailed plan with instructions for winterizing the greenhouse/fieldhouse shall be provided by the Contractor and inserted in the operation and maintenance manuals.

END OF SECTION

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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: _____

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SECTION 220505 - PLUMBING 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 22 Section, Common Work Results for Plumbing 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.

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D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

E. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

F. 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. ALTERNATES

A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

1.7. LEAD FREE REQUIREMENTS

A. All plumbing fixtures, equipment, and devices that contact potable water must be lead free per the State requirements.

1.8. PLASTIC PIPE PENETRATIONS

A. Install UL listed collars, sealing methods, and firestopping at all plastic pipe penetrations of smoke walls and fire rated walls per NFPA.

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. Sanitary Underground - Within Building to 5 Feet Outside of Foundation Wall:

a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM

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D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2. Sanitary and Vents Above Floor Inside Building:

   a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

3. Indirect Waste Piping:

   a. Pipe & Fittings: Hard drawn Type L copper tubing with cast brass drainage fittings. ASTM B88-78 and ANSI B16.1877. All exposed indirect waste piping shall be chrome plated or primed and painted with silver paint.

4. Storm Water Above Floor Inside Building:

   a. PVC Pipe: Schedule 40 DWV or cellular core. Fittings: Schedule 40 PVC, ASTM D 2665 or ASTM F891 socket fittings. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

5. Domestic Cold Water Outside of Building Below Ground or Under Building to Point 5 Feet from Building Line:

   a. Pipe: 2-1/2 inches & smaller, soft temper type K. ASTM B88 - No joints below grade except as approved by the Engineer.
   3 inches & larger, ductile iron pipe for water, ANSI 21.50 & 21.51 with double thickness cement mortar lining, ANSI 21.4.
   b. Fittings & Joints: wrought copper solder joint fittings, ANSI B16.22. Joints for copper piping shall be ASTM B32, SOLDER, grade 95TA.
   Cast iron pressure fittings, ANSI 21.10, Class 250. Mechanical specification for mechanical joint for cast iron pressure pipe & fittings ANSI A21.11. Joints for ductile iron pipe shall be AWWA C111, rubber gasket with 3/4 inch diameter rods.

6. Domestic Hot, Cold, Hot Water Recirculating, Emergency Fixture Tempered Water, Piping Inside Buildings, Above Grade:

   a. Pipe or Tubing: 2 inches & smaller, all water lines soft temper Type K copper tubing below ground, hard temper Type L copper tubing above ground, ASTM B88, or Type 304/304L, Schedule 10S, stainless steel to ASTM A312.
   2-1/2 inches & larger, hot dipped galvanized steel A120, ASTM A53, Grade B, Schedule 40 steel, or hard copper tube, Type L with copper-tube dimensioned grooved ends; copper ground - end fittings; copper tubing, keyed couplings; and grooved joints. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)
   Provide dielectric fittings between steel and copper. Victaulic Style 47 or approved equal.
   b. Fittings & Joints: Copper tubing fittings and joints shall be solder type wrought copper - 95-5 silver solder or braze (lead and antimony based solders are prohibited). Galvanized steel pipe fittings and joints shall be ANSI B16.12 hot dipped galvanized threaded ends and 125 lb. galvanized cast iron fittings or 150 lb. galvanized malleable iron.
      i. Stainless steel fittings shall be Vic-Press or approved equal for Schedule 10S pipe. Fittings shall be precision, cold drawn, stainless steel with

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EPDM O-ring seals. (Seals shall be UL classified in accordance with ANSI/NSF61 for Potable Water service.) Fittings rated for working pressures to 500-psi.

ii. Grooved joint couplings shall consist of two ductile iron housing segments cast with offsetting angle pattern bolt pads, FlushSeal elastomer gasket, and ASTM A449 electroplated steel bolts and nuts. (Gasket shall be UL classified in accordance with ASNI/NSF61 for Potable Water service, and shall meet the lead content requirements of NSF-372.) Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 807N or approved equal. Couplings shall be coated blue enamel.

iii. Installation-Ready™ fittings for grooved end copper tubing shall be manufactured to copper-tube dimensions. Fittings shall be ductile iron conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, complete with PVDF (Poly Vinylidene Fluoride) and Grade "EHP" EPDM-HP (Grade 'T' Nitrile) gasket; and ASTM A449 electroplated steel bolts and nuts. System shall be rated to 300 psi (2065 kPa) with Type K or L Copper Tubing.

1) UL classified in accordance with NSF-61 for potable water service. The system shall meet the low-lead requirements of NSF-372.

iv. For copper/stainless steel/CPVC pipe the gasket shall be potable water grade P compound with a red and blue stripe color code for operating temperatures from 0°F to 180°F.

1) Reference shall always be made to the latest published Victaulic selection guide for gaskets for proper gasket selection for the intended purpose.

c. Gate Valves: 2-1/2 inches & larger - OS&Y, IBBM flanged, 125 lb. standard solid wedge.

i. 2 inches & smaller - bronze solder end, bronze body, solid wedge, rising stem, 200 lb. w.o.g. non-shock. However, use brass valves only on all copper pipe.

d. Butterfly Valves: Cast brass body to UNS C87850, elastomer pressure responsive seat, aluminum-bronze disc with stainless steel stem. Stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Copper-tube dimensioned grooved ends, suitable for working pressures to 300-psig CWP Victaulic Style 608N or approved equal.

e. Ball Valves: Shut-off valves 2-inches and smaller shall be ball valves. Ball valves shall be 150 lbs, brass or bronze body, standard port, 2 piece body, TFE seats with bronze trim. Ball valves shall be threaded end or solder end, or Vic-Press end as required to accommodate piping. Ball valves shall be as manufactured by Victaulic, Conbraco, Crane, Apollo, Nibco, Watts or engineer approved equal.

f. Unions: 2-1/2 inches & larger - 150 lb. brass companion flanges.

i. 2 inches & smaller - wrought copper, ground joint solder ends; threaded hexagonal stainless steel union with Vic-Press ends, Victaulic P589 or approved equal.

g. Check Valves: 2-1/2 inches & larger - IBBM, 125 lb. std. flanged bronze swing check, with metal disc; 2-inches and smaller - 125 lb. std. screwed or solder ends.

h. Globe Valves: 2 inches and smaller, bronze body, bronze trim, rising stem, hand wheel, inside screw, renewable composition disc, solder ends, 150 lb, with back seating capacity.

i. 2 inches & larger: IBBM, 150 lb, bronze trim, rising stem, handwheel OS&Y, plug type disc, flanged ends, renewable seat and disc.

ii. Globe valves shall be Conbraco, Crane, Nibco, Milwaukee, Watts or approved equal.

i. Combination Shut-off/Balancing Valves:

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i. Victaulic/TA Hydronics, Taco Circuit Setter, Bell & Gossett Circuit Setter Plus, Flowset Accuset, Gerand, or engineer approved equal, ½ inch-3 inches 300 psi rated globe type or ball valve with DZR brass Ametal (copper-alloy) or bronze body/brass ball construction with glass and carbon filled TFE seats, in-line flow meter and balancing and shut-off valve with built in ball valve for flow adjustment. Valve shall have memory stop, calibrated nameplate, Schrader valve connections and preformed molded insulation. Valves shall be leaktight at full rated working pressure. Balance valve size shall be selected based on manufacturer's acceptable flow range and design flow rate. Pressure drop through combination shut off balance valves shall not exceed 5 feet of head at design flow rate. Where required for flow rates below 0.6 GPM, provide "reduced flow" combination shut-off balance valves sized so that the flow rate is within the manufacturer's recommended flow range.

j. 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.

k. (Alternate): At contractor's option, Viega ProPress pressure seal mechanical fittings may be utilized.

i. Viega ProPress, Mueller Streamline PRS or approved equal, Pressure Seal Fittings: Bronze, or copper shall conform to ASME B16.51, ICC LC 1002, IAPMO PS 117, NSF 61, and NSF 61-G or NSF 372. Pressure Seal fittings ½-inch thru 4-inch for use with ASTM B88 copper tube type L and ½-inch up to 1-1/4-inch annealed copper tube. Pressure Seal fittings shall have an EPDM sealing element grip ring, PBT separator ring, EPDM sealing element and Smart Connect (SC) or Sure PS Leak Detection.

7. Gas Piping:

a. Pipe: Inside Building Above Ground: Schedule 40 uncoated black steel pipe, ASTMA 53 or A120.

b. Outside Building, Below Ground: Copper type L tubing, ASTM B88 Below Ground.

c. Outside building above grade/roof: Schedule 40 black steel pipe, ASTM A53 or A120.

d. Fittings & Joints: 150 lb. screwed malleable iron ASTM B16.3 with joints sealed with litharge and glycerin. Piping 2 ½ inches and larger and any concealed piping within walls must be welded, ASTM A24 forged steel welded type joints shall be threaded or welded to ANSI B31.1 or ASME Sec. 1.

e. Plug Valves: 2- ½ inches & larger ASME B16.38 and MSS SP-78 cast iron lubricated plug valves with 125 psig pressure rating, 3 turn type. Gas valves are prohibited above ceilings.

f. Cocks: 2 inches& smaller - bronze, Crane 270. AGA certified bronze body, plug type with bronze plug, ball type with chrome plated brass ball, for 5 psig or less gas. Include AGA stamp, flat or square head or lever handle, and threaded ends conforming to ASME B1.20.1

g. Ball Valves: Full flow, double seal, ball type with bronze body, Buna-N seals and O-ring packing, chrome plated brass ball and designed for working pressures up to 175 psig. Valves shall be 3 turn type. MSS SP-78, class 175 WOG.

h. Gas Vents: Install vent piping for gas pressure regulators and gas trains, extend outside building to a non-hazardous location away from any potential source of ignition, and vent to atmosphere. Pipe material shall be identical to gas piping

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here-in before specified. Terminate vents with turned down, reducing elbow fittings with corrosion-resistant insect screen in large end.

i. Finish: All gas piping downstream of regulator, installed exposed in a kitchen, or piping installed on a roof shall be primed and finished with two coats of rust resistant paint with pewter gray finish. Paint shall be two part epoxy-exterior paint as manufactured by Pittsburgh Paint, Themeco, or approved equal. Painting shall be provided under another Section of these Specifications.

8. Compressed Air:

a. Pipe: Standard weight steel pipe, Schedule 40, black, ASTMA A53 or A120; or Schedule 10S stainless steel, ASTM A312, with plain ends.

b. Fittings & Joints: 250 lb ASME B16.3 malleable iron fittings or ASTM A234, forged steel welding type. Joints shall be threaded or welded to ANSI B31.1 or ASME Section 1 requirements.

c. Stainless steel fittings shall be Vic-Press or approved equal for Schedule 10S pipe. Fittings shall be precision, cold drawn, stainless steel with HNBR O-ring seals. Fittings rated for working pressure to 500-psi.

d. Ball Valve: Victaulic Series P569, Worcester ball valve Type X-411T, approved equal.

9. Gas Fired Condensing Water Heating Condensate Piping

a. Piping shall be PVC pipe, ASTM D1785 schedule 40 with ASTM D2466 socket fittings for schedule 40. Join PVC pipe/fittings utilizing solvent cement ASTM D2564 with ASTM F 656 primer.

b. Provide backwater valve (ball float type) at connections of condensate piping to stormwater piping and air gap fitting. Backwater valve shall be Model Z1099 as manufactured by Zurn or approved equal. Backwater valve shall have drain coated cast iron body, plastic ball float, bronze backwater bushing and replaceable neoprene seat.

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.

D. Welding fittings for steel pipe shall meet the requirements of ASTM Standard A-23 and shall be standard catalog products. Fittings fabricated by metering and notching pipe will not be accepted.

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, Carpenter and Patterson, or approved equal for pipe ¾-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:

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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 - ½	6	8	3/8
2	8	8	3/8
2 – ½	10	9	½
3	12	10	½
4	14	12	5/8
5	14	12	5/8
6	16	14	3/4
8	18	16	7/8
10	20	18	7/8
12	20	18	7/8

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B. Install hangers for soil piping with the following maximum horizontal spacing and minimum rod

diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. PS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
6. NPS 15 (DN 375): 48 inches (1200 mm) with 1-inch (25-mm) rod.
7. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

C. Install supports for vertical soil piping every 4 feet (1200 mm).

D. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters.

E. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 ½ and NPS 2 (DN and DN 50): 48 inches (1200 mm) with 3/8 inch (10-mm) rod.
2. NPS 3 (DN 80): 48 inches (1200 mm) with ½ inch (13 mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8 inch (16 mm) rod.
4. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4 inch (19 mm) rod.
5. NPS 8 to NPS 12 (DN 200 to DN 300): 48 inches (1200 mm) with 7/8 inch (22 mm) rod

F. Install supports for vertical PVC piping every 48 inches (1200 mm).

G. 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.

H. Hangers for pipe sizes ½ to 1 ½ inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.

I. Hangers for cold pipe sizes 2 inches (50 mm) and over: Carbon steel, adjustable, clevis.

J. Hangers for cold pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.

K. Hangers for cold pipe sizes 6 inches (150 mm) and over: adjustable steel yoke, cast iron roll, double hanger.

L. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.

M. Multiple or Trapeze hangers for hot pipe sizes 6 inches (150 mm) and over: Steel channels with welded spacers and hanger rod, cast iron roll.

N. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook

O. Wall support for pipe sizes 4 inches (100 mm) and over: Welded steel bracket and wrought steel clamp.

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P. Wall support for hot pipe sizes 6 inches (150 mm) and over: welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

Q. Vertical Support: Steel riser clamp.

R. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

S. Floor support for hot pipe sizes to 4 inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

T. Floor support for hot pipe sizes 6 inches (150 mm) and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

U. Copper pipe support: Carbon steel ring, adjustable, copper plated.

V. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

W. 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.

X. For Pipe Hangers installed in corrosive environments such as chemical storage rooms, janitor's closets, barn,…etc. the same shall (including hardware) shall be finished with on Electro-Galvanized Finish such as Galv-Krom® or approved equal.

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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.

B. Check valves in circulator discharges shall be horizontal type.

C. Multi-purpose valve (non-slam check valve, throttling valve, shut-off valves and calibrated balancing valve) shall be provided at discharge side of each constant speed pump. The valve shall be of heavy-duty cast iron construction with standard ANSI flanged connections and rated for a maximum working pressure of 175 psig at 240°F. The valve shall be fitted with a stainless steel stem or stem sleeve and brass seat with "O" ring seal. Valve shall be Taco "Plus One" Number 300-4.2, Bell and Gossett 3DS Triple Duty Valve, Armstrong, or as approved equal, and shall have check and plug valve features plus a memory stop with pointer and scale. Provide additional shut-off valve to allow servicing of check valve if a multipurpose valve is utilized in lieu of separate check, shut-off, and balance valve. Provide additional shut-off valve downstream of multi-purpose valve to allow servicing of multi-purpose check valve feature. Provide pre-manufactured, removable insulation covers for all multipurpose valves.

2.4. BACKWATER VALVE

A. Provide backwater valves for all floor drains, A/C condensate drains, and foundation drains connecting directly to the storm water system and where indicated on drawings. Backwater valves shall be constructed of coated cast-iron body, hub inlet and offset spigot outlet, bronze bolted cover, automatic type valve seat and flapper which remains closed during periods of non-operation. Provide RectorSeal Clean Check extendable backwater valves for underslab/below-grade condensate lines as indicated on drawings.

B. Extend access cover to finished floor and terminate in an adjustable floor cleanout as specified hereinbefore.

1. Josam Back Water Valve
2. Zurn Series No. Z1095-FC
3. Jay R. Smith Series No. Fig. 7012

2.5. STRAINERS

A. Strainers shall be of the basket or "Y" type and shall be heavy and durable, constructed of best grade gray iron with the bottoms drilled and plugged. Bodies shall have arrows clearly cast on the sides to show flow direction. Strainers shall be equipped with easily removable covers and brass sediment baskets made of brass not less than #22 gauge in thickness. Total area of basket perforations shall be not less than four times the cross section of the entering pipe. Flow shall be into basket, and then out through the perforations. Strainers shall be suitable for water or the intended fluid. Strainers 2 inches and smaller shall have threaded or solder ends, 2 inches and larger shall have flanged ends.

B. Strainer screens shall be stainless steel with perforations and shall be 1/16-inch for pipe sizes 5 inches and less, 1/8-inch (40 percent open area) perforations for pipe sizes 6-inch and greater.

C. Provide valved and capped (with chain) blowdowns in each strainer. Blowdown valves shall be Appolo 78-100/200 series or as approved equal.

D. Strainers shall be manufactured by Watts, Mueller, Armstrong, Yarway, Spirax/Sarco or as approved equal.

2.6. 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.

C. Flanges for steel pipe over 2 inches shall be 150 psig, forged steel, and slip on type. Gaskets shall be 1/16 inch thick pre-formed neoprene.

D. Flanges for copper pipe over 2 inches shall be bronze. Gaskets shall be 1/16 inch thick preformed neoprene.

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2.7. MANUAL AIR VENTS

A. Manual air vents shall be similar to the hereinafter specified gauge valves. Provide 1/4-inch size on ¾-inch pipe and smaller, ½ -inch size on 1-inch pipe and larger. Install at all high points of piping. Valves shall be Crane No. 88, Honeywell or as approved equal, with threaded ends, bronze body, bronze or brass bonnet and bronze stem.

2.8. THERMOMETERS

A. Unless otherwise indicated, thermometers shall be ASTM E1, in a glass type, organic filled, 9-inch scale size, corrosion-resistant metal case, with "any-angle" mounting with positive locking device. Trerice Industrial Thermometers, Weksler Instruments, Ernst Gage Co., Miljoco, or approved equal. Insertion stem length shall suite the pipe size and configuration. Thermometer wells shall be brass

with brass union hubs in copper and in ferrous piping. Where piping is insulated or otherwise covered, use wells with lagging extension. Where wells are installed in pipe tees at turns, increase pipe size so that well does not restrict flow. Accuracy shall be 2 percent.

B. Unless otherwise indicated, thermometer ranges shall be as follows:

1. Domestic cold water: 0 degrees F to 100 degrees F, 1 degrees F Division.
2. Domestic hot and hot water recirculating: 30 degrees F to 180 degrees F, 2 degrees F Division.
3. Tempered Water: 30 degrees F to 100 degrees F, 2 degrees F Division.

C. Provide heat conducting compound in wells.

2.9. PRESSURE GAUGES

A. Unless otherwise indicated, pressure gauges shall be the bronze bourdon tube type, 4-1/2-inch dial, stem mounting, cast aluminum adjustable pointer, 1 percent accuracy over middle half of scale range, 1-1/2 percent over balance: Trerice Model 600C; Weksler Instruments, Ernst Gage Co., Miljoco, or as approved equal.

B. Gauges shall have pressure, vacuum, compound, or retard ranges as required, select ranges so that the normal readings are at the approximate midpoint and maximum system pressures do not exceed full scale.

C. Furnish and install a gauge valve at each pressure gauge. Gauge valves shall be Crane Model No. 88, Needle Valve, Ernst Gage Co. FLG 200, Wexler Instrument Corp. Type BBV4, or approved equal, rated for pressure intended.

D. Gauge connections for pressure gauges, thermometers, or control instruments shall be made using tee fittings, except that gauge connections up to 1-inch size in steel may be using threaded extra heavy pipe couplings welded directly to the main, provided that the main is at least 2-inch size for 2-inch connections, 3-inch size for 3/4-inch connections, and 4-inch size for 1-inch connections. Minimum gauge connection shall be 2-inch ips.

E. Provide snubbers on all gauges. Snubbers shall be No. 872 by Trerice, RS1/RS6 by Wexler Instruments, Miljoco or as approved equal.

2.10. PIPING SPECIALTIES

A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of all base mounted and vertical in-line pumps, connections to air compressors, all vibrating equipment and elsewhere as shown. Refer to Division 23 Section, Vibration Control for HVAC, Plumbing and Fire Protection Equipment for specifications.

B. Pressure relief valves shall be provided in the number and sizes required to relieve 110 percent of the full input to the systems. Valves shall be rated; and installed in accordance with ASME, and CSD-1 including all amendments. Pipe discharge full size to floor drain, (with union) and support discharge pipe to prevent exerting any strain on relief valve body, piping to be Type-L copper. Water safety relief valves shall be Watts Series 740, Conbraco, Series 154A, Bell and Gossett, or approved equal. Provide pressure gauge adjacent to all safety relief valves.

C. Gas relief valve piping shall be sized and installed in accordance with the latest edition of ASME Boiler & Pressure Vessel Code, CSD-1 including amendments. Pipe material shall be as specified for gas piping. Gas relief valve piping material shall be the same as hereinbefore specified for gas

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piping. Install stainless steel mesh screen and turndown on all gas relief valve/vent piping terminations.

2.11. 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.

2.12. DIELECTRIC CONNECTIONS:

A. Furnish and install electrically insulated dielectric unions, waterway fittings, or flanges, as manufactured by Victaulic Company, 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.
4. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service, and shall meet the low lead requirements of NSF-372. Basis of Design: Victaulic Series 647.

2.13. 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 ¾-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.

2.14. 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.

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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 F.

2.15. GAS PRESSURE REGULATORS

A. Gas pressure regulators shall be as manufactured by Equimeter, Inc., Maxitrol Co., Rockwell, Fisher Controls, American Meter Co., Pietro Fiorentini, or approved equal. Gas pressure regulators shall maintain a constant downstream pressure with a variable inlet pressure.

B. Gas pressure regulators shall comply with ANSI Z21.18 and shall be single stage, steel jacketed, corrosion-resistant type. Include atmospheric vent, elevation compensator, with threaded ends conforming to ASME B1.20.1 for 2 inch NPS and smaller and flanged ends for 2 ½ inch NPS and larger.

C. Gas pressure regulator shall be a positive lock-up type regulator where required by equipment manufacturer.

D. Each pressure regulator shall have an identification stamped on diaphragm cover and shall be painted AGA grey. Regulator inlet and outlet pressures, and flow volume in cubic feet per hour of specified gas are as indicated on the contract drawings.

E. Install water heater gas pressure regulators a minimum of 3 feet and no more than 8 feet from the water heaters per the manufacturer's requirements.

2.16. EQUIPMENT RUN-OUT FLEXIBLE GAS PIPE CONNECTIONS

A. Description: Comply with AGA LC 1 and include the following:

1. Tubing: Corrugated stainless steel with plastic jacket or coating.
2. Fittings: Copper alloy with ends made to fit corrugated tubing. Include ends with threads according to ASME B1.20.1 if connection to threaded pipe or fittings is required.
3. Striker Plates: Steel, designed to protect tubing from penetrations.
4. Manifolds: malleable iron or steel with protective coating. Include threaded connections according to ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
5. Available Manufacturers:
   a. OmegaFlex, Inc.
   b. Titeflex Corp.
   c. Tru-Flex Metal Hose Corp.
   d. Ward Industries, Inc.
6. Flexible gas piping shall only be utilized adjacent to equipment. All other gas piping shall be rigid gas piping as specified.

2.17. 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.

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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 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.

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D. All valves, strainers, caps, and other fittings shall be readily accessible.

E. Rough-in and final connections are required to all equipment and fixtures provided under this Contract.

F. Drain valves with hose connections shall be provided at low points for drainage of piping systems. Blow down valves shall be provided at the ends of all mains and branches so as to properly clean by blowing down the lines throughout in the direction of normal flow.

G. Discharge lines from all relief valves shall be piped to within 4-inches of floor and extend to floor drains wherever floors are not pitched to drains. Pitch the relief valve piping away from the relief valve to issue that no fluid can be trapped in valve discharge. Support all relief valve piping to prevent exerting strain on the relief valve body. The end of the relief valve discharge piping shall not be threaded to prevent capping or plugging.

H. 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.

I. Cutoff valves shall be provided on each branch line from the mains on all plumbing lines.

J. Shut-off valves shall be installed at the inlet and outlet of each piece of equipment to permit isolation for maintenance and repair.

K. Balancing valves shall be installed in all domestic re-circulating systems and at all pumps, and where indicated on the drawings.

L. Unions shall be installed on all bypasses, at all connections to equipment, where shown on drawings or where required to facilitate removal of equipment whether shown or not.

M. 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.

N. 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.

O. Install all valves with stem upright or horizontal, not inverted.

P. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.

Q. Provide clearance for installation of insulation and access to valves and fittings.

R. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

S. All water containing pipes shall be routed clear of combustion air dampers and louvers to prevent freezing condition when dampers are open.

T. Provide manual air vents at top of piping systems.

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U. Install Schrader valves with ball valves to allow all domestic water and sanitary pipes to be blown out with compressed air for wintertime freeze protection.

V. Where access doors are required, install piping so that valves can be grouped together to minimize the quantity of access doors.

W. Install manufactured U.L. listed firestop collars at all floor/wall penetrations for all PVC and CPVC pipe penetrations.

3.2. THERMOMETER AND PRESSURE GAGE INSTALLATION REQUIREMENTS.

A. Install thermometers/gauges and adjust vertical and tilted positions.

B. Install separable sockets in vertical position in piping tees where fixed thermometers are indicated.

1. Install with socket extending to one-third diameter of pipe.
2. Fill sockets with oil or graphite and secure caps.

C. Install pressure gages in piping tees with pressure-gage valve located on a pipe at most readable location.

D. Adjust faces of thermometer and gages to proper angle for best visibility.

E. Clean windows of thermometer and gauges and clean factory-finished surfaces. Replace cracked and broken window, and repair scratched and marred surfaces with manufacturer's touch up paint.

3.3. 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. Examine grooved ends for form and cleanliness. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.

G. Do not attempt to repair defective valves; replace with new valves.

H. Install valves as indicated, according to manufacturer's written instructions.

I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

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J. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

K. Locate valves for easy access and provide separate support where necessary.

L. Install valves in horizontal piping with stem at or above the center of the pipe.

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

N. 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.

3.4. WASTE AND VENT PIPING INSTALLATION REQUIREMENTS

A. Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets of the flow line. All pipe when laid shall rest on the full length of the barrel and bell holes shall be dug in trench bottoms to make joints. Pipe shall not be adjusted to grade by use of block or wedges. Where rock or old foundations are encountered, trenches shall be excavated 6-inches below grade and crusher run limestone shall be used as a bedding material to support barrel of pipe.

B. As the work progresses, the interior of the sewer shall be cleared of all dirt and superfluous materials of every description.

C. Trenches shall be kept free from water until the pipe jointing material has set and pipe shall not be laid when the conditions of the trench or the weather is unsuitable for such work. At all times, when work is not in progress, all open ends of pipe and fittings shall be securely closed to the satisfaction of the Engineer, so that no trench water, earth or other substance will enter the pipe or fittings.

D. Slip joints will be permitted only in trap seals or on the inlet side of the trap. Unions on the sewer side of the trap shall be ground faced, and shall not be concealed or enclosed. Install bell and spigot pipe with bell end upstream.

E. Threaded joints shall be American Standard taper screw threads with permacel joint compound applied to the male thread. Connections between threaded pipe and cast iron pipe shall have a ring or half coupling screwed on to form a spigot end on the threaded pipe.

F. Establish invert elevations, slopes for drainage to 1/8 inch per foot. Maintain gradients.

G. Provide all traps with threaded drain plugs for winterization and freeze protection.

3.5. 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. Grooved Joints: Grooved joint shall be installed in accordance with the manufacturer's written

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recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

D. 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.

E. 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.

F. Where copper piping joins steel piping, approved bronze adapters shall be used.

G. 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.

H. When installing gas piping which is to be concealed (i.e., in walls), unions, tube fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combination of fittings shall not be used. All concealed piping within walls shall be welded.

1. Gas Piping
2. Final Gas Connections: Unless otherwise specified herein, final connections shall be made with rigid metallic pipe and fittings.
3. Pipe Joints:

    a. Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.
    b. Threaded Metallic Joints: Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing

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compound for gas service. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

c. Welded Metallic Joints: Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stores so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

d. Thermoplastic Joints: Jointing procedures shall conform to AGA 01. Solvent cement or heat of fusion joints shall not be made between different kinds of plastics.

e. Joining Thermoplastic to Metallic Piping: When compression-type mechanical joints are used, the gasket material in the fittings shall be compatible with the plastic piping and with the gas in the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting, and the stiffener shall be flush with the end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. A split tubular stiffener shall not be used.

f. Special Requirements; Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall comply with NFPA 54.

g. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches (100mm) outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar epoxy-polyamide paint according to SSPC-Paint 16.

h. Install gas meter per manufacturer's requirements.

4. Install concrete filled, steel, schedule 40, painted pipe bollards around gas meter regulator.

5. Gas pressure regulators shall be installed and located per the manufacturer's requirements for water heaters the gas regulators shall not be installed less than 3 feet nor more than 8 feet from the water heaters unless the manufacturer require otherwise. For boilers, the gas pressure regulators shall not be installed closer than 10 feet from the boilers, unless the manufacturer requires otherwise. Vent all gas pressure regulator vent pipes to the building exterior prior NFPA-54 and CSD-1 requirements.

I. Plastic piping solvent cement joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe handling practice of cleaners, primers, and solvent cements. Apply primer.

2. PVC Piping: Join according to ASTM D2855.

3.6. HANGERS AND SUPPORTS 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 Victaulic, Grinnells Figure 173/273, Sure-Joint, or approved equal. Provide approved spacers between saddles and pipe where flexible insulation is specified. Provide insulation protection shields for insulated piping without saddles. Shields shall be Carpenter Patterson, Grinnell Figure 167 or as approved equal.

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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 Carpenter Patterson, 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 Carpenter Patterson, 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. Refer to structural documents for appropriate connection/attachment materials to building.

3.7. AIR VENTING INSTALLATION REQUIREMENTS

A. The top of each plumbing piping system and other points as indicated or where necessary for the removal of air from the system or equipment, shall be vented using an approved type of manual air vent.

B. In addition to manual air vents at high points of system, each item of water heat transfer equipment shall be manually vented using an approved type manual air vent. All air vents shall be accessible.

3.8. DIRT POCKETS INSTALLATION REQUIREMENTS

A. Dirt pockets shall be installed at the base of all risers, upstream of gas regulators, and ahead of all gas equipment and as indicated on the drawings.

3.9. EXPANSION LOOPS AND SWING CONNECTION INSTALLATION REQUIREMENTS

A. Install expansion fittings according to manufacturer's written instructions.

B. Install expansion fittings in sizes matching pipe size in which they are installed.

C. Align expansion fittings to avoid end loading and torsional stress.

D. Install pipe bends and loops cold sprung in tension or compression as required to partly absorb

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tension or compression produced during anticipated change in temperature.

E. Attach pipe bends and loops to anchors.

1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

F. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

G. Connect risers and branch connections to plumbing equipment with at least four pipe fittings, including tee in riser.

H. Connect mains and branch connections to plumbing equipment with at least four pipe fittings, including tee in main.

I. Install expansion loops, guides, and anchors on all CPVC domestic water piping as required per manufacturer's instructions.

3.10. PIPING IDENTIFICATION REQUIREMENTS

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
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
Over 10	32	3 ½

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3.11. VALVE IDENTIFICATION REQUIREMENTS

A. All valves shall be tagged with a numbered tag.

B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.

C. Provide a minimum of six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in each mechanical equipment room including each air handling unit mechanical equipment room. Additional copies shall be provided in each copy of the O&M manuals.

3.12. CLEANING PIPING AND EQUIPMENT REQUIREMENTS

A. All water, plumbing piping, and pumped condensate 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 purged of all air.

B. All water and pumped condensate piping system shall be flushed clean with fresh water. See Division 22 Sections, Plumbing Fixture and Plumbing Equipment for domestic potable water cleaning and sterilization.

3.13. BACKWATER VALVE INSTALLATION REQUIREMENTS

A. Install backwater valve with access door to allow service and cleaning of ball check valve.

B. Access door shall be adequate size to allow full clearance to backwater valves. Paint exterior of access door to match existing wall finish.

C. Backwater valve size shall be as indicated on floor plans.

3.14. PRESSURE SEAL FITTING INSTALLATION REQUIREMENTS

A. Viega, ProPress Pressure Seal bronze, Mueller Streamline, or approved equal or copper fittings: Sealing element shall be verified for the intended use. Tube ends shall be cut on a right angle (square) to the tube. Tube ends shall be reamed and chamfered, all grease oil or dirt shall be removed from the tube end with a clean rag. Visually examine the fitting sealing element to ensure there is no damage, and it is properly seated into the fitting. Utilizing a Viega Insertion Depth Inspection Gauge mark the tube wall, with a felt tip pen, at the appropriate location, or insert the tube fully into the fitting and mark the tube wall at the face of the fitting. Always examine the tube to ensure it is fully inserted into the fitting prior to pressing the joint. ProPress fittings shall be installed according to the most current edition of the Viega installation guidelines. Installers shall attend a Viega ProPress installation training class.

B. After ProPress, Mueller Streamline, or approved equal. Pressure seal fittings have been installed a “two step test” shall be followed. Pressurize the system with application appropriate test medium, water between 15 and 85 psi, or air/dry nitrogen between .5 and 45 psi. Check the pressure gauge for pressure loss. If the system does not hold pressure, walk the system and check for un-pressed fittings. Should you identify an un-pressed fitting ensure the tube is fully inserted into the fitting and properly marked, prior to pressing the joint. After appropriate repairs have been made, retest the system per local code, or specification requirements, not to exceed 600 psi with water or 200 psi when using air fitting.

END OF SECTION

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SECTION 220701 - PLUMBING 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 22 Section, Common Work Results for Plumbing.

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 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 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 E 96, “Standard Test Methods for Water Vapor Transmission of Materials”.
e. ASTM C 585, “Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)”.
f. ASTM C 612, “Standard Specification for Mineral Fiber Block and Board Thermal Insulation”.
g. ASTM C 1136, “Standard Specification for Barrier Material, Vapor, “Type 1 or 2 (Jacket only).
h. ASHRAE 90.1 “Energy efficient design of new buildings except low-rise residential buildings”, latest edition.

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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

C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristics.

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

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mechanical damage.

1.8. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

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 F mean temperature, for service temperatures between -60 degrees F and +450 degrees F with all service poly-encapsulated jacket. Pipe insulation shall be fiberglass ASJmax SSL II with double closure system as manufactured by Owens Corning, Johns Manville, Knauf or approved equal.

B. 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 Foster 85-20/85-50 or Childers CP-82 (5 gallon cans only) adhesive. Jacket and butt strips shall be off-white color and shall be equivalent to Owens-Corning Fiberglass 25-ASJ, Johns Manville, Knauf, or approved equal.

C. 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. Cold piping: Apply a tack coat of vapor barrier coating and reinforcing mesh. After ½ hour, apply second coat of same vapor barrier coating, UL labeled, Type C, for cold water piping. Hot piping, Type H for hot water piping: Apply tack of breather mastic. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of breather mastic over the reinforcing cloth, working it to a smooth finish. As an option to the above hot fittings, a polyvinyl chloride fitting cover may be supplied.

D. 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.

E. 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

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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.

F. For piping located outside of the building, a 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 and shall be sealed completely with metal jacketing sealant. Sealant shall be Foster 95-44 or Childers CP-76. 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.

G. On cold systems such as domestic cold water, rainleaders, vapor barrier performance is extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a vapor barrier 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. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeance shall be 0.03 perms or less at 45 mils dry at test by ASTM E96.

H. 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, grooved joint PVC fitting valve and coupling covers shall be utilized. Grooved joint 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.

I. 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.

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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. For hot or cold piping systems larger than 3-inches (7.5 cm) in diameter, operating at temperatures less than +200 degrees F (93 degrees C) and insulated with fiber glass, high density inserts such as foam with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +_200 degrees F (93 degrees C), Owens-Corning Pink or IIG, Calcium Silicate pipe insulation shall be used for high density inserts.
3. Owens-Corning Pink Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi (7kg/cm).
4. 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.
5. 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.
6. 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
Above Grade Trap Priming Lines	½ -inch thickness
All Above Grade Floor Drain Piping Serving AHU Condensate Drains include Drain Sumps and Auxiliary Drain Pipes from Auxiliary Pans	1-inch thickness
All Domestic Hot and Cold Water Piping, including Hot Water Re-circulating Piping	1-inch thickness
All Drain Piping from Cooling Coils/Evaporators	½-inch thickness
Electric Water Cooler Drains, Kitchen Equipment Drains	1-inch thickness
Emergency Fixture Tepid Water Piping	1-inch thickness
Tepid Water for Emergency Fixtures	1-inch thickness

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2.4. EQUIPMENT INSULATION MATERIALS AND THICKNESSES

A. The following equipment shall be insulated with Fiberglass Rigid Board Insulation or Foam Plastic Insulation:

1. All piping within emergency mixing valve cabinets.
2. All Pump Volutes and Strainers.
3. Backflow Preventer Valve Bodies.

4. Domestic Water Meters.
5. Expansion Tanks.
6. Plumbing Pumps.

B. Insulation for cold surfaces shall be 1-1/2-inch thickness, 6 lb. density, 705 FRK with a "K" rating of .23 at 75 degrees F mean temperature. Insulation for hot surfaces except as otherwise noted shall be 1-1/2-inch thickness, 6 lb. density, 705 with a "K" rating of .23 at 75 degrees F mean temperature. Insulation shall be applied with staggered joints firmly butted and joined. The insulation shall be held in place by steel bands. Bands shall be 1-inch by 25 gauge galvanized steel spaced on not over 12-inch centers. All joints and voids shall be filled with Owens-Corning #110 cement, well troweled into openings. For 705 FRK insulation, all joints and voids shall be FRK taped and vapor sealed. There shall be applied over the insulation surface 1-inch galvanized wire netting laced together at all edges and wired to the steel bands with 16 gauge soft annealed wire. Over this shall be applied 2-inch thick layer of Owens-Corning #110 cement applied in two layers. Install metal corner beads at all corners and edges in order to provide a permanent installation. Onto the dry cement surface apply a brush coat of Foster Sealfas 30-36 or Childers CP-50AMV1 lagging adhesive at the rate of 60-70 square feet per gallon. Cleanouts, nameplates, and manholes shall not be insulated, and the insulation on surrounding surfaces shall be neatly beveled off at such openings.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum at least 0.040 inch (1.0 mm) thick.
3. For below ambient services, install a vapor barrier coating at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

D. Mechanical fasteners shall be utilized to hold insulation to surface with bands as required to hold the curvature of the material.

E. Support rings shall be provided to support the top head insulation where required.

F. Outdoor installations require a weather barrier mastic for protection of the insulation jacketing.

G. Insulation types materials shall be suitable for temperatures encountered by each item of equipment.

H. Install removable insulation sections at all cleanouts, test ports, and items that must be periodically tested.

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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. VOC content not to exceed 250 g/L.
3. Color: High Gloss White
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.

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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 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 coating.
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.

5. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

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B. Equipment Insulation:

1. General:

a. Install insulation in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
b. Install insulation on equipment after installation of heat tracing, painting, testing, and acceptance tests.
c. Install insulation materials with smooth, even surfaces. Rework poorly fitted joints. Do not use joint sealer or mastic as filler for joint gaps and excessive voids resulting from poor workmanship. Apply insulation using staggered joint method for both single and double layer installation, applying each layer of insulation separately.
d. Coat insulated surfaces where specified on contract drawings with layer of insulating cement, troweled in a workmanlike manner, leaving a smooth and continuous surface. Fill in seams, broken edges, and depressions. Cover over wire mesh and joints with cement sufficiently thick to remove surface irregularities.
e. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage. Seal all tears, punctures and other penetrations of equipment insulation facing.
f. Where specification calls for field-applied all-service vapor barrier jacketing, it shall be neatly fitted and tightly secured. Lap seams 2-inches (5cm) (min.). Seal all joints with adhesive. Tape with 3-inches (7.5cm) matching pressure-sensitive tape or 3-inch (7.5cm) glass fabric and vapor barrier coating.
g. On exposed equipment, locate insulation and cover seams in least visible location.

2. Removable Insulation: Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance, such as vessel covers, fasteners, flanges, frames accessories, manholes, handholes, cleanouts ASME stamp, and manufacturer nameplates.
3. Areas Left Uninsulated: Items such as manholes, handholes, clean-outs, ASME stamp, and manufacturers' nameplates should be left uninsulated unless omitting insulation would cause a condensation problem. When such is the case, provide removable insulation and appropriate tagging to identify the presence of these items. Provide neatly beveled edges at interruptions of insulation.
4. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather barrier mastic protective finish or jacketing as recommended by the jacketing manufacturer.

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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 equipment insulation shall have a field applied PVC jacket cover neatly cut and pasted over equipment insulation. PVC shall be high gloss white and shall be 20 mils thick. Exposed areas include, but are not limited to, all mechanical equipment rooms/fan rooms, above architectural ceiling clouds, mezzanines, penthouses, janitor’s closets, kitchens, electric rooms, and piping exposed in an occupied space.

B. 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.

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.

END OF SECTION

NOT FOR BIDDING

SECTION 224000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1. GENERAL

A. For General Mechanical Requirements, see Division 22 Section, Common Work Results for Plumbing & Division 01, General Requirements.

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

C. All exposed bolts, screws, etc., shall be vandal proof.

D. All plumbing materials, equipment and fixtures shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.

E. Piping and insulation are specified under other sections.

F. Use "Sani-Sett" setting compound for fixtures.

G. Provide all materials, equipment and perform all labor required to install plumbing system complete as specified, as drawings indicated and as required by the following:

1. State of Delaware
2. International Plumbing Code
3. Sussex County local Code
4. City of Georgetown Code
5. All other authorities have jurisdiction.

H. Comply with the current lead-free laws per the requirements of the state in which the project is being constructed.

I. Provide stops for all plumbing fixtures and equipment. Stops are to be accessible.

J. Provide P traps on fixtures for which traps have not been included as part of furnished equipment. Trap size to equal size of fixture tailpiece.

K. All exposed metal parts of fixtures shall be chromium plated brass. Piping, fittings, valves, traps and accessories including escutcheons for piping shall be chromium plated where exposed in finished areas.

L. All faucets for the following list shall be listed for drinking-water or commercial applications by the National Sanitation Foundation (NSF) or Underwriters Laboratory (U.L.). All required faucets shall comply with NSF Standard 61 for both lead content and leaching rate. Submit documentation indicating compliance for all required faucets.

1. Lavatories

NOT FOR BIDDING

2. Commercial kitchen sinks

3. Drinking fountains

4. Ice makers

M. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Electrical Manufacturers' Association (NEMA).
5. Underwriters Laboratories (UL).

1.2. REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-floor Plumbing Fixtures for Public Use

B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.

D. ANSI/ASMI A112.19.2 - Vitreous China Plumbing Fixtures.

E. ANSI/ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

F. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.

G. ANSI/ASME A112.19.5 -Trim for Water-Closet Bowl, Tanks, and Urinals (Dimensional Standards).

H. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.

I. ANSI/ARI 1010 - Drinking-Fountains and Self- Contained, Mechanically Refrigerated Drinking Water Coolers.

J. ANSI/NFPA 70 - National Electrical Code.

K. IBC - International Building Code

1.3. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 01, Section General Requirements.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

NOT FOR BIDDING

1.4. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings and per the manufacturer.

B. Confirm that millwork is constructed with adequate provisions for the installation of counter top lavatories and sinks.

1.5. EXTRA MATERIALS

A. Provide two sets of faucet washers and flush valve service kits to the Owner. Provide correspondence to Engineer that extra materials have been turned over to the Owner.

B. For science room fixtures, furnish to Owner in a suitable container spare quantity of lime chips for each bottle trap of the project.

1.6. GRAB BAR COORDINATION

A. For handicapped plumbing fixtures coordinate location of flush valves with grab bars prior to installation.

1.7. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

PART 2 PRODUCTS

2.1. WALL-MOUNTED WATER CLOSETS

A. WC-1 Wall Hung, Exposed Manual Flush Valve

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

a. Kohler Model K-4325 Kingston
b. American Standard
c. Crane
d. Sloan
e. Zurn

2. Bowl:

a.	Material:	Vitreous china
b.	Type:	Siphon Jet
c.	Style:	Flushometer Valve
d.	Height:	Standard
e.	Rim Contour:	Elongated
f.	Spud Size; Location:	NPS 1-1/2; Top

3. Flushometer Valve:

a. Diaphragm Type: Sloan Model Royal #111, Delany, Zurn or approved equal.

NOT FOR BIDDING

b. Chrome plated brass.
c. ADA compliant non-hold open handle.
d. 1-inch I.P.S. screwdriver back check angle stop.
e. Spud coupling and flange.
f. Free spinning vandal resistant stop cap.
g. Adjustable tail piece.
h. High back pressure vacuum breaker flush connection.
i. Sweat solder adapter with cover tube and cast set screw wall flange.
j. Split Ring Wall Support: Sloan Model J-312-A.
k. Provide 3-year limited Manufacturer's warranty.

4. Toilet Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.

5. Carrier: Zurn, Josam, or Watts cast iron watercloset Carrier with fittings as required. ANSI/ASME A112.6.1 adjustable cast iron frame integral drain hub and vent, adjustable speed, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

B. WC-1A Wall Hung, Exposed Manual Flush Valve, Handicapped

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

a. Kohler Model K-4325 Kingston
b. American Standard
c. Crane
d. Sloan
e. Zurn

2. Bowl:

a.	Material:	Vitreous china
b.	Type:	Siphon Jet
c.	Style:	Flushometer Valve
d.	Height:	A.D.A. Compliant
e.	Rim Contour:	Elongated
f.	Spud Size; Location:	NPS 1-1/2; Top

3. Flushometer Valve:

a. Diaphragm Type: Sloan Model Royal #111, Delany, Zurn or approved equal.
b. Chrome plated brass.
c. ADA compliant non-hold open handle.
d. 1-inch I.P.S. screwdriver back check angle stop.
e. Spud coupling and flange.
f. Free spinning vandal resistant stop cap.
g. Adjustable tail piece.
h. High back pressure vacuum breaker flush connection.
i. Sweat solder adapter with cover tube and cast set screw wall flange.
j. Split Ring Wall Support: Sloan Model J-312-A.
k. Provide 3-year limited Manufacturer's warranty.

4. Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.

NOT FOR BIDDING

5. Carrier: Zurn, Josam, or Watts cast iron watercloset Carrier with fittings as required. ANSI/ASME A112.6.1 adjustable cast iron frame integral drain hub and vent, adjustable speed, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.2. WALL-HUNG URINALS

A. U-1 Wall-Hung, Exposed Manual Flush Valve

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

   a. Kohler Model K-4991-ET Bardon
   b. American Standard
   c. Sloan
   d. Zurn

2. Fixture:

   a. Material: Vitreous china
   b. Type: Washout
   c. Rim Height: Standard
   d. Spud Size; Location: NPS 3/4; Top
   e. Outlet Size; Location: NPS 2; Back

3. Flushometer Valve:

   a. Diaphragm Type: Sloan Model Royal #186, Delany, Zurn or approved equal.
   b. Chrome plated.
   c. ADA compliant non-hold open handle.
   d. 3/4-inch I.P.S. screwdriver back check angle stop.
   e. Spud coupling and flange.
   f. Free spinning vandal resistant stop cap.
   g. Adjustable tail piece.
   h. High back pressure vacuum breaker flush connection.
   i. Sweat solder adapter with cover tube and cast set screw wall flange.
   j. Split Ring Wall Support: Sloan Model J-312-A.
   k. Provide 3-year limited Manufacturer's warranty.

4. Carrier: Zurn, Josam or Watts cast iron urinal carrier with fittings as required. ANSI/ASME A112.6.1A; cast iron and steel frame with tubular legs, legs for floor and wall attachment, threaded fixtures studs for fixture hanger, bearing studs.

B. U-1A Wall-Hung, Exposed Manual Flush Valve, Handicapped

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

   a. Kohler Model K-4991-ET Bardon
   b. American Standard
   c. Sloan
   d. Zurn

2. Fixture:

   a. Material: Vitreous china

NOT FOR BIDDING

b.	Type:	Washout
c.	Rim Height:	A.D.A. Compliant
d.	Spud Size; Location:	NPS 3/4; Top
e.	Outlet Size; Location:	NPS 2; Back

3. Flushometer Valve:

a. Diaphragm Type: Sloan Model Royal #186, Delany, Zurn or approved equal.
b. Chrome plated.
c. ADA compliant non-hold open handle.
d. 3/4-inch I.P.S. screwdriver back check angle stop.
e. Spud coupling and flange.
f. Free spinning vandal resistant stop cap.
g. Adjustable tail piece.
h. High back pressure vacuum breaker flush connection.
i. Sweat solder adapter with cover tube and cast set screw wall flange.
j. Split Ring Wall Support: Sloan Model J-312-A.
k. Provide 3-year limited Manufacturer's warranty.

4. Carrier: Zurn, Josam or Watts cast iron urinal carrier with fittings as required. ANSI/ASME A112.6.1A; cast iron and steel frame with tubular legs, legs for floor and wall attachment, threaded fixtures studs for fixture hanger, bearing studs.

2.3. WALL-MOUNTED LAVATORIES

A. LAV-1 Wall-Hung, Deck Mounted Manual Faucet

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

a. Kohler Model K-2032 Greenwich
b. American Standard Lucerne
c. Crane
d. Zurn

2. Fixture:

a.	Material:	Vitreous china
b.	Type:	Wall-Hung
c.	Rim Mounting Height:	Standard
d.	Nominal Size:	20-3/4”L x 18-1/4”W
e.	Faucet-Hole Punching:	Three Holes, 4-inch centers
f.	Faucet-Hole Location:	Top
g.	Color:	White
h.	Mounting Material:	Concealed Arm Carrier

3. Faucet:

a. Chicago Faucet 802-VE39VP317ABCP (0.35 GPM), Sloan, American Standard
b. Deck Mounted
c. Wrist Blade Handles
d. Low-Flow Outlet
e. Polished Chrome Finish
f. 4-inch Spout
g. Unit shall operate in either direction at less than 5 lbs. push at 80 psi water

NOT FOR BIDDING

pressure.

h. Certification to comply with ADA shall be furnished

4. Strainer:

a. Chicago Faucet Model 327A, American Standard
b. 1-1/4-inch tailpiece
c. Non-removable brass strainer
d. Grid strainer waste
e. Chrome plated finished.

5. P-Trap:

a. Cast Brass 1-1/4-inch "P" trap

6. Stops:

a. Chicago Faucet Model l005-ABCP valve stops.
b. 3/8-inch loose key cap
c. Removable tee handle
d. Wall flange
e. Chrome plated finished.

7. Thermostatic Mixing Valves:

a. Provide and install below fixture.
b. See Part 2 “Thermostatic Mixing Valves”.

8. Carrier:

a. Zurn, Josam, or Watts cast iron and steel carrier.
b. ANSI/ASME A112.6.1
c. Cast iron and steel frame with tubular legs.
d. Lugs for floor and wall attachment.
e. Concealed arm supports.
f. Bearing plate and studs.

B. LAV-1A Wall-Hung, Deck Mounted Manual Faucet, Handicapped

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

a. Kohler Model K-2032 Greenwich
b. American Standard Lucerne
c. Crane
d. Zurn

2. Fixture:

a.	Material:	Vitreous china
b.	Type:	Wall-Hung
c.	Rim Mounting Height:	A.D.A. Compliant
d.	Nominal Size:	20-3/4” L x 18-1/4”W
e.	Faucet-Hole Punching:	Three Holes, 4-inch centers
f.	Faucet-Hole Location:	Top

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g. Color: White
h. Mounting Material: Concealed Arm Carrier

3. Faucet:

a. Chicago Faucet 802-VE39VP317ABCP (0.35 GPM), Sloan, American Standard
b. Deck Mounted
c. Wrist Blade Handles
d. Low-Flow Outlet
e. Polished Chrome Finish
f. 4-inch Spout
g. Unit shall operate in either direction at less than 5 lbs. push at 80 psi water pressure.
h. Certification to comply with ADA shall be furnished

4. Strainer:

a. Chicago Faucet Model 327A, American Standard
b. 1-1/4-inch tailpiece
c. Non-removable brass strainer
d. Grid strainer waste
e. Chrome plated finished.

5. P-Trap:

a. Cast Brass 1-1/4-inch "P" trap

6. Stops:

a. Chicago Faucet Model l005-ABCP valve stops.
b. 3/8-inch loose key cap
c. Removable tee handle
d. Wall flange
e. Chrome plated finished.

7. Thermostatic Mixing Valves:

a. Provide and install below fixture.
b. See Part 2 “Thermostatic Mixing Valves”.

8. Carrier:

a. Zurn, Josam, or Watts cast iron and steel carrier.
b. ANSI/ASME A112.6.1
c. Cast iron and steel frame with tubular legs.
d. Lugs for floor and wall attachment.
e. Concealed arm supports.
f. Bearing plate and studs.

9. Lavatory Protective Enclosure:

a. Provide and install Truebro Model # 2018 lav shield lavatory enclosure on all lavatories with sensor operated faucets. Protective enclosure shall be ADA conforming, 20-inch x 18-inch wheelchair accessible. Unit shall have white finish, be constructed of high impact, stain resistant vinyl, and include seven (7)

NOT FOR BIDDING

wall anchors.

2.4. MULTI-STATION LAVATORIES

A. LAV-17B Three (3) Station, Deck Mounted Manual Faucet, Handicapped

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

a. Bradley Verge LVAD-3
b. Sloan ELS-43000

2. Station:

a. Triple hand washing station
b. Wall Mounted
c. Faucet:
i. Chicago Faucet Model 802-VE2805-665ABCP or approved equal.
ii. Push Button, manual metering valve.
iii. Low-Flow Outlet of 0.5 GPM
iv. Provide three (3) faucets.
d. Lavatory system shall include all waste and supply connections to wall, and thermostatic mixing valve with stop, strainer, and check valves.
e. Station shall come with 4" center set faucet drillings for each faucet.
f. Bowl material for each station shall be a cast polyester resin complying with ANSI Z124.3 and ANSI Z124.6. Bowl finish shall be decorative stone.
g. Lavatory system shall be secured to a rigid base concealing all supply and waste connections.
h. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
i. Certification to comply with ADA shall be furnished.

2.5. MOP SINKS – SERVICE SINKS

A. JS-1 Mop Sink, Corner Unit

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

a. Stern Williams Model Corlow-SBC

2. Fixture:

a. Material: Terrazzo
b. Type: Corner, Floor-mounted
c. Receptor composed of pearl grey marble chips and white Portland unit, ground smooth, grouted, and sealed to resist stains.
d. Stainless steel cap of one piece 20 gauge, 302 stainless steel cast integral on threshold.
e. Provide and install stainless steel BP splash Catcher panels on adjacent walls.

3. Faucet:

a. Chicago Faucet 897-RCF, Speakman, American Standard
b. Rough Chrome Finish

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c. Vacuum breaker spout
d. Stop in arms
e. 3/4-inch hose thread outlet.
f. Pail Hook
g. Wall Brace
h. Stern-Williams T-35 hose, bracket and mop hanger.

B. JS-7 Service Sink (Stainless Steel)

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

a. Elkay Model B1C Dependabilt
b. Kohler
c. Just

5. Fixture:

a.	Material:	Stainless Steel – 18-gauge
b.	Type:	Wall Mounted w/ stainless steel legs
c.	Nominal Basin Size:	24”x24”x12”
d.	Rim Guard:	Stainless Steel
e.	Wall Hanger Supports	

6. Faucet:

a. T&S Model B-0674-BSTR, Chicago Faucet 305-VBRCF
b. Rough Chrome Finish
c. Vacuum breaker spout
d. Adjustable Stop supply arms
e. 3/4-inch hose thread outlet.
f. Pail Hook
g. Vandal Proof Lever Handles

7. Strainer:

a. Jomar Model SS-306 Snap-N-Loc basket strainer with brass locknut and tailnut.
b. Deep cup body and basket shall be 300 series stainless steel

8. P-Trap:

a. Cast Brass 3-inch "P" trap

9. Thermostatic Mixing Valves:

a. Provide and install below fixture.
b. See Part 2 “Thermostatic Mixing Valves”

2.6. WATER COOLERS – FOUNTAINS

A. EWC-4 Electric Water Cooler, Dual Height, Surface Mounted, Handicapped, Bottle Filling Station

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

NOT FOR BIDDING

a. Elkay Model LZSTL8WS
b. Halsey Taylor
c. Haws
d. Oasis PG8EBFSL

2. Fixture:

a. Barrier Free
b. Dual Height with mounting frame
c. 8 GPH at 90°F ambient
d. 50°F outlet drinking water with 80°F inlet water
e. Top shall be stainless steel
f. Bubbler valve electronically controlled
g. Bubbler shall be vandal resistant
h. Activated by touch pads on sides and front for electronically timed period of flow.
i. Cabinet shall be powder coated on heavy gauge steel, color to be selected by Architect.
j. Supplied with plug-in, 3-wire grounding type service
k. Operation on 120 VAC, Single Phase, 60Hz
l. Lower Spout Outlet shall be mounted 36-inches maximum above floor.
m. Upper Spout Outlet shall be mounted 42-inches maximum above floor.
n. Water cooler and installation shall conform to all requirements of American Disabilities Act Guidelines and ANSI A117.1.

3. Bottle Filling Station:

a. Electronic Sensor for No-Touch activation
b. Automatic 20 second shut-off timer
c. 1.1 GPM flow rate with laminar flow
d. Water Sentry® Plus, 3,000 gallon capacity filter
e. Certified to NSF/ANSI 61, UL 399 and CAN/CSA 22.2 No. 120.
f. Provide spare set of replacement filter packs (3 filters per pack) and turn over to Owner.

4. Refrigerant shall be R-134a or equivalent environmentally friendly refrigerant.

5. Provide Carrier as manufactured by Elkay or approved equal.

6. Provide cane apron for water cooler (required where water coolers project more than 4 inches into the corridor).

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2.7. EMERGENCY FIXTURES

A. EM-1 Emergency Eyewash (Wall Mounted) (Handicapped)

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

a. Guardian GGBF1721-T
b. Bradley S19-220BF
c. Approved Equal

2. Fixture:

a. Unit and installation shall comply with ANSI Z358.1, ANSI A117.1 and ADA

latest edition.

b. 10-inch diameter stainless steel eyewash bowl.
c. Chrome plated brass spray head assembly.
d. Twin soft flow eye wash heads with dust covers.
e. Provide l/2-inch brass stay-open eyewash valve operated by plastic push handle.
f. Furnish each unit with tailpiece and trap for connection to sanitary system per the Plumbing Code
g. Wraparound skirt shall be corrosion resistant stainless steel.
h. Provide wall mount support brackets, 1-1/2-inch trap, stop valves.
i. Mount top of unit at 36-inches above finished floor.
j. Provide and mount universal identification sign.

3. Units shall be tested per ANSI Z358.1 prior to turning over to Owner. Contractor shall train Owner in proper usage per Manufacturer's Instructions and ANSI requirements.

4. Furnish each unit with all equipment necessary for field testing of emergency fixtures per ANSI Z358.1 requirements.

5. Refer to Part 2 “Products” of this section for Emergency Mixing Valve.

6. Furnish with flow switch including local audible/visual alarm and interlock to the building management system.

7. Furnish and install solid state signaling system flow switch for combination emergency eyewash/shower emergency fixtures; 85dB horn, green/amber LED beacon, and double pole, double throw brass flow switch, 1-1/4 inch NPT, 24VDC; remote building management system compatible; recessed NEMA 1 General Purpose interior use enclosure for electrical components.

B. EM-4 Combination Emergency Eyewash / Shower (Handicapped)

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

a. Guardian GBF1909
b. Bradley S19314TT
c. Approved Equal

2. Fixture:

a. Unit and installation shall comply with ANSI Z358.1, ANSI A117.1 latest edition and ADA requirements.
b. Shower Head: 10” diameter ABS plastic with 20 GPM flow control.
c. Shower Valve: 1” IPS chrome plated brass stay-open ball valve. Furnish with stainless steel actuating arm and 47” stainless steel pull rod.
d. Eye/Face Wash Bowl: 11” diameter stainless steel.
e. Spray head assembly: Chrome plated brass eyewash spray head assembly.
f. Twin soft flow eye wash heads with dust covers, internal flow control and filter to remove impurities from water flow.
g. Eye/Face Wash Valve: Provide l/2-inch brass stay-open eyewash valve operated by plastic push handle.
h. Unit to be floor mounted. Provide floor mount flange.
i. Supply: 1-1/4” NPT female top or side inlet.
j. Waste: 1-1/4” NPT female outlet. Outlet can be positioned at either 9” of 19” above finished floor.

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k. Provide and install wrap around modesty curtain with each unit.
l. Provide and mount universal identification sign.

3. Units shall be tested per ANSI Z358.1 prior to turning over to Owner. Contractor shall train Owner in proper usage per Manufacturer's Instructions and ANSI requirements.

4. Furnish each unit with all equipment necessary for field testing of emergency fixtures per ANSI Z358.1 requirements.

5. Refer to Part 2 “Products” of this section for Emergency Mixing Valve.

6. Furnish with flow switch including local audible/visual alarm and interlock to the building management system.

2.8. CLOTHES WASHERS

A. LY-3 Commercial Washing Machine

1. The commercial washing machine shall be specified under another Division of the Specifications. Provide rough-in and final connection under this Division. Provide indirect waste, flexible hoses, drain trough, gas piping, shock absorbers, etc., as detailed on the Contract Drawings.

2. Inlet Hoses:

a. Two, 1-inch diameter, 60 inch long, ASTM D 3571 clothes washer inlet hoses with female hose-thread couplings.

3. Furnish and install damper interlock with combustion air damper per sequence of operation.

2.9. OUTLET BOXES – WATER SUPPLY

A. OB-1 Refrigerator

1. Refrigerator provided in another Division of Specifications. Provide rough-in, Outlet box and final connections under this Division.

2. Sioux Chief: Model No. 696-RG1010MF with top supply and shut-off valve with water hammer arrester. Provide flexible hose (1/2-inch) between Refrigerator and outlet box. Provide vacuum breaker on threaded outlets to prevent back siphonage. Unit shall be 16-gauge steel with white epoxy finish.

3. Provide sufficient copper tubing to allow movement of refrigerator for cleaning.

B. OB-3 Ice Maker

1. Ice Maker provided in another Division of Specifications. Provide rough-in, Outlet box and final connections under this Division, including indirect waste outlet to floor sink.

2. Sioux Chief: Model No. 696-RG1010MF with top supply and shut-off valve with water hammer arrester. Provide flexible hose (1/2-inch) between Ice Maker and outlet box. Provide vacuum breaker on threaded outlets to prevent back siphonage. Unit shall be 16-gauge steel with white epoxy finish.

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3. Provide sufficient copper tubing to allow movement of refrigerator for cleaning

4. Ice Maker Cold Water Inlet Filter

a. Contractor shall provide and install a cartridge type water filter on the cold water inlet to the owner furnished ice maker as detailed on the contract drawings. Housing shall be constructed of PVC with 3/4-inch NPT connections. Heads shall be cast bronze nickel plated with nickel plated "T" handle cap nut. Unit shall have pet cock bottom drain. Housing shall contain two (2) 20 micron cartridge filters. The entire filter assembly shall be rated for 150 psig. Unit shall be capable of handling a minimum 6 gpm. Housing shall be as manufactured by Keystone or approved equal.

b. Install filter housing to allow access for service and filter replacement.

2.10. HOSE BIBBS - HYDRANTS

A. HB-1 Hose Bibb

1. Chicago Faucet No. 952 or approved equal hose and faucet. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose threaded spout, polished chrome plated where exposed in finished areas, with hand wheel and removable key, integral vacuum breaker in conformance with ANSI/ASSE 1011.

2. Hose bibbs in finished areas shall be polished chrome finish.

3. Approved Manufacturers: Chicago Faucet, American Standard, Crane, T&S Brass, or Watts.

B. HYD-1 Wall Hydrant (Exterior)

1. Provide and install recessed anti-siphon wall hydrant, 3/4-inch non-freeze, key operated wall hydrant with hinged locking cover, polished bronze box and cover and bronze casing and integral vacuum breaker. Non-Freeze, exterior wall hydrants shall be Zurn Model Z-1320-XL, Josam, Wade, J.R. Smith, Mifab, Watts or approved equal.

2. Seat and disc shall be removable from front of the hydrant. Wall thickness; see architectural drawings. Wall hydrants shall conform to ANSI/ASSE 1019 with wall plate, lock shield and removable key.

C. HYD-2 Wall Hydrant (Interior)

1. Provide and install recessed wall hydrants where indicated on the contract drawings. Recessed wall hydrants shall be Zurn Model Z-1330, Josam, Ancon, Mifab, Watts or approved equal.

2. Units shall be encased Ecolotrol “anti-siphon" wall hydrant for interior wall installation. Unit shall be suitable for hot or cold water as indicated on Contract Drawings.

3. Each unit shall be complete with integral backflow preventer, all bronze interior parts, non-turning operating coupling with hemispherical neoprene plunger and 3/4-inch solder inlet.

4. Furnish each unit mounted in a stainless steel box and hinged cover with operating key lock and "water" stamped on cover.

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5. Furnish each unit with the following accessories:

   a. 3/4 inch – 90 degrees inlet elbow with union nut
   b. Cylinder lock
   c. Key operator

2.19. FLOOR DRAINS

A. General Requirements

1. Provide Nikaloy strainers on all floor drains unless specified otherwise.

2. Provide flashing clamps on all drains penetrating waterproofing membrane.

3. Provide suitable flashing material and clamping collar for drains which are not set in place when slab is poured.

4. Provide backwater valves for all floor drains connecting directly to the storm water system. Depending on conditions of the particular installation, backwater valves may be an integral part of the drains or a separate device. Accessibility to valves must be maintained for maintenance. Provide an adequately sized extension sleeve up to floor or grade as required.

5. Backwater valves are normally closed, flapper type with bronze or brass seat and disc and stainless steel pin.

6. Provide traps for all floor drains connected to the sanitary system.

7. Provide E & S, Sioux Chief, or PPP primer valve (one valve per trap, per floor drain) on all remote floor drains. When installed on fixture in finished area, primer valve shall be concealed behind a Josam 58650, Watts, or Zurn access door. In Mechanical Rooms, mezzanines, penthouses, and all other locations indicated on the contract drawing, priming lines shall be connected to automatic trap primer.

8. In lieu of joints specified in piping section, neoprene gaskets may be used if designed for use with the drains and cleanouts employed and if approved by the local plumbing authority.

9. Where applicable, for floor drains utilized for washing machines, provide a stainless steel lint screen/strainer.

10. When floor drains collect condensate from a neutralizer kit, the floor drains shall be provided with epoxy coating.

11. Approved Manufacturers: Josam, J.R. Smith, Zurn, Wade, Ancon, Mifab, Watts.

B. FD-1 Floor Drain – Round – Nickel Bronze Strainer

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

   a. Zurn ZN-415B
   b. Watts FD-100-A

2. Floor and shower drain, dura coated cast iron body with bottom outlet, combination

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invertible membrane clamp and adjustable collar with seepage slots and Type "B" polished nickel bronze strainer. Provide with ½ -inch trap primer connection.

2.20. FLOOR SINKS

D. FS-2 Floor Sink (12”x12”x6”)

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

a. Zurn Z-1900
b. Watts FS-730

2. Sani-Flor receptor, 12-inch x12-inch x 6-inch deep cast iron body and square, slotted grate with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.

a. Two (2) removable ½ grates with each unit.
b. ½ -inch trap primer connection.
c. Stainless steel mesh bucket screen.

2.21. TRENCH DRAINS

A. TD-2 Trench Drains

1. Zurn-882 12"-inch wide pre-sloped trench drainage system. Glass-filled polyester fiberglass drain channel with 1/8 -inch per foot bottom slope. All sections modular 8-foot length with interlocking ends. Complete with heavy duty, dura-coated steel frame at surface, combination anchor tabs/leveling devices at appropriate locations, and heavy duty galvanized steel grate suitable for automotive traffic. Install trench drain and all accessories per local codes and Zurn Industries, Inc. Instructions. A minimum of 4-inches of concrete must surround each trench segment.

1. Catch Basins (Trench Drain Systems): Provide Zurn Z-817 catch basins in the quantity as indicated on the contract drawings. Catch basins shall be 12-inches x 24 -inches with external trench adapter supplied to make transition between the trench and basin. Catch basins shall be polyester glass-filled fiberglass reinforced body, complete with heavy duty, dura-coated steel frame and heavy duty galvanized steel grate suitable for automatic traffic. Provide sediment bucket with each catch basin and 2-inch trap primer connection in trap.

2.22. THERMOSTATIC MIXING VALVES (INDIVIDUAL FIXTURE TYPE)

A. Furnish and install thermostatic mixing valves where indicated at public lavatories, and below all lavatories and hand sinks and kitchen hand sinks that are provided with hot water temperatures above 109 degrees F.

B. Thermostatic mixing valves shall be Bradley S59-4000A, Watts, Moen, Leonard Ecobix, Acorn, or approved equal for installation under lavatories. Provide in-line check valves, lead free body, escutcheon plates, inlet filters, and insulation as required. Thermostatic mixing valves shall be adjusted to deliver 105 degrees Fahrenheit hot water when supplied with 140 degrees Fahrenheit delivering hot water. Furnish with adjusting cap with locking feature.

C. The thermostatic mixing valves shall be listed for use at the scheduled flow rate of the equipment

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served.

D. The thermostatic mixing valves shall be ASSE standard 1070 listed.

2.23. PLUMBING FIXTURE SUPPORTS

A. Wall mounted urinal supports, Josam 17810 plate type with cast iron headers, box steel stanchions, block type cast iron feet with bearing plate.

B. Support for wall mounted urinals, lavatories, sinks, drinking fountains, etc.:

C. Where fixtures are supported from concrete or cinder block walls, install No.10 USSG Steel plate on the opposite side of the wall and bolt hangers or supports through plate. Where opposite side of wall is exposed to view, place bolts in core of blocks and fill core with cement.

D. Where lavatories with wall hangers have been specified and fixtures are supported from metal stud frame partitions, fixture brackets or mounting lugs shall be through bolted to steel channel crosspieces not less than 1-1/2-inch wide anchored to studs. Bolt heads shall be welded to channel web.

E. Concealed arm type lavatory supports, Josam 17100 with cast iron headers, box steel stanchions, block type cast iron feet and header; and chrome plated cast brass threaded escutcheons for slab type lavatories.

F. Flush mounted drinking water cooler supports, Josam 17550 plate type, box steel stanchions, block type cast iron feet.

G. Water closet chair carriers, Josam 12000 Series for horizontal and vertical installations.

2.24. HANDICAPPED LAVATORY/SINK INSULATION

A. All handicapped lavatories and sinks shall be provided with under counter pipe and trim insulation.

B. Insulation shall be fully molded "P" trap and angle valve insulated Hand-I-Lav Guard, Truebro, Pro-Extreme Model #101, 102, and 105 to suit.

C. Insulation to meet ADA #4 19.4, ANSI A117.1, ASTM C1822, Type III and International Plumbing Code.

D. Self-extinguishing ASTM D635 burn characteristics, thermal conductivity ASTM C177 K-Value ' 1.17.

E. Insulation thickness to be minimum 2 inch.

F. Where lav. Guards are provided insulation may be omitted.

2.25. EMERGENCY COMBINATION EYEWASH/SHOWER MIXING VALVES

A. Furnish and install factory fabricated, hot-and-cold-water-tempering equipment with dual manifold thermostatic mixing valves. Units shall be manufactured by Guardian Equipment, Power’s, Speakman, Leonard, or approved equal.

B. Thermostatic Mixing Valves: Designed to provide 85 degree F (29 degree C) tepid, potable water

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at emergency combination eyewash/shower stations to maintain temperature at plus or minus 5 degrees Fahrenheit (3 degrees C) throughout required 15 minute test period, and in case of unit failure to continue cold-water flow with union connections, controls, integral strainer, metal piping, adjustable high temperature limit, outlet and inlet thermometers, check stops, and where indicated a corrosion resistant enclosure.

C. Capacity Range: As scheduled on Contract Drawings.

D. Furnish each unit with painted, heavy duty mounting bracket from serving valve to panel on wall. Cabinet shall be fully recessed, stainless steel, and lockable.

E. Units shall be provided such that inlets can be rotated 360 degrees for top or bottom supply.

F. Where installed exposed in finish spaces units shall be chrome plated finish.

G. Comply with ANSI Z 358-1 2009 and shall comply with the lead free laws per the requirements of the state in which the project is being constructed.

H. Emergency fixture mixing valves shall be ASSE 1071 compliant.

2.26. FIXTURE STOPS/SUPPLIES

A. For all lavatories/sinks stops and supplies shall be Chicago Faucets No. 1017-CR43829, Angle Stop Fitting with Supply Tube and Loose Key. Chrome plated solid brass construction. 2-1/4" Metal tee handles with tapered square. Slow compression check cartridge that shall open and close 360º for fine adjustment, valves shall close with water pressure, furnish with square tapered stem. ½" NPT female thread inlet 3/8" O.D. female compression outlet. Slip wall flange. 3/8" O.D. x 12" bullnose flexible supply riser. ECAST construction with less than 0.25% lead content by weighted average. This product shall be tested and certified to industry standards: ASME A112.18.1/CSA B125.1, Certified to NSF/ANSI 61, Section 9 by CSA, California Health and Safety Code 116875 (AB1953-2006), Vermont Bill S. 152, and NSF/ANSI 372 Low Lead Content.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install all equipment in accordance with manufacturer's instructions.

B. Setting heights of lavatories, drinking fountains, etc., shall be as directed prior to installation and shall be coordinated with Architectural Contract Documents.

C. Install floor mounted fixtures only after finished floor has been installed.

D. Provide rubber concussion washers between vitreous china fixtures and supporting brackets.

E. Protect chromium plated trim from corrosive solutions used to clean tile work.

F. Provide white, silicone caulking where fixtures come in contact with walls and floors. Sealant shall be mildew resistant type in accordance with ANSI A-136.1.

G. Install components plumb and level.

H. Unless otherwise noted, drains are to be installed at the low point of floors. Protect drains during

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remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

I. Install floor drains in low points so the top of grates are at or below the finished floor level.

J. Drains not functioning properly shall be removed and re-installed properly at the expense of the contractor.

K. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

L. Install and secure fixtures in place with wall supports, wall carriers and bolts.

M. Solidly attach water closets to floor with lug screws. Lead flashing is not intended to hold fixture in place.

N. Install flush valve handles on the open side of all ADA waterclosets in accordance with ANSI requirements.

O. Fixtures shall be vitreous china unless otherwise noted. Cast iron fixtures shall have acid resisting enamel finish unless noted otherwise, color shall be white.

P. Flush valves shall be self-closing, non-hold open type with vacuum breaker and perform satisfactorily when subject to inlet water pressure varying from 15 to 75 psi. Flush valves shall be as specified, Sloan, Delaney, Zurn, Toto, or approved equal.

Q. Provide flexible risers and loose key stops for all lavatories and sinks. Provide 17 ga. chrome plated brass tail piece and trap with cleanout for all lavatories and sinks.

R. Fittings for fixtures supplied by others, such as science sinks and kitchen equipment are provided under another division of these specifications. Connections of these fixtures to the plumbing system are provided under this section.

S. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve a complete operating system.

T. Field test all emergency eyewash units and combination eyewash/shower units per ANSI Z358.1 latest edition.

U. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

V. All plumbing vents within a 10'-0" radius of any rooftop unit or intake louver shall be extended to a height of 3'-0" above fresh air intake.

W. Slopes and invert elevations of all interior piping shall be established before any piping is installed in order that proper slopes will be maintained. All piping shall be located and determined where to be run to avoid conflict with other trades.

X. Unless otherwise noted, all plumbing piping shall be routed as high as possible between bottom of roof joists and above ceiling to allow proper installation of ductwork, fire protection piping, conduits, etc.

Y. Coordinate with Architectural Drawings before roughing in plumbing.

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Z. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

AA. See site plan for extent of all piping leaving and entering building.

BB. See domestic water riser diagrams for location of valves, shock absorbers, etc.

CC. Make proper hot water, cold water, hot water recirculating, waste, and vent connections to all fixtures and equipment even though all branch main, elbows and connections are not shown.

DD. Unless otherwise noted, sanitary waste piping shown is below floor and all other piping is overhead, above ceiling. Domestic hot, cold and recirculating water piping shall be installed between ceiling and attic insulation.

EE. Unless otherwise noted, horizontal sanitary piping shall be pitched 1 percent.

FF. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

GG. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.

HH. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.

II. For sizes of all sanitary and vent piping see plumbing fixture schedule and sanitary/vent riser diagrams.

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3.2 PLUMBING SPECIALTY INSTALLATION REQUIREMENTS

A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.

B. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.

C. Secure supplies to supports or substrate.

D. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve as appropriate is not indicated.

E. Install water-supply stop valves in accessible locations.

F. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

G. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.

3.3 FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

A. Fixtures such as built-in-sink in counters and kitchen equipment may be provided under other divisions of the specifications and are complete with strainer and tailpiece. Fittings, accessories and connection of these fixtures to the plumbing system are provided under this section.

B. Rough-in and final connection includes but is not limited to all domestic water, waste, vent, gas and

compressed air systems. Furnish stops, strainers, vacuum breakers, and under counter insulation where not furnished under another Division of these specifications.

3.4 TESTING

A. After plumbing fixtures are connected, all piping and fixtures shall be tested for operation and a smoke or peppermint test shall be made on all soil, waste and vent piping.

B. After the building has been occupied and the various equipment is in actual use, the Contractor shall make an operating test of all equipment at a time directed by the Engineer to determine that all contract requirements are met.

3.5 CLEANING AND STERILIZATION

A. After final testing for leaks, all potable water lines shall be thoroughly flushed, by plumbing contractor, to remove foreign material. Before placing the systems in service, sterilize the new water lines in accordance with local health department codes and at a minimum according to the following procedure:

B. Through a 3/4-inch hose connection in each branch main and building main, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine into system.

C. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.

D. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 ppm chlorine, retain this water in the system for at least three (3) hours.

E. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system. It is not necessary to retain chlorine in any system for twenty-four hours to achieve sterilization. AWWA states that 200 ppm chlorine for three hours is sufficient.

F. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.

G. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 ppm.

H. Obtain representative water sample from the system for analysis by an independent and recognized bacteriological laboratory.

I. If the sample tested for coliform organisms is negative, a letter and laboratory report shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization. Additionally, this report shall be forwarded to the Owner as well as be included in the O&M Manual.

J. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.

K. Take precautions to avoid use of plumbing fixtures and domestic water systems during sterilization period. Place signs on all plumbing fixtures and outlets during sterilization period.

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3.6 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.7 PREPARATION

A. Review the Kitchen Equipment Consultant's equipment cut sheets. Confirm rough-in location and size of fixtures and openings prior to commencing work.

B. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.8 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.9 ADJUSTING

A. Adjust stops, valves, infrared fixtures for intended water flow rate to fixtures without splashing, noise, or overflow.

3.10 CLEANING

A. At completion, clean plumbing fixtures and equipment. Polish all chrome plated faucets, accessories, equipment, and piping.

B. All electric water cooler coils shall be cleaned of all construction dust and debris prior to building occupation by Owner.

3.11 FIXTURE HEIGHTS

A. Install fixtures to heights above finished floor as required by local Plumbing Code, Americans with Disabilities Act (A.D.A.), Authority Having Jurisdiction, and Architectural Contract Drawings. In the absence of a local code requirements, install fixtures to heights above finished floor as follows.

B. Water Closet

1. Standard 15 inches to top of bowl rim.

2. Handicapped 18 inches to top of seat.

C. Lavatory

1. Standard 31 inches to top of basin rim.

2. Handicapped 34 inches to top of basin rim.

D. Drinking Fountain

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1. Standard 36 inches to top of basin rim.

2. Handicapped 34 inches to top of basin rim.

E. Water Closet Flush Valves

1. Standard 11 inches min above bowl rim.

2. Recessed 10 inches min. above bowl rim.

F. Combination Emergency Shower/Eye Wash

1. Handicapped 84 inches to bottom of shower head and 38 inches to eye wash receptor rim.

END OF SECTION

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SECTION 224005 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1. GENERAL

A. For General Mechanical Requirements, see Division 22 Section, Common Work Results for Plumbing & Division 01, General Requirements.

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

C. All exposed bolts, screws, etc., shall be vandal proof.

D. All plumbing materials and equipment shall be new and of best grade, free of defects and complete with all required appurtenances and accessories.

E. Piping and insulation are specified under other sections.

F. Provide all materials, equipment and perform all labor required to install plumbing system complete as specified, as drawings indicated and as required by the State of Delaware, Town of Georgetown Code, the local code, and all other authorities have jurisdiction.

G. Provide stops for all plumbing equipment. Stops are to be accessible.

H. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

I. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
5. National Electrical Manufacturers' Association (NEMA).
6. Underwriters Laboratories (UL).

J. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.2. REFERENCES

A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

B. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

C. ANSI/ASE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

D. ANSI A112.21.1 - Floor Drains.

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E. ANSI A112.26.1 - Water Hammer Arrestors.

F. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

G. PDI WH-201 Water Hammer Arresters.

H. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

I. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

J. ANSI/NFPA 54 - National Fuel Gas Code.

K. ANSI/NFPA 70 - National Electrical Code.

L. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum).

M. IBC - International Building Code

1.3. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of General Requirements.

B. Accept equipment on site in factory packaging. Inspect for damage.

C. Protect installed equipment from damage by securing areas and by leaving factory packaging in place to protect equipment and prevent use.

1.4. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings and per the manufacturer.

1.5. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.6. EXTRA MATERIALS

A. Provide one set of pump seals for each type of model of pump provided on this project.

B. For all condensing water heaters, provide spare set of lime chips for all condensate neutralizers.

PART 2 PRODUCTS

2.1. CLEANOUTS

A. Provide cleanouts in sanitary and storm drainage systems at ends of runs, at changes in direction, near the base of stacks, every 50 feet in horizontal runs, of 4-inch diameter or less, every 100 feet in horizontal runs over 4-inches, and where indicated.

B. Cleanouts shall be full size of pipe up to 4-inches and shall be 4-inches for larger sizes. Where

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installed in finished floors inserts shall match adjacent floor construction.

C. Materials and Approved Manufacturers: Josam, J.R. Smith, Zurn, Wade or Ancon, Mifab, Watts, equal to Josam numbers given below:

1.	Concealed Piping		C.I. Pipe
2.	Unfinished Areas		
3.	Floors		57000-Z-CI
4.	Walls		58600-PLG
5.	Finished Areas Floors		
6.	Terrazzo	56040-13	
7.	Composition Tile		57000-X-12
8.	Ceramic Tile		57000-X
9.	Carpet		56070-14
10.	Carpet insert to match adjacent carpet in type, color and grade.		
11.	Finished Areas Walls		
12.	Plaster/Dry Wall		58640-COT
13.	Tile/CMU		58600-COT

2.2. SHOCK ABSORBERS

A. Provide shock absorbers equal to Josam Shokstops at all fast closing valves, at the top of all cold water risers, at each flush valve or battery of flush valves, and where indicated. Sizes and locations shall be in accordance with PDI Standard WH-201.

B. Shock absorbers shall conform to ANSI A112.26.1, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psig working pressure.

C. Approved Manufacturers: Josam, Wade, Zurn, J.R. Smith, Sioux Chief, Watts, or approved equal.

2.3. VACUUM BREAKERS

A. Provide vacuum breakers on water connections to fixtures and equipment where minimum air gaps required by Plumbing Code are not possible and on hose bibbs and other outlets to which hoses can be attached.

B. Vacuum breakers not subject to back pressure, Watts No. 288A; vacuum breakers subject to back pressure, Watts Series 9D or for hose threads, Watts Series 8A.

C. Provide atmosphere vacuum breakers at all water connections to garbage disposers, hose spray units as required by Plumbing Code.

D. Hose connection backflow preventers shall be ASSE 1052, suitable for at least 5 gpm flow and applications with up to 10 foot head back pressure. Include two (2) check valves, intermediate atmospheric vent, and non-removable, ASME B1.20.7 garden-hose thread on outlet.

E. Hose connection vacuum breakers shall be ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze finish hose connections may be rough bronze.

F. Approved manufacturers: Watts, Beeco, B&K Industries, Zurn, Sparco, Conbraco or approved equal.

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2.4. VACUUM RELIEF VALVES

A. Provide vacuum relief valves on cold water supply to water heaters, where indicated on the contract drawings, or where required by the authority having jurisdiction.

B. Vacuum relief valves shall be Watts Regulator Co. Series 36A, Josam, or approved equal.

C. Furnish and install ball valve for servicing the same.

2.5. DOMESTIC WATER RECIRCULATING PUMPS

A. Provide and install domestic water re-circulating pumps of the size, capacity and electrical characteristics as indicated on the contract drawings. Pumps shall be in-line circulators Model 113B as manufactured by TACO, Bell and Gossett, Thrush, Armstrong, Patterson, or approved equal.

B. Pumps shall be non-overloading throughout the range of the curves. Pumps shall have center line discharge for positive venting, flanged bodies, and same size suction and discharge.

C. Motors shall be resilient mounted, split phase motor with built-in overload protector and equipped with sleeve bearings for quite operation. Impeller shall be one piece dynamically balanced with stainless steel shaft, bronze sleeve bearing, two piece carbon/ceramic seal assembly and one piece spring coupling.

D. All circulators utilized for domestic water service shall be stainless steel or all bronze construction.

2.6. BACKWATER VALVES

A. Backwater valves shall be provided at all connections of floor drains or area drains to stormwater piping systems and where indicated on contract drawings.

B. Backwater valves shall be ANSI A112.21.2, coated cast iron body and cover, brass valve, access cover, extension sleeve and cover.

C. Backwater valves shall be equal to Josam 67360-15.

D. Extend access cover to finished floor and terminate in cleanout.

E. Approved Manufacturers: Josam, Zurn, Wade, Smith, Ancon or approved equal.

2.7. GAS FIRED DOMESTIC WATER HEATERS

A. Water Heater(s) shall be model BTH as manufactured by A. O. Smith, Lochinvar, State, Bradford White, Bock, PVI, or approved equal. Water heater(s) shall be of the seamless glass lined steel tank construction in which the glass coating is applied to the water side surfaces of the tank after the tank has been assembled and welded. The condensing flue coil shall be coated on the flue gas side with A. O. Smith's proprietary or equal acid resistant glass lining designed for use in condensing heaters.

B. The heater shall be suitable for sealed combustion direct venting using PVC air intake pipe and PVC exhaust pipe for a total distance of (50') equivalent feet of vent and 50' equivalent feet of intake. The heater shall be factory assembled and tested. The power burner shall be of a design that requires no special calibrations or start up. The heater(s) shall be approved for 0-inch clearances to combustibles.

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C. The control shall be an integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of temperature settings.

D. The tanks shall be foam insulated and equipped with a ASME rated temperature pressure relief valve. The water heater shall be UL listed and exceed the minimum efficiency requirements of ASHRAE/IES 90.1b-1992.

E. The heater shall be listed by SCAQMD Rule 1146.2 Low NOx. Water Heater shall comply with Delaware Pressure Vessel Code and ASME CSD-1.

F. Provide unit with brass drain valve and install on 4-inch high housekeeping pad as detailed on the contract drawings.

G. The water heater shall be tested at start-up by a qualified representative of the manufacturer. Provide a check list outlining start-up procedures to Engineer for review. A start-up report as provided by the manufacturer shall be completed and submitted before final acceptance of the domestic hot water heater system. Include copy of start-up report in O&M Manuals.

H. Conduct flue gas analysis on unit as required by water heater manufacturer.

I. Where multiple units are indicated furnish manifold kits to balance water flow through each heater.

J. Furnish units with electronic temperature control with LED readout.

K. Accessories: Air proving switch, housekeeping pad, low water cut-off, condensate neutralization kit, temperature and pressure relief valve. The temperature and pressure relief valve must be visible and accessible not hidden behind jacket.

L. Warranty: Total unit warranty of five (5) years.

M. A properly sized gas pressure regulator to be provided by the manufacturer and installed by the contractor.

2.8. BACKFLOW PREVENTER (REDUCED PRESSURE PRINCIPAL TYPE)

A. Furnish and install reduced pressure principal backflow preventers at all cold water make-up connections to HVAC water systems and where indicated on contract drawings.

B. Backflow preventers shall be of bronze body construction, inlet and discharge OS&Y gate valves, stainless steel check and relief valve seats, stainless steel relief valve shafts and flange bolts. Ball valve test cocks shall be bronze body.

C. Pressure ratings shall be up to 175 psi and temperature ratings shall be up to 210 degrees F continuous.

D. Install unit per local code requirements and authorities having jurisdiction. Unless otherwise noted, install backflow preventers between 12 inches and 60 inches above finished floor.

E. Units shall be approved by ASSE 1013, UPC, UL, and shall be No. 909 with air gap fitting and inlet/outlet gate valves as manufactured by Watts Regulator, Conbraco, Wilkens, or as approved equal. Pipe discharge to nearest floor drain/floor sink. Provide minimum 18-inch clearance for servicing and testing.

F. Pipe discharge of backflow preventer full size to closest floor drain utilizing type "L" copper.

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2.9. BACKFLOW PREVENTER (DOUBLE CHECK VALVE ASSEMBLY TYPE)

A. Furnish and install double check valve assembly backflow preventers at all cold water make-up connections to kitchen waste coolers, dishwashers, and where else indicated on contract documents.

B. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module sets and seat discs shall be replaceable.

C. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall include two resilient seated isolation valves and four top mounted, resilient seated test cocks.

1. Furnish each backflow preventer with the following accessories and options:

a. bronze strainer
b. quarter turn, full port, resilient seated ball valve shut-off
c. union connections

D. Provide minimum 18-inch clearance for servicing and testing.

E. The assembly shall meet the requirement of ASSE Std 1015 and AMCA Std C510.

F. Double check valve backflow preventers shall be Watts No. 007, Conbraco, Wilkens, Ancon, or approved equal.

G. Furnish test kit for field testing units. Watts Model TK-9A Analog Differential Gauge or approved equal.

2.10. BACKFLOW PREVENTER (DOUBLE CHECK VALVE ASSEMBLY TYPE) (VERTICAL TYPE)

A. Furnish and install vertical double check valve assembly backflow preventers at incoming water services and where else indicated on contract documents. Backflow preventers shall be suitable and listed for vertical installation.

B. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module sets and seat discs shall be replaceable.

C. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall include two resilient seated isolation valves and four top mounted, resilient seated test cocks.

D. Furnish each backflow preventer with the following accessories and options:

1. OS & Y Gate Valves.
2. Ball Valve Test Cocks.
3. Approval for vertical up flow installation.

E. Provide minimum 18-inch clearance for servicing and testing.

F. The assembly shall meet the requirement of ASSE Std 1012 and AMCA Std C510.

G. Double check valve backflow preventers shall be Watts No. 757, Conbraco, Wilkens, Ancon, or approved equal.

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2.11. TRAP SEAL PRIMER VALVES (DIRECT CONNECT TO DOMESTIC WATER)

A. Supply type, Trap-Seal primer Valves

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

a. MIFAB, Inc.
b. PPP, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS ½ (DN15) threaded union, or solder joint.
6. Gravity Drain Outlet connection: NPS ½ (dn 15) threated or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
8. Distribution Unit: Outlet quantities required.
9. Backflow Preventer: Atmospheric vented drain chamber.

2.12. TRAP PRIMING STATION-AUTOMATIC TRAP PRIMER

A. Trap priming stations shall be Precision Plumbing Products, Inc., Electronic Trap Priming manifold Model PT, MIFAB, Sioux Chief, Watts, or approved equal. The manifold shall supply a minimum of 2 ounces of potable water per opening at 20 PSIG once in each 24 hour period. The Electronic Trap Priming Manifold must be capable of equally priming from 4 through 30 individual floor drain traps. Utilize where four (4) or more floor drains require priming pipes.

B. The unit shall be factory assembled and prepiped, and shall include a bronze body 3/4-inch female NPT WOG rated ball valve 3/4-inch, Water Hammer Arrestor, copper barrel with brass piston and type "L" copper sweat connection, electronic brass body 3/4-inch solenoid valve, and type "L" copper manifold with brass 2-inch compression fitting and orifice opening for precision water distribution to each floor drain trap. Unit shall be pre-piped with atmospheric vacuum breaker.

C. Electronic components shall include single point power connection at 120 volt 1 phase 60 hertz, manual over-ride switch, minimum 5 amp breaker, 24 hour geared timer with relay and 5 second dwell function. Separate water hammer arrestor can be provided outside station if integral arrestor is not available.

D. All components shall be factory assembled, tested and supplied in a 16 gauge steel NEMA 1 enclosure suitable for surface or recess mounting, as indicated on contract drawings. In addition, all components must comply with nationally recognized standards. The Precision Plumbing Products Electronic Trap Priming Manifold shall be fully warranted for the life of the plumbing system.

E. When only a single trap primer is required, as in the case of a restroom with one floor drain in a toilet (or similar) the contractor may submit, in lieu of an electronic multiple station, a single station for review by the Engineer. The fixture serving the trap primer must be within 10' of the trap. Components shall be brass, bronze, and chrome, of the highest quality.

F. Access door shall be finished with a prime coat and fire rated where installed in a rated wall. Access door latch shall be Allen key type.

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2.13. TRAP PRIMING STATION MINI-AUTOMATIC TRAP PRIMER

A. The mini trap priming stations shall be Precision Plumbing Products, Inc., Electronic Trap Priming manifold Model MPB, MIFAB, Sioux Chief, Watts, or approved equal. The manifold shall supply a minimum of 8 ounces of potable water per opening at 60 PSIG once in each 24 hour period. The Mini Trap Priming Manifold must be capable of equally priming from 1 to 4 individual floor drain traps. Utilize where three (3) or less floor drains require priming pipes.

B. The unit shall be factory assembled and prepiped, and shall include a bronze body 3/4-inch female NPT WOG rated ball valve 3/4-inch, Water Hammer Arrestor, copper barrel with brass piston and type "L" copper sweat connection, electronic brass body 3/4-inch solenoid valve, and type "L" copper manifold with brass 2-inch compression fitting and orifice opening for precision water distribution to each floor drain trap. Unit shall be pre-piped with atmospheric vacuum breaker.

C. Electronic components shall include single point power connection at 120 volt 1 phase 60 hertz, manual over-ride switch, minimum 2 amp breaker, 24 hour geared timer with relay and 12 second dwell function. Separate water hammer arrestor and can be provided outside station if integral arrestor is not available.

D. All components shall be factory assembled, tested and supplied in a 16 gauge steel NEMA 1 enclosure suitable for surface or recess mounting, as indicated on contract drawings. In addition, all components must comply with nationally recognized standards. The Precision Plumbing Products Electronic Mini Trap Priming Manifold shall be fully warranted for the life of the plumbing system.

E. When only a single trap primer is required, as in the case of a restroom with one floor drain in a toilet (or similar) the contractor may submit, in lieu of an electronic multiple station, a single station for review by the Engineer. The fixture serving the trap primer must be within 10' of the trap. Components shall be brass, bronze, and chrome, of the highest quality.

F. Access door shall be finished with a prime coat and fire rated where installed in a rated wall. Access door latch shall be Allen key type. Furnish with distribution units as required.

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2.14. DOMESTIC WATER EXPANSION TANKS

A. Provide and install domestic water expansion tanks of size, capacity and as indicated on contract drawings. Domestic water expansion tanks shall be Therm-X-TROL as manufactured by AMTROL Inc., Flexcon, Wessels, Taco, Armstrong, or approved equal. Mount tank as detailed on the drawings.

B. Domestic water expansion tanks shall be specifically designed for use in potable water systems. Tanks shall be pre-charged to require pressure at the factory. The maximum working pressure shall be 150 psig. The maximum operating temperature shall be 200 degrees F. Expansion tanks shall contain removable FDA approved butyl bladder.

C. Before installation, Contractor shall adjust the tank air pre-charge pressures to equal city water pressure.

D. The tank must be constructed in accordance with Section VIII of the A.S.M.E. boiler and pressure vessel code and stamped 150 psig working pressure.

E. Accessories: Pressure gauge and air charging fitting, tank drain, pre-charge as indicated on contract drawings and factory installed clip angles.

2.15. COMPRESSED AIR SYSTEMS

A. Furnish and install all components, piping, fittings, gauges, relief valves, flexible connectors, valves, drains, filters, refrigerated air dryers, regulators, lubricators, hose reels necessary to form a complete and operating a shop compressed air systems to the extent indicated on the contract drawings utilizing new air compressor(s) and tank. This contractor is responsible for all equipment, rough-in and final connections as detailed on the contract drawings/specifications.

B. Contractor shall mount air compressor/receiver on vibration isolation material and bolt to concrete housekeeping pad. Flexible piping shall be provided between receiver and piping systems. Contractor shall provide and install piping from each compressors tank drain and refrigerated air dryer drain to adjacent floor drain. Compressed air piping shall be pitched to drain at suitable locations in the system. Refer to Division 22 Section, Plumbing Piping, Fittings, & Valves for pipe material and installation requirements.

C. Air compressors: Furnish and install lubricated, reciprocating air compressors of the size, capacity, arrangement, and electrical characteristics as detailed on the contract drawings. Air compressors shall be Champion, Gardner Denver, Quincy, Ingersol Rand, Kaeser or approved equal. Air compressors shall include the following performance features:

1. Provide factory assembled and tested, simplex packaged and assembled, 100 percent continuous duty rated, belt driven, splash or pressure lubricated, two stage reciprocating, piston type, centrifugal air compressors as indicated, of capacities and electrical characteristics indicated on contract drawings.
2. Compressors shall be cast iron construction with multi-finned cylinders for maximum cooling, gasket free integral cylinder/head, ductile iron crankshaft, aluminum or cast iron pistons and connecting rods, Swedish steel disc type valves, balanced flywheel with fan cooling blades, large diameter, finned inter-coolers, positive acting centrifugal un-loader, tapered roller bearings, inter-stage pressure relief valves, heavy duty 5 micron inlet filter/mufflers, oil sight gauge and drain, low oil shutdown switch, enclosed OSHA belt guards, EPACT '92 energy efficient open drip proof motor, and U.L. listing.
3. Air compressors shall be tank mounted. Tank mounted compressors shall include ASME code 200 PSIG vertical air receiver. Air receiver shall include 0-300 PSIG liquid filled pressure gauge with snubber and needle valve, bucket high drain valve, ASME code bronze pressure relief valve, hand operated ball valve, factory set pressure switch. The receiver shall have base ring or support legs for mounting to concrete housekeeping pad. Vibration isolators shall be provided for the receiver. Receiver shall include automatic timed solenoid drain as specified. Tank shall be fully primed and finished in manufacturer's standard finish.
4. Air compressor shall be arranged for automatic start-stop control. Each compressors shall be supplied with pressure switch to control each compressor. Each pressure switch shall have adjustable differential control.
5. Each air compressors shall be supplied with an air cooled after-cooler. After cooler shall bring compressed air discharge temperature to within 20 degrees F of ambient air temperature. Unit shall be finned radiator type and packaged directly on compressor. A packaged moisture separator and trap shall be provided to remove all condensate removed from compressed air.
6. Compressed air systems shall be supplied with unit mounted and wired control panel as follows:

    a. Control panel shall be NEMA 1 general purpose indoor enclosure
    b. Combination Magnetic motor starters with individual thru-the-door disconnects, motor overloads and external reset buttons
    c. Hand-Off-Automatic Selector Switches
    d. Control voltage transformers - Primary & Secondary
    e. Low oil monitor with shutdown

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f. Power on light
g. Compressor run light
h. Automatic alternator timed rotation alternator
i. Phase loss protection

7. Compressor package shall have one year parts warranty from date of start-up, or (18) months from date of shipment. Compressed air end shall have (60) month warranty from date of start-up or (66) months from date of shipment. This shall include parts and labor on compressor air end.

D. Refrigerated Air Dryer: Furnish and install a cycling refrigerator air cooled dryer with the capacity and electrical characteristics as scheduled on the contract drawings. Refrigerated air dryer shall be Heatsink Model HSE as manufactured by Zeks, Arrow Pneumatics, Ingersoll-Rand or approved equal. Furnish refrigerated air dryer with the following performance features:

1. Unit shall be heat sink type and consist of a mechanical refrigeration system, equipped with automatic temperature control that will cycle the refrigerated system to match variable loads from 0 percent to 100 percent capacity.
2. Specially formulated heat sink material shall surround a smooth bore copper tube on tube evaporative section. The heat sink material shall be cooled by the refrigeration system which in turn shall cool the tubes to cool the dry compressed air. Refrigeration compressor horsepower shall be as specified on contract documents and shall be hermetic type equipped with automatic start-stop capacity control.
3. Moisture separator shall be low velocity centrifugal type.
4. Unit shall be controlled by micro-processor controller including exchanger temperature, % savings digital display, dew point temperature, adjustable dew point setting, automatic solenoid drain with drain open/closed adjustment, drain test switch, anti-rapid cycle timer, high temperature alarm light with relay for remote, low temperature alarm light with relay for remote, Fahrenheit and Centigrade temperature display, refrigerant suction pressure gauge, installed drain trap, on/off switch with power on light.
5. Unit shall be U.L. listed and furnished with packaged automatic solenoid drain. Pipe condensate trap to floor drain and install dryer on a 4-inch high housekeeping pad.

E. Compressed Air filters: Furnish and install particulate and coalescing filters of capacity and quantity as indicated on the contract drawings. Filters shall be as follows:

1. 3-Micron Particulate filters - Units shall have corrosion resistant cast aluminum ally head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O"ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 3-micron absolute removal. Unit shall be Zeks "PT" series, Arrow, Ingersoll-Rand, Kaeser or approved equal.
2. 0.3 Micron Coalescing Filter - Unit shall have corrosion resistant cast aluminum alloy head and aluminum alloy bowl. Bowl assembly shall have threaded connections with "O" ring seal for easy access for cartridge replacement. Unit shall have durable enamel finish. Filter shall have pressure drop indicator to indicate filter replacement and installed internal automatic drain. Unit shall have 0.3-micron absolute removal. Unit shall be Zeks "LT" series, Arrow, Ingersoll-Rand, Kaeser or approved equal.
3. All filters and housings shall be constructed to withstand 250 psig maximum working pressure.

F. Compressed Air Pressure Regulators: Provide and install pressure regulator where indicated with built-in safety relief valve. Outlet pressure is to be set as specified and to remain constant regardless of inlet air pressure and changes in downstream flow requirements. Unit to be provided with high pressure gauge on outlet and high pressure gauge on inlet. Provide three (3) valve bypass around pressure reducing station as detailed on contract drawings. Pressure regulator shall be constructed

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of aluminum alloy or Zinc, diaphragm operated, direct acting, spring loaded design with manual adjustment knob and rated 300 psig maximum. Unit shall be relieving type with balanced valve design. Main pressure regulator shall be Arrow, Hankison, Kaeser, Wilkerson or approved equal.

G. Compressed Air Combination Pressure Regulator/Filter/Lubricator: Furnish and install combination pressure regulator/filters/ lubricators of the capacity and quantity as indicated on the contract drawings. Units shall be provided with built-in safety relief valve. Outlet pressure to be maintained at scheduled value regardless of inlet air pressure and changes in downstream flow requirements. Unit to be provided with high pressure gauge on outlet and inlet. Valve body shall be constructed of zinc. Assembly shall be diaphragm operated, direct acting, spring loaded design with balanced valve design. Filter shall be constructed of sintered polypopylene. Lubricator shall be equipped with drip chamber and sight dome for observing oil drop entering airstream, with a oil-feed adjustment screw and quick-release collar for easy bowl removal. Lubricant shall be non-detergent, petroleum base oil no heavier than SAE 10. The maximum oil droplet flow rate shall be one drop of oil for every SCFM air delivered at 80 psig. Combination units shall be Model C as manufactured by Wilkerson, Arrow, Hankison, Kaeser, Mastercraft, or approved equal.

H. Each compressed air system shall be equipped with a main safety relief valve. Safety relief valves shall be ASME BPVC Section VIII DI and ASME BPVC Section IX Code stamped safety valve, for unfired pressure vessels, bronze, with threaded or flanged connectors; factory set and sealed.

I. Provide and install pressure gauges at all locations shown on contract drawings. Pressure gauges shall be ANSI/ASME B40.1 rated, Accuracy Grade A, for air, with steel or brass case, and nonshatterable safety glass, and a pressure blowout back to prevent glass from flying out in case of an explosion. Gauges shall have a 3 1/2-inch minimum diameter dial and a dial range of approximately twice working pressure.

J. Furnish and install as indicated on drawings, timed automatic condensate drain. Unit shall be 200 PSIG working pressure. Unit shall consist of condensate reservoir, timer operated solenoid drain. Unit shall have fully adjustable drain cycle time, fully adjustable valve open duration, power on light, valve open light, NEMA 4 UL/CSA approved housing, solid state timer, and eight foot, three prong power cord. Units shall be as manufactured by Arrow Pneumatics, Hankison, Zeks, Sparten or approved equal.

K. Furnish and install adjustable pressure regulators at each compressed air drop, hose reel and equipment as detailed on the contract drawings. Pressure regulators shall include balanced valve design, spring loaded diaphragm, adjustment knob, built-in pressure gauge, drain plug and zinc body. Units shall be selected and constructed to withstand a maximum working pressure of 250 psig. Units shall be as manufactured by Arrow Pneumatic, Hankison, Zeks, Sparten, Vanguard or approved equal.

L. Provide and install quick disconnect couplings at all drops and wherever indicated on contract drawing. Quick disconnect coupling shall be all brass and suitable for a working pressure of not less than 200 psig. Female side of coupling shall (fixed end) have male thread connection with automatic shutoff. Provide male side of coupling with hose stem and ball check to bleed pressure from hose and prevent hose whipping. Provide two (2) quick disconnects at compressed air drops where indicated on contract drawings. Quick connect/disconnect hose couplings shall be as manufactured by Aero-Quip, Champion, Hansen, Schrader or approved equal.

M. Provide and install compressed air hose reel assemblies at all locations shown on the contract drawings. Hose reel assemblies shall be Model HRL 35-35 as manufactured by Appleton, Reelcraft, or approved equal. Each hose reel shall be complete with 35 Ft of ½-inch diameter hose rated for a minimum of 250 psig. Hose reels shall include ball stop, locking ratchet, four roller hose guides with adjustable arms, orange epoxy/polyester finish, and Model SHRL-A swivel base for full 360° rotation. Hose reels shall be mounted as approved by Structural Engineer. Provide structural support

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extension steel so as to not exceed manufacturer's maximum mounting height.

N. Where indicated on contract drawings, contractor shall provide rough-in and final connection to equipment provided by owner or under another Division of these specifications.

O. Factory start-up shall be provided by manufacturer's representative. Start-up shall include a minimum (4) hours and should include complete operational check of compressed air system, pressure switch adjustments, motor amp draw, and correct operation of all system components. Manufacturer's representative shall also instruct owner's personnel on operation and maintenance of the compressed air system components.

2.16. THERMOSTATIC MIXING VALVES (INDIVIDUAL FIXTURE TYPE)

A. Furnish and install thermostatic mixing valves at all lavatories, shampoo sinks, pedicure sinks, and kitchen hand sinks that are provided with hot water temperatures above 109 degrees F.

B. Thermostatic mixing valves shall be Bradley S59-4000A, Watts, Acorn, Sloan, Caleffi, or approved equal for installation under lavs. Provide in-line check valves, lead free body, escutcheon plates, inlet filters, and insulation as required. Thermostatic mixing valves shall be adjusted to deliver 105 degrees Fahrenheit hot water when supplied with 140 degrees Fahrenheit delivering hot water. Furnish with adjusting cap with locking feature.

C. The thermostatic mixing valves shall be ASSE standard 1070 listed.

2.17. ICE MAKER COLD WATER INLET FILTER

A. Provide and install a cartridge type water filter on the cold water inlet to the kitchen ice maker as detailed on the contract drawings. Housing shall be constructed of PVC with 3/4-inch NPT connections. Heads shall be cast bronze nickel plated with nickel plated "T" handle cap nut. Unit shall have pet cock bottom drain. Housing shall contain two (2) 20 micron cartridge filters. The entire filter assembly shall be rated for 150 psig. Unit shall be capable of handling a minimum 6 gpm. Housing shall be as manufactured by Keystone or approved equal.

B. Install filter housing to allow access for service and filter replacement.

2.18. IN-LINE COLD WATER INLET FILTER

A. Provide and install a cartridge type water filter on the cold water inlet to the water heaters as detailed on the contract drawings. Housing shall be constructed of PVC with 3/4-inch or 1 inch NPT connections. Heads shall be white talc reinforced polypro head. Housing shall contain one (1) 10 micron cartridge filters. The entire filter assembly shall be rated for 150 psig with maximum 5 psig pressure drop. Unit shall be capable of handling a minimum 15 gpm. Cartridge shall be nominal 4" diameter, 20" long pleated polypropylene, pleated polyester or other NSF safe material as required to meet specified performance. Provide filter with wall mounting bracket. Housing shall be as manufactured by Keystone, AMTROL, Watts, ITT Water Equipment, Culligan, International, or approved equal.

B. Install filter housing to allow access for service and filter replacement.

C. Provide 5 spare cartridges. Document in writing that cartridges have been turned over to Owner and forward copy to the Architect.

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2.19. GREASE INTERCEPTORS

A. Furnish and install Schier Great Basin™ grease interceptor model #GB which shall be lifetime guaranteed and made in USA of seamless, molded polyethylene with minimum 7/16" uniform wall thickness. Interceptor shall be furnished for below-grade installation with adjustable cover adapter and Safety Star® access restrictor built into each cover adapter.

B. Interceptor shall be certified to ASME A112.14.3/CSA B481.1-2022 (Type D) and ANSI/CAN/IAPMO Z1001-2-21.

C. Interceptor flow rate shall be 100 GPM or 200 GPM as scheduled.

D. Interceptor grease capacity shall be 10,061 lbs. @ 100 GPM or 9,446 lbs. @ 200 GPM.

E. Interceptor grease capacity at 99% efficiency shall be 9.897 lbs. @ 100 GPM or 8,093 lbs. @ 200 GPM.

F. Cover shall provide water/gas-tight seal and have minimum 16,000 lbs. load capacity.

G. Interceptor shall be furnished with field cut riser model #FCR2 to enable access for below grade installation.

2.20. SAND INTERCEPTOR

A. Furnish and install an underground sand interceptor of the size and capacity as indicated on the Contract Documents.

B. Sand interceptors shall be Mifab, Zurn or approved equal.

C. Sand interceptor shall be sanitary epoxy coated inside and outside fabricated 10 gauge steel sand interceptor. Unit shall include: removable cross bar, four 3" (76) threaded vent connections, solid straining baffles, stainless steel calibrated orfice plate, securing bolts(s), sediment bucket with perforated baffle beside inlet, deep seal trap, sewer gas stopper, internal air relief by-pass, and steel powder epoxy coated non-skid rectangular gasketed lid(s).

D. Furnish units with the following options: Extensions, anchor flange, and aluminum lids.

2.21. INDUSTRIAL RETRACTABLE WATER HOSE REEL

A. Industrial Retractable Water Hose Reel shall be Model 7850 OLPSW57 as manufactured by ReelCraft or approved equal.

B. Unit shall be capable of mounting to structural steel. Include applicable mounting bracket.

C. The reel's base and guide arm shall be formed from high-grade steel and engineered with structural forms and gussets to yield the greatest amount of strength. Reel shall be used for water.

D. Unit shall come with full flow, stress free swivel to insure maximum service life. Hose shall be plumbed into the base to eliminate the risk of undue stress on the swivel.

E. Hose reel shall have a long life drive spring. De-clutching arbor shall be provided to eliminate possibility of spring damage due to reverse winding.

F. All components of Hose Reel shall have individually powder coated components to prevent

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corrosion.

G. Inlets: 1/2-inch NPT cold water. Hose Outlet: 3/4-inch NPT.

H. Pressure: 300 psi max. Temperature: 150°F max.

I. Hose Nozzle: Industrial application type nozzle suitable for 180 degrees F with finger touch spring control, self-closing automatic shut-off, stainless steel body and stainless steel internal parts.

J. Accessories: Vacuum breaker hose connection, powder coated finish, stainless steel hose rack, 3/4-inch EPDM hose with 50 Ft length, couplings, stainless steel spring protector.

PART 3 EXECUTION

3.1. GENERAL INSTALLATION REQUIREMENTS

A. Install all equipment in accordance with manufacturer's instructions.

B. Install components plumb and level.

C. Cleanouts in vertical pipes shall be installed in tees near floor. Cleanouts in horizontal pipes shall be installed with wyes on long sweep quarter beds. Cleanouts punching water proofing membranes shall have flashing clamps. Cleanout access covers in dry wall or gypsum board shall be painted to match walls.

D. Extend cleanouts to finish floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

E. Encase exterior cleanouts in concrete flush with grade.

F. Install water heaters in accordance with manufacturer's instructions and to AGA, NSF, ANSI/NFPA 54, UL requirements and Delaware Boiler and Pressure Vessel Safety Act and Regulations. For gas fired water heaters, conduct a combustion flue gas analysis. Submit flue gas analysis report to Engineer for review. Record and submit design and actual draft at appliance vent connection.

G. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve a complete operating system.

H. Install domestic water storage tanks in accordance with manufacturer's instructions.

I. Provide painted steel pipe support for tanks independent of building structural framing members.

J. Clean and flush domestic water heater tanks after installation. Seal until pipe connections are made.

K. Support piping adjacent to all pumps such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches (100 mm) and over.

L. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

M. All plumbing, vents in exterior walls shall be offset a minimum of 3'-0" in ceiling at roof before penetration.

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N. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

O. All plumbing vents within a 10'-0" radius of any rooftop unit or intake louver shall be extended to a height of 3'-0" above fresh air intake.

P. Slopes and invert elevations of all interior piping shall be established before any piping is installed in order that proper slopes will be maintained. All piping shall be located and determined where to be run to avoid conflict with other trades.

Q. Unless otherwise noted, all plumbing piping shall be routed as high as possible between bottom of roof joists and above ceiling to allow proper installation of ductwork, fire protection piping, conduits, etc.

R. Coordinate with Architectural Drawings before roughing in plumbing.

S. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

T. See site plan for extent of all piping leaving and entering building.

U. See domestic water riser diagrams for location of valves, shock absorbers, balance valves, etc.

V. Make proper HW, CW, hot water recirculating, waste, and vent connections to all equipment even though all branch main, elbows and connections are not shown.

W. Cleanouts shall be provided near base of each vertical waste or solid stack. Provide 18" minimum clearance for access.

X. Domestic hot, cold and recirculating water piping shall be installed between ceiling and roof insulation.

Y. Unless otherwise noted, horizontal sanitary piping pitches shall be 1 percent.

Z. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

AA. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.

BB. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.

CC. For sizes of all sanitary and vent piping see plumbing fixture schedule and sanitary/vent riser diagrams.

3.2. DOMESTIC WATER HEATER INSTALLATION REQUIREMENTS

A. Install units on concrete bases, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Anchor units to substrate.

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C. Install combustion air and flue vents as detailed on contract drawings. Terminate and install combustion air and flue vent piping per manufacturer's requirements.

D. Install condensate hose below exhaust elbow per manufacturer's requirements. Extend condensate hose continuous downward pitch and discharge into condensate neutralizer. Install lime chips in condensate neutralizer.

E. Install temperature and pressure relief valves in top portion of storage tank shells of units with storage. Use relief valves with sensing elements that extend into shells. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain. Install union on relief valve discharge piping. Install automatic air vent at top of hot water supply piping with union ball valve.

F. Install pressure relief valves in water piping for units without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

G. Install vacuum relief valves in cold water inlet piping.

H. Install unit drain piping as indirect waste to spill into open drains or over floor drains. Install hose end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section, Plumbing Piping, Fittings and Valves for drain valves.

I. Install thermometers on unit inlet and outlet piping. Refer to Division 22 Section, Plumbing Piping, Fitting and Valves for thermometers. Install pressure gages on unit piping.

J. Fill unit with water. Install domestic water expansion tank and charge with air. Install piping adjacent to units to allow service and maintenance.

K. Connect hot and cold water piping with shutoff valves and unions. Connect hot water circulating piping with shutoff valve, check valve, and union.

L. Make connections with dielectric fittings where piping is made of dissimilar metal.

M. Electrical Connections: Power wiring is specified in Division 26 Sections. Arrange wiring to allow unit servicing.

N. Ground equipment

1. Tighten electrical connectors and terminals according to manufacturers published torque tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.Engage a factory authorized service representative to perform startup service.

O. In addition to manufacturer's written installation and startup checks, perform the following:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
2. Verify that piping system tests are complete.
3. Check for piping connection leaks.
4. Check for clear relief valve inlets, outlets, and drain piping. Check operation of circulators.
5. Test operation of safety controls, relief valves, and devices. Energize electric circuits.
6. Adjust operating controls.
7. Adjust hot water outlet temperature settings. Do not set above 140 deg F 60 deg C unless piping system application requires higher temperature.

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3.3. PLUMBING SPECIALTY INSTALLATION REQUIREMENTS

A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.

B. Install backflow preventers of type, size, and capacity indicated, at each water supply connection to mechanical equipment and systems, and to other equipment and water systems as indicated. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment. Install air gap fitting on units with atmospheric vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer. Label all piping downstream of backflow preventers as "non-potable" water.

C. Field test all backflow preventers and submit test reports to Engineer. Furnish test kits as required for field testing.

D. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.

E. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve, and where indicated.

F. Install hose bibbs with integral or field installed vacuum breaker.

G. Install wall hydrants with integral or field installed vacuum breaker.

H. All hose bibs shall be mounted 18" above finished floor, unless otherwise specified.

I. All wall hydrants shall be mounted 24" above finished grade unless otherwise specified.

J. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of one percent and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow. Install trap priming stations plumb and level with adequate access for servicing and maintenance.

K. For all trap primer pipes label the same as to the location of the floor drain served.

L. For floor drains located in toilet rooms and similar spaces where flush valves are utilized. Contractor may utilize trap primer line from flush valve tail piece.

M. Install backwater valves in building drain piping as indicated. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing. Fasten wall hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated. For exterior installation provide handhole with hinged cover and top mounted to be flush with grade.

N. Fasten recessed, wall mounting plumbing specialties to reinforcement built into walls.

O. Secure supplies to supports or substrate.

P. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve as appropriate is not indicated.

Q. Install water supply stop valves in accessible locations.

R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within

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cabinets and millwork. Use deep pattern escutcheons if required to conceal protruding pipe fittings.

S. Include wood blocking reinforcement for recessed and wall mounting plumbing specialties.

T. Install ball valves at all shock absorbers to allow removal for service/replacement.

3.4. WATER METER INSTALLATION REQUIREMENTS

A. Install water meters, piping, and specialties according to AWWA M6 requirements.

1. Install plate strainer upstream of water meter.
2. Install displacement type water meters with shutoff valve on water meter inlet. Install valve on water meter outlet and valved bypass around meter, unless prohibited by authorities having jurisdiction.
3. Install compound type water meters with shutoff valves on water meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
4. Install detector type water meters with shutoff valves on water meter inlet and outlet and on full size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers. Install roughing in piping and specialties for water meter installation according to utility's instructions and requirements.

B. Install power and control wiring from water meter to ATC system.

C. Field insulate and jacket water meter to prevent condensation.

D. Provide spare strainer screen for all water meters with integral strainers.

E. Install power wiring to water meter and encoder/reader.

3.5. FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

A. Fixtures such as built in sink in counters and kitchen equipment are provided under other divisions of the specifications and are complete with strainer and tailpiece. Fittings, accessories and connection of these fixtures to the plumbing system are provided under this section.

B. Rough-in and final connection includes but is not limited to all domestic water, waste, and vent, gas and compressed air systems. Furnish stops, strainers, vacuum breakers, and under counter insulation where not furnished under another Division of these specifications.

3.6. KITCHEN EQUIPMENT INSTALLATION

A. The kitchen equipment plumbing fixtures are provided under the Architectural Division of these specifications. Rough-in and final connection shall be provided under this Division. Coordinate final connection and rough-in dimensions with Architectural Contract drawings.

B. The rough-in requirements are as scheduled on the drawings. The equipment No's are per the kitchen equipment drawings.

C. Water Inlets:

1. Water inlets shall be located above the positive water level wherever possible to prevent siphoning of liquids into the water supply system. Wherever conditions shall require a

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submerged inlet, a suitable type of check valve (except in jurisdictions where check valves are prohibited) and vacuum breaker shall be placed on the fixture to prevent siphoning. Where exposed to view, piping and fittings shall be chrome-plated.

D. Drain Lines:

1. Plumbing Contractor shall provide and install indirect waste lines from equipment which will discharge into floor drains or safe wastes in accordance with Plumbing Rough-In plans, chrome-plated where exposed. Extend to a point at least 1-inch (or as required by local codes) above the rim of the floor drain, cut bottom on 45 degree angle and secure in position.
2. All horizontal piping lines shall be run at the highest possible elevation and not less than 6-inch above finished floor, through equipment where possible.
3. No exposed piping in or around fixtures or in other conspicuous places shall show tool marks of more than one thread at the fitting.
4. Provide suitable pressure regulating valves for all equipment with such components that might reasonably be expected to be affected over a period of time by adverse pressure conditions.

E. Sealants:

1. Provide and apply sealant where kitchen equipment plumbing fixtures come in contact with walls and floors.
2. Sealant, shall conform to ASTM C920; type S Grade NS, Class 25, Use Nt, with characteristics that when fully cured and washed meets requirements of Food and Drug Administration Regulation 21 CFR 177.2600 and N.S.R. RTV-732 for use in areas where it comes in contact with food.
3. Dow-Corning #780 or General Electric “Silastic”, or approved equal, in either clear or approved color to match surrounding surfaces and applied in accordance with manufacturers recommendations for a smooth, sealed finish.

3.7. TESTING

A. After plumbing fixtures are connected, all piping and fixtures shall be tested for operation and a smoke or peppermint test shall be made on all soil, waste and vent piping.

B. After the building has been occupied and the various equipment is in actual use, the Contractor shall make an operating test of all equipment at a time directed by the Engineer to determine that all contract requirements are met.

3.8. CLEANING AND STERILIZATION

A. After final testing for leaks, all potable water lines shall be thoroughly flushed, by plumbing contractor, to remove foreign material. Before placing the systems in service, sterilize the new water lines in accordance with local health department codes and at a minimum according to the following procedure:

1. Through a ¾-inch hose connection in each branch main and building main, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine into system.
2. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.
3. When chlorinated water has been brought to every faucet and tap with a minimum

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concentration of 200 ppm chlorine, retain this water in the system for at least three (3) hours.

4. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system. It is not necessary to retain chlorine in any system for twenty-four hours to achieve sterilization. AWWA states that 200 ppm chlorine for three hours is sufficient.
5. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.
6. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 ppm.
7. Obtain representative water sample from the system for analysis by an independent and recognized bacteriological laboratory.
8. If the sample tested for coliform organisms is negative, a letter and laboratory report shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization. Additionally, this report shall be forwarded to the Owner as well as be included in the O&M Manual.
9. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.
10. Take precautions to avoid use of plumbing fixtures and domestic water systems during sterilization period. Place signs on all plumbing fixtures and outlets during sterilization period.

3.9. EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.10. PREPARATION

A. Review the Kitchen Equipment Consultant's equipment cut sheets. Confirm rough-in location and size of fixtures and openings prior to commencing work.

B. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.11. INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.12. CLEANING

A. At completion, clean plumbing equipment.

3.13. SAND INTERCEPTOR INSTALLATION REQUIREMENTS

A. Install cleanouts upstream and downstream of interceptor.

B. Install custom risers and traffic-rated heavy duty manholes and frames.

END OF SECTION

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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.

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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

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

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D.	ADC	-	Air Diffusion Council
E.	AGA	-	American Gas Association
F.	AMCA	-	Air Movement and Control Association
G.	ANSI	-	American National Standards Institute
H.	ARI	-	Air Conditioning and Refrigeration Institute
I.	ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
J.	ASME	-	American Society of Mechanical Engineers
K.	ASPE	-	American Society of Plumbing Engineers
L.	ASTM	-	American Society for Testing and Materials
M.	CAGI	-	Compressed Air and Gas Institute
N.	CS	-	Commercial Standard
O.	DNREC	-	Delaware Department of Natural Resources
P.	FM	-	Factory Mutual
Q.	IBC	-	International Building Code
R.	IEEE	-	Institute of Electrical and Electronics Engineers
S.	MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry
T.	NEC	-	National Electrical Code
U.	NEMA	-	National Electrical Manufacturers Association
V.	NFPA	-	National Fire Protection Association
W.	NFPA 101	-	Life Safety Code, 2024 Edition
X.	NFPA 150	-	Fire and Life Safety in Animal Housing Facilities Code, 2025 Edition
Y.	NSF	-	National Sanitation Foundation
Z.	SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
AA.	UL	-	Underwriters' Laboratories

BB. State of Delaware Fire Protection Regulations, 2026 Edition.

CC. 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.

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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 six (6) 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.

I. For resubmissions, the Contractor must address in writing all of the Engineer’s comments on the original submission to verify compliance.

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.

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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

1. Access Doors/Panels including layouts and locations
2. Airflow Monitoring Stations
3. Air Distribution Systems
4. Automatic Temperature Control Systems and Equipment
5. Backwater Valves
6. Carbon Dioxide Sensors
7. Carbon Monoxide Sensors
8. Ceiling Paddle Fans
9. Central Control and Monitoring Systems (CCMS) and Equipment
10. Coordinated Drawings
11. Dewpoint Temperature Sensors
12. Drip Pans
13. Duct Materials
14. Electric Recessed Cabinet Convectors
15. Electric Duct Heating Coils
16. Electric Unit Heaters
17. Electric Radiant Heat Panels
18. Energy Recovery Ventilators and Energy Recovery Modules
19. Equipment Rails
20. Exterior Equipment/Duct/Piping Supports
21. Exterior Pipe Roller Supports
22. Fans
23. Filters
24. Filter Housings/Mixing Boxes
25. Fire Stopping - Methods and Materials
26. Fire Dampers
27. Gas Furnaces including Flue Materials
28. Gas Fired Radiant Heaters Including Flue/Combustion Air Materials
29. Grilles, Registers, Diffusers
30. Horizontal Recessed Cabinet Unit Heaters
31. Horizontal Electric Unit Heaters
32. Identification Systems
33. Intake Hoods
34. Louvers and Insulated Blank-Off Panels
35. Material and Equipment Lists
36. Operations and Maintenance Manuals
37. Pipe Enclosures
38. Pipe Materials Including Itemized Schedules
39. Preliminary Testing and Balancing Reports
40. Radiant Heat Panels
41. Refrigerant Mitigation Controls
42. Roof Curbs
43. Schrader Fittings with Ball Valves
44. Screen shots of ATC System Graphics
45. Split System Heat Pumps, Ductless
46. Strainers
47. Test Certificates
48. Thermal Insulation Materials Include Table Summaries
49. Thermometers and Gauges
50. Unit Heaters

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51. Variable Frequency Drive Motor Bearing Protective Rings
52. Variable Speed Drives
53. Vertical Cabinet Unit Heaters
54. Vibration Isolation Materials
55. Water Heater Flue/Combustion Air Piping
56. Weatherproof Assembly Components
57. 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. Where required arrange for manufacturer to ship equipment in modules.

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 work¬manlike 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.

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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 of 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.

D. Paint the perimeter of all housekeeping pads safety yellow.

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

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the existing and new work in a finished and workman like condition.

1.15. EXCAVATION AND BACKFILLING

A. General

1. Perform all necessary excavation, or installation of work under Division 23, in whatever materials or conditions encountered, using suitable methods and equipment.
2. Accurately establish required lines and grades and properly locate the work.
3. Determine the locations of all existing utilities before commencing the work.

B. Excavation: (Refer also to other portions of the specifications)

1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.
3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling: (Refer also to other portions of the specifications)

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

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. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

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1.19. REFRIGERANT SYSTEM CAPS

A. For all exterior grade and roof mounted equipment containing refrigerant install lockable caps on service valves to prevent tampering. Lockable caps shall be Model NPR as manufactured by Rector Seal or approved equal. Provide Model NPR Novent screwdriver tool with swiveling tip. Caps shall be suitable and specific for the refrigerant type utilized.

1.20. 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, or embedded in construction.

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. VRV/VRF Systems: Variable Refrigerant Volume/Variable Refrigerant Flow Systems.

1.21. 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

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edition.

C. 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.

D. Department of Energy (DOE) compliance: Pump manufacturers shall comply with US Department of Energy (DOE) energy conservation standard for "clean water pumps" 1-200 horse power, less than 459 feet of head and greater than 25 gpm. These pumps shall be evaluated using the Pump Energy Index (PEI) of equal to or lesser than 1.0. the PEI number shall appear on the pump name plate and shall be available for the record at http://er.pumps.org.

E. Where Energy Star certification exists for equipment utilized on this project, the equipment must be Energy Star certified. Provide Energy Star certification with submittals.

1.22. 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.

1.23. COORDINATION WITH SUSSEX TECHNICAL HIGH SCHOOL I.T. DEPARTMENT

A. All equipment that interfaces with the internet shall be coordinated with the Sussex Technical High School I.T. Department to verify that the same is suitable for use on the Sussex Technical High School I.T. infrastructure. Coordinate with the Sussex Technical High School I.T. Department regarding the allowable frequency bands to avoid interference with the Sussex Technical High School I.T. infrastructure.

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1.24. VFD BYPASSES

A. When VFD's are specified with integral bypasses and the equipment manufacturer is not able to provide bypasses due to equipment space constraints, then the manufacturer must provide spare VFD's for each fan/pump.

1.25. A2L REFRIGERANT REQUIREMENTS

A. All refrigerants utilized on this project shall be lower flammability and lower toxicity refrigerants as defined by ASHRAE Standard 34-Designation and Safety Classification of refrigerants. Per ASHRAE 34-2019, this project shall only utilize A2L refrigerants in HVAC equipment such as R-32 and R-454B.

B. Refrigerants classified as B-1, B2i, A2, B2, A3, and B3 shall not be utilized.

C. All scroll compressor products shall be manufactured in compliance with UL-60335-2-40.

D. All equipment including installations shall comply with ASHRAE 15-2022 requirements and International Mechanical Code requirements whichever is more stringent.

E. The installing contractor shall submit a declaration to the authority having jurisdiction that the refrigerant systems have been installed and tested per ASHRAE 15-2022.

F. Provide equipment with U.L listed refrigerant mitigation controls per ASHRAE 15-2022 requirements.

G. HVAC equipment manufacturer shall submit calculations indicating compliance with ASHRAE 15-2022.

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 Electrical Code. All wiring, conduit, etc., installed in ceiling plenums must be plenum rated per NFPA and the International Building Code.

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.

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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.

K. Where a motor disconnect is indicated downstream of a variable frequency drive (VFD) provide interlock wiring from the auxiliary contacts on the disconnect to the VFD to de-energize when the disconnect is turned "off".

L. Where equipment under this Division is specified with integral disconnecting means, the same shall be a single disconnecting means for disconnecting all ungrounded main power supply conductors that is capable of being locked in the open ("off") position in accordance with the National Electrical Code and the local electrical inspector.

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 l.

C. Motors used with variable-frequency controllers shall have ratings, characteristics, and features coordinated with and approved by the variable frequency controller (drive) manufacturer. As a minimum the following shall apply to variable frequency controlled motors:

1. Motors shall be manufactured to withstand peak voltages of 1600 volts with .1 microsecond rise time per NEMA MG-1.
2. Critical vibration frequencies of motor shall not be within operating range of variable frequency controller output.
3. Temperature rise: Match rating for Class B insulation.
4. Insulation: Class F.
5. Thermal Protection: Conform to MG1 requirements for thermally protected motors.

D. 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

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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 WR2 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.

E. 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.

F. 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.

G. 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
2HP	86.5 percent	85 percent

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MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent
7½ HP	91 percent	86 percent
10HP	91.7 percent	85 percent
15HP	93.0 percent	85 percent
20HP	93.0 percent	86 percent
25HP	93.6 percent	85 percent
50HP and above	94.5 percent	88 percent
60 HP	95.0 percent	90 percent
75HP	95.0 percent	90 percent
100 HP	95.4 percent	90 percent
125 HP	95.8 percent	95 percent
150 HP and above	96.0 percent	95 percent

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H. 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.

I. For motors serving equipment being controlled by a variable speed drive, motor shall be premium efficiency inverter duty rated.

J. 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.

K. 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.

L. Provide manufacturer’s warranty for all motors for minimum of 5 years including all labor and materials.

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.

2.5. VARIABLE FREQUENCY DRIVE MOTOR BEARING PROTECTIVE RINGS:

A. For all motors driven by a variable frequency PWM drive include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents. Grounding rings shall be manufactured by AEGIS SGR or approved equal.

B. Furnish units with two (2) year warranty.

C. Size and select Bearing Protective Rings per the manufacturer requirements based on the motor size, shaft diameter, and shaft shoulder length. For motors with slingers furnish and install NEMA /IEC kit as required.

D. Furnish and apply Colloidal silver shaft coating to all shafts with Bearing Protective Rings to improve shaft voltage discharge capability.

2.6. ENCLOSURES

A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:

1. Dry Interior Locations: NEMA 1.
2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.
3. Corrosive Locations, Including Janitor's Closets, Chemical Storage Rooms and Similar Space: NEMA 4X.

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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.

G. Do not install equipment, ductwork, or piping over electrical gear, electrical panels, motor controllers, and similar electrical equipment. Install equipment, ductwork, and piping to maintain clear space above and in front of all electrical components per the National Electric Code.

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 workman-like 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.

C. Concrete housekeeping pads and foundations shall be not less than 4 inches high and shall extend a minimum of 6 inches beyond equipment bases. Provide wire-mesh reinforcement; chamfer exposed edges and corners; and finish exposed surfaces smooth.

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, fire dampers, 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 minimum of 12 inches x 12 inches for hand access, 18 inches x 18 inches for shoulder access and 20 inches x 30 inches for full body access where required. Review locations and sizes with Architect prior to fabrication. Provide U.L. approved and labeled access doors where installed in fire rated walls or ceilings. Doors shall

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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. Label inside of access door as to what it serves.

E. 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.

F. Where access doors are installed in wet locations (i.e. shower rooms, toilet rooms, concessions, kitchens, dishwasher rooms, barn, and similar spaces, etc…) provide aluminum access doors/frames.

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.

G. All exposed ductwork, piping, equipment, etc. shall be painted. Colors shall be as stated in this division or as selected by the Architect and conform to ANSI Standards.

H. All exterior roof mounted ductwork, equipment, piping, breeching, and vents shall be painted to match roof in color as selected by Architect.

I. All exposed ductwork, piping, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

J. All exposed ductwork, piping, equipment, etc., in Mechanical Rooms, Penthouses, Mezzanines, and Storage where PVC jacketed shall not require painting. Label and identify and color code as specified.

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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.

F. Provide moisture protection for ductwork in areas which are not under roof or where ductwork would be exposed to rainwater.

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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. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record demonstration and training video recordings. Record each training module separately.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Engineer

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

3.10. 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.

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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 six (6) 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. Provide at least 8 hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner. Additional instruction time for the automatic temperature control (ATC) system is specified in Division 23 Section, "Instrumentation & Controls of HVAC & Plumbing Systems".

H. Contractor shall demonstrate Sequences of Operation of all equipment in presence of Owner's representative, Engineer, and ATC subcontractor.

3.11. 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.

G. Extend all floor sleeves through floor at least 3/4-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.

H. Sleeves for penetrations in concessions, kitchen, and food service areas shall finish .375 inches

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above floor or flush with wall surfaces and be neatly pointed up to fit snuggly against floor or wall material.

3.12. RECORD DRAWINGS

A. Upon completion of the mechanical installations, the Contractor shall deliver to the Architect one complete set of prints of the mechanical 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 to Architect.

3.13. 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 (2) 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. Contractor shall repair and/or replace any/all damage to finishes and furniture resulting from their corrective work.
4. That the entire work shall be water-tight and leak-proof.

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3.14. 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.

3.15. OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared six (6) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals 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 – Sussex Technical High School – Bid Pack C - 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. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of Volume 1 (if applicable) of hard copies of the manual.

D. 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 variable frequency drives, and 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 Department, HVAC Inspector, and Electrical Inspector Certificates.
14. Start-up reports for equipment.
15. 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.
16. Insert color graphic with embedded parameters for ATC system into record and information booklet.
17. Filter charts indicating equipment served, size, and type of filter required.
18. Certificate of ASHRAE 15 compliance for A2L refrigerants.
19. Pipe pressure/vacuum test forms.

E. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of volume 1 (if applicable) of hard copies of the manual.

F. 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.

3.16. INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit, and use composite installation and coordination drawings to assure proper

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coordination and installation of work. Drawings shall include, but not be limited, to the following:

1. Complete Ductwork, Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with lights, electrical equipment, HVAC equipment and structural amenities.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, piping and ductwork in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manufacturer's literature showing internal wiring.

D. Refer to Division 01 Section “Project Management and Coordination” for additional requirements related to coordination drawings.

3.17. 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 twenty-four (24) hours. Testing to be witnessed by Owner's representative and documented in writing.

SYSTEM	TEST PRESSURE
Refrigerant Piping	600 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.

E. All testing shall be witnessed by Construction Manager.

F. All refrigerant piping shall be installed and tested per ASHRAE 15-Safety Standard for Refrigerant Systems.

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3.18. 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.

3.19. ADDITIONAL FILTERS AND BELTS

A. One complete set of additional filters and belts shall be turned over to the owner upon final acceptance of the building by the owner. Provide correspondence to the Engineer (copy) documenting that additional filters and belts have been turned over to Owner.

B. All filters and belts shall be tagged and identified for equipment served. Furnish filters in protection wrap.

3.20. 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 this Section, to Owner for approval.

END OF SECTION

NOT 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: _____

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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.

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1.3. QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. 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. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

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. Refrigeration Piping:

a. Concealed: Tube Size ¾ -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 brazed, AWS A5.8, BCUP silver/phosphorous/copper alloy with melting range 1190 to 1480 degrees F.

b. Concealed: Tube Size 7/8 inch through 4-1/8inches:
Copper tube, Type ACR, soft annealed temper; wrought-copper, brazed-joint fittings; brazed joints.

c. Exposed: Tube Size ¾ Inch and Smaller:
Copper pipe, Type ASTM B88, Type K with brazed wrought-copper fittings conforming to ASME B16.22. Filler metal shall be brazing type conform to AWS A5.8.

d. Exposed: Tube Sizes 7/8 Inch and Larger:
Copper pipe, Type ASTM B88, Type K with brazed wrought-copper fittings conforming to ASME B16-22. Filler metal shall be brazing type conforming to AWS A5.8.

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

f. 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.

g. 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.

h. 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.

i. 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 brazed-end connections.

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j. 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.

k. 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 brazed-end connections.

2. Cooling Coil A/C Condensate Drain and Floor Drain Piping that is Collecting A/C Condensate Piping:

a. Pipe & Fittings: All A/C condensate drain piping, including floor drain piping that is collecting A/C condensate, 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. Also install cleanout at all equipment traps for cleaning and service.

b. Provide backwater valve (ball float type) at connections of condensate piping to stormwater piping and air gap fitting. Backwater valve shall be Model Z1099 as manufactured by Zurn or approved equal. Backwater valve shall have drain coated cast iron body, plastic ball float, bronze backwater bushing and replaceable neoprene seat.

c. Exterior condensate pipe penetrations must exit exterior wall above flashing. Extend discharge away from exterior walls as detailed.

3. Gas Fired Condensing Furnace Condensate Piping:

a. Piping shall be PVC pipe, ASTM D1785 schedule 40 with ASTM D2466 socket fittings for schedule 40. Join PVC pipe/fittings utilizing solvent cement ASTM D2564 with ASTM F656 primer.

B. Extended Valve Stems:

1. 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 insulated piping. Valve stem and collar shall be selected to suit insulation thickness and maintain valve handles outside of insulation.

C. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.

2.2. PIPE HANGERS

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, Victaulic, or Shurjoint for pipe ¾-inch and larger, and Figure 65 for pipe 2-inches and smaller, or approved equal Victaulic, Shurjoint, Carpenter Patterson, 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 Victaulic or Shurjoint. 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:

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NOMINAL PIPE SIZE IN	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
3/4 & 1	5	3/8
1 - ½	8	3/8
2	8	3/8
2 – ½	9	½
3	10	½
4	12	5/8
5	12	5/8
6	14	3/4
8	16	7/8
10	18	7/8
12	18	7/8

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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 ½ to 1 ½ 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. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.

F. Vertical Support: Steel riser clamp.

G. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

H. Copper pipe support: Carbon steel ring, adjustable, copper plated.

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.

K. For exterior pipe supports provide stainless steel, supports, brackets, hardware and anchors.

L. For pipe hangers installed in corrosive environments such as chemical storage rooms, janitor's closets…etc. the same shall (including hardware) shall be finished with on Electro-Galvanized Finish such as Galv-Krom® or approved equal.

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. PIPING SPECIALTIES

A. Gas relief valve piping shall be sized and installed in accordance with the latest edition of ASME Boiler & Pressure Vessel Code, CSD-1 including amendments. Pipe material shall be as specified for gas piping. Gas relief valve piping material shall be the same as hereinbefore specified for gas piping.

2.5. 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.

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2.6. DIELECTRIC CONNECTIONS:

A. Furnish and install electrically insulated dielectric waterway fittings, unions or flanges, as manufactured by Victaulic Company Style 47, EPCO Sales, Inc., or approved equal at the following locations:

1. Where steel piping systems join copper piping.
2. Where copper tube connects to 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.
4. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service, and shall meet the low-lead requirements of NSF-372. Basis of Design: Victaulic Series 647.

2.7. 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 ¾-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.

2.8. 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.

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.

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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 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. Ends of pipe shall be reamed so as to remove all burrs.

B. 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.

C. All valves, strainers, caps, and other fittings shall be readily accessible.

D. 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.

E. 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.

F. Install all valves with stem upright or horizontal, not inverted.

G. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

3.2. 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 and test 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. All exposed piping shall be hard copper tubing with brazed joints. Refer to Architectural Contract Documents to determine exposed areas.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

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F. Install piping adjacent to units to allow service and maintenance.

G. Install piping free of sags and bends. Install VEE clevis hangers and VEE troughs on pipes less than ¾”inch in diameter.

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, 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.

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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).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400mm); minimum rod size, 3/8 inch (9.5mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400mm); minimum rod size, 3/8 inch (9.5mm).

W. For all interior refrigerant pipe/tubing that is less than 3/4inch in diameter, utilize VEE type clevis hanger Model 200 V and VEE type trough Model 200 VT; as manufactured by Carpenter and Patterson or approved equal. VEE trough materials shall be carbon steel with pre-galvanized finish. Install as required to maintain maximum hanger spacing requirements.

X. Support multifloor vertical runs at least at each floor.

Y. 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.

Z. 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, Sporlan, or approved equal, liquid line solenoid valve l20V/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.

AA. All accessories shall be ARI rated. Furnish required nitrogen and refrigerant to fully test and charge system. Flood piping system with nitrogen when brazing.

BB. Refrigerant piping shall be Type 1 hard temper (ACR) copper tubing with wrought copper brazed fittings. Make joints with brazed wrought copper fittings.

CC. 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.

DD. All refrigerant/suction lines sets shall be fully insulated. Exterior pipe insulation shall be fully jacketed as specified in Division 23 Section, “HVAC Insulation”. Exposed interior pipe insulation shall be fully jacketed as specified in Division 23 Section, “HVAC Insulation”.

EE. Follow ASHRAE 15, latest edition procedures for charging and purging of systems and for disposal of refrigerant.

FF. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

GG. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

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HH. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

II. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

JJ. Fully charge completed system with refrigerant after tested.

KK. Provide electrical connection to solenoid valves.

LL. Refrigerant monitoring piping shall be connected to refrigerant monitoring equipment and piped per the Manufacturer's requirements.

MM. Install liquid indicators in liquid line leaving condenser, and on leaving side of liquid solenoid valves.

NN. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.

OO. Install strainers in main liquid line where multiple expansion valves with integral strainers are used.

PP. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

QQ. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

RR. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping and 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 500 psig or higher as required by authorities having jurisdiction.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

SS. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

TT. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

UU. Adjust set-point temperature of the conditioned air or chilled-water controllers to the system design temperature.

VV. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.

NOT FOR BIDDING

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.

WW. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

XX. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

YY. 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.

3.3. PIPE JOINTS INSTALLATION REQUIREMENTS

A. Brazed 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 brazing material per joint for each size pipe shall be used in accordance with the manufacturer's recommendations.
5. Brazed 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 brazing material starts to melt to insure an even distribution of the brazing material.
7. The excess brazing material shall be removed while it is still in the plastic state leaving a fillet around the cup of the fitting.
8. Brazed joints shall be suitable for working pressure of 550 psig and for working temperature of not less than 250 degrees F. The type of brazing material 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.

B. Where copper piping joins steel piping, approved bronze adapters shall be used.

C. Prohibited Connections: No direct weld 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.

NOT FOR BIDDING

3.4. 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.

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.

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Q. Refer to structural documents for appropriate connection/attachment materials to building.

3.5. PIPING IDENTIFICATION INSTALLATION REQUIREMENTS

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
2 ½ to 6	12	1 ¼
8 to 10	24	2 ½
Over 10	32	3 ½

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3.6. VALVE IDENTIFICATION REQUIREMENTS

A. All valves shall be tagged with a numbered tag.

B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.

C. Provide a minimum of six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in each mechanical equipment room including each air handling unit mechanical equipment room. Additional copies shall be provided in each copy of the O&M manuals.

3.7. CLEANING PIPING AND EQUIPMENT

A. All A/C condensate 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.

END OF SECTION

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SECTION 230548 - VIBRATION CONTROLS FOR HVAC & PLUMBING 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, Vibration Mounting and Controls, 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 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.

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1.4. PROJECT RECORD DOCUMENTS

A. Record actual locations of hangers including attachment points.

1.5. COLOR CODING

A. All springs shall be color coded for load carrying capacity.

1.6. ALTERNATES

A. Refer to Division 01 Section, Alternates - Alternates for description of work under this section affected by alternates.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Isolators shall be the equivalent of the following types by Mason Industries, Inc., Korfund, Inc., Kinetic Noise Control, Inc., Vibro Acoustics 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

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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.

B. Spring Isolator: Spring type isolators shall be free standing and laterally stable without any housing and complete with ¼ " neoprene acoustical friction pads between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflections, compressed spring height and solid spring height. Mountings shall be type SLF as manufactured by Mason Industries, Inc. or as approved equal.

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.

D. Precompressed Suspension Spring Isolators: Vibration hangers shall be as described in "C" above, but they shall be precompressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a scale drawing of the hanger showing the 30° capability. Hangers shall be type PC30N.

E. Ductwork Suspension Spring Isolators: Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. 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. Spring shall have a minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps. Submittals shall include a scale drawing of the hanger showing the 30° capability.

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Hangers shall be type W30.

2.9. INERTIA BASES

A. Structural Bases: Vibration isolator manufacturer shall furnish integral structural steel bases. Bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of one inch- bases shall be type WF.

B. Structural Rails: Vibration isolator manufacturer shall provide steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment. Inverted saddles shall be type ICS.

C. Concrete Bases: Vibration isolator manufacturer shall furnish rectangular structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. In general, bases shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6". Forms shall include minimum concrete reinforcement consisting of half inch bars or angles welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom, or additional steel as is required by the structural conditions. Forms shall be furnished with steel members to hold anchor-bolt sleeves when the anchor bolts fall in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Concrete shall be 3,000 psi concrete. Mass of concrete inertia bases shall be minimum of 2 times weight of isolated equipment. Bases shall be type K.

2.10. 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 plys 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 90o 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.

C. 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.

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

E. 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 Diameter (Inches)	Length (Inches)
½ "	12"
3/4"	12"
1 ½ "	12"
1 ½ "	12"
2"	12"
2 ½ "	12"
3"	18"
4"	18"
5"	24"
6"	24"
8"	24"
10"	24"
12"	36"
14"	36"
16"	36"

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F. 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.

2.11. 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.

2.12. 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. A minimum of 4" thick reinforced concrete housekeeping pads shall be provided under all floor mounted equipment. Rest subbases on structural floor and reinforce with steel rods interconnected with floor reinforcing bars by tie bars hooked at both ends. Provide at least one (1) inch clearance between subbases and inertia bases, steel bases, and steel saddles with machinery in operation.

D. All vibration isolators exposed to weather or humid environment shall be hot dipped galvanized with springs coated with neoprene in accordance with paragraph hereinbefore described.

E. Concrete inertia bases shall be a minimum of two (2) times the weight supported. Clearance between the underside of the inertia base and the housekeeping pad below shall not be less than 1 inch. Concrete shall be 3000 psi. Install inertia bases in accordance with the recommendations of the machinery manufacturer and the inertia base manufacturer.

F. Anchor Bolts and Grout: Secure machinery to foundations and inertia bases with anchor bolts. Grout equipment with baseplates, the full area under baseplates with premixed non-shrinking grout. After grout has set, remove wedges, shims, and jack bolts and fill spaces with grout.

G. Common Machinery Foundations: Mount electrical motors on the same foundations as driven machinery. Support piping connections, strainers, valves, and risers on the same foundation as the pumps.

H. 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.

I. 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.

J. 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.

K. 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.

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L. 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.

M. 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.

N. 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 degrees without touching any object.

O. 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.

P. 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.

Q. Install in accordance with manufacturer's instructions.

R. Install isolation for motor driven equipment.

S. Bases:

1. Set steel bases for one inch (25mm) clearance between housekeeping pad and base.
2. Set concrete inertia bases for 2 inch (50mm) clearance between housekeeping pad and base.
3. Adjust equipment level.

T. Install spring hangers without binding.

U. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

V. 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.

W. 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.

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3.3. ISOLATION FOR SPECIFIC EQUIPMENT

A. The vibration isolator manufacture 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. Air Compressors:

1. All air compressors shall be mounted on concrete inertia bases supported on stable steel springs in series with ribbed neoprene pads selected for not less than 1.5 inch static deflection under full operating load. Mason Industries type SLF or as approved equal.

C. Energy Recovery Ventilators and Energy Recovery Modules:

1. All energy recovery modules and energy recovery ventilators, shall be supported on stable steel springs in series with ribbed neoprene pads selected for not less than 2.0" deflection under full operating load. Mason Industries type SLF springs or as approved equal. Following the manufacturer's specific installation instructions for specific equipment is acceptable.

D. Fans:

1. Fans up to 22" wheel diameter shall be mounted stable steel springs in series with ribbed neoprene pads selected for not less than 1.0" static deflection (Mason Industries Type SLF or equivalent).
2. Fans with wheel diameters 24" and greater shall be mounted on unhoused stable steel springs in series with ribbed neoprene pads and structural rails selected for not less than 1.5" static deflection (Mason Industries Type SLF or equivalent and structural rails Type ICS with thrust restraint provisions) and rails shall be Type ICS.
3. All fans suspended from the ceiling, joists or roof structure, including outside air fans, return fans, relief air, ventilation fans, and exhaust fans, shall be suspended using hangers incorporating steel springs in series with neoprene, selected for not less than 2.0" static deflection under full load (Mason Industries Type 30N or equivalent).

E. All horizontal, vertical, and recessed unit heaters 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).

F. Conventional Ductless Units: Indoor ductless units shall be supported with rubber grommet type suspension isolators. Outdoor ductless units shall be supported on ribbed neoprene pads resting on roof curbs (roof application) or concrete pad as indicated.

3.4. MANUFACTURER'S FIELD SERVICES

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

END OF SECTION

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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 Sections, 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, plumbing 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. Where balance valves and/or flow meter fittings are not indicated utilize ultrasonic flow meter to record fluid flow rates in gallons per minute.

1. Perform all work required to prepare the building HVAC and Plumbing systems for testing, adjusting, and balancing indicated by the Contract Documents as follows:

   a. Verify the air systems are ready for balancing.
   b. Verify the hydronic systems are ready for balancing.
   c. Verify the control systems are ready for balancing.
   d. Notify appropriate parties the system is ready for balancing.

2. Scope of work.

   a. Testing, adjusting, and balancing (TAB) of the HVAC systems, Plumbing Systems, and related ancillary equipment will be performed by an independent, third party, AABC Certified Agency, selected and employed directly by the Contractor. The preparation and corrections necessary for the testing and balancing of these systems, as described herein, are the responsibility of the Contractor.
   b. As part of the project Construction Contract, the Contractor shall make any changes or replacements to the sheaves, belts, dampers, valves, or other components required for correct balance as advised by the TAB Agency, at no additional cost to the Owner.
   c. The Contractor shall provide and coordinate the services of qualified, responsible subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting, and balancing period.
   d. In order that all systems may be properly tested, adjusted and balanced as required herein by these Specifications, the Contractor shall operate the systems at their expense for the length of time necessary to properly verify their completion and readiness for TAB, and the entire duration required for the TAB process.

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e. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The Contractor shall allow adequate time for the testing and balancing activities of the Owner-provided services during the construction period and prior to Substantial Completion, as defined in the AIA General Conditions and Supplementing Condition of this Construction Document.

f. The Drawings and Specifications indicate valves, dampers, and miscellaneous adjustment devices to be adjusted to obtain optimum operating conditions. It is the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access, as requested by the TAB Agency. Any malfunction encountered by TAB personnel and reported to the Contractor shall be corrected by the Contractor immediately so that the balancing work can proceed with a minimum of delays.

g. The scope of work, as defined herein, is to advise the Contractor of the coordination, adjustment, and system modifications that will be required under the project work to complete Owner requirements for final TAB. The Contractor's original bid shall allow for the costs of all work which may be required in the TAB phases, and which may be necessary for the completion of the TAB work as defined by the TAB Agency.

3. Submittals. The TAB Agency shall submit an agenda that will include:

a. Field observation reports.
b. An overview of system TAB procedures.
c. System testing which will include where ducts will be traversed, which instrumentation will be used, how correction factors for grille and diffuser will be obtained, how measurements will be verified at maximum and minimum, and how control components will be verified.
d. Report forms with each system's components identified and numbered.

E. The items requiring testing, adjusting, and balancing include, but are not limited to, the following:

Air Systems:
1. Air Flow Monitoring Stations
2. Ceiling Paddle Fans
3. Coils (Air Temperatures & Static Pressure Drops)
4. Diffusers, Registers and Grilles
5. Duct Smoke Detectors
6. Ductless Split System Units (Indoor and Outdoor units)
7. Energy Recovery Modules
8. Energy Recovery Ventilators
9. Electric Duct Heating Coils
10. Electric Heating Coils
11. Electric Radiant Heat Panels
12. Electric Unit Heaters
13. Exhaust Fans
14. Fans
15. Fire Dampers
16. Gas Fired Radiant Heaters
17. Gas Furnaces
18. Greenhouse HVAC Systems
19. Heat Recovery Systems
20. Intake/Relief Hoods
21. Radiant Heat Panels
22. Static Pressure Sensors

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23. Unit Heaters
24. Ventilation Fans
25. Zone Branch and Main Ducts

Hydronic Systems:
1. Condensate Pumps
2. Condensate overflow safety switches
3. Domestic Re-circulating Systems and Water Heater
4. Emergency Fixture Mixing Valves
5. In-line Pumps
6. Thermostatic Mixing Valves

1.2. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.3. GENERAL COMMISSIONING REQUIREMENTS

A. Refer to Division 01 Section, "General Commissioning Requirements" for description of work under this Division affected by General Commissioning.

1.4. PRELIMINARY 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. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

C. Beginning of work means acceptance of exiting conditions.

1.5. QUALIFICATIONS OF THE BALANCE AGENCY

A. The balancing agency shall be a member of the Associated Air Balance Council (AABC).

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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 by the certified test and balance engineer.

D. All personnel used on the project will be employees of an AABC Certified Agency. All work will be performed under the direct supervision of the AABC Certified Test and Balance Engineer (TBE). All work will be performed with AABC Certified Test and Balance Technicians (TBT) Resumes including education, experience, and certification of each person on the project shall be submitted.

E. Warranty. The AABC Agency shall submit a National Project Performance Guaranty.

1.6. PERSONNEL

A. All personnel used on the project will be employees of an AABC Certified Agency. All work will be performed under the direct supervision of the AABC Certified Test and Balance Engineer (TBE). All work will be performed with AABC Certified Test and Balance Technicians (TBT). Resumes including education, experience, and certification of each person on the project shall be submitted as informational submittals.

1.7. WARRANTY

A. The AABC Agency shall submit a National Project Performance Guaranty.

1.8. PRE-BALANCING CONFERENCE

A. Convene a conference one week prior to commencing work of this Section with all appropriate individuals.

1.9. 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 grilles, 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

1.10. COORDINATION

A. It will be necessary for the balancing agency to perform its services in close coordination with the mechanical contractor.

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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 construction manager, 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.

1.11. 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.

1.12. RESPONSIBILITIES OF THE TAB AGENCY

A. Liaison and Early Inspection. The following reviews, observations, and tests shall be performed by the TAB Agency:

1. Review the mechanical drawings and specifications for balanceability and provide commentary. Verify proper types and locations of all Test and Balance devices.
2. During construction, review all approved HVAC submittals such as control diagrams, air handling devices, hydronic devices, and other components that pertain to TAB work and balanceability. Assist the commissioning agent with all Functional Performance Testing.
3. Perform construction observations and submit a written report:

    a. On the ductwork prior to insulation and/or ceiling cover-up.
    b. On the piping prior to insulation and/or ceiling cover-up.

4. Witness duct pressure test as defined in the specifications, and submit a written report.
5. Perform a pre-balance site review, and submit a written report.
6. During the balancing process, abnormalities and malfunctions of equipment or components may be discovered by the TAB personnel. The Construction Inspector, Architect, Engineer, and Owner shall be advised in writing so that the condition(s) can be corrected by the Contractor. The written document need not be formal, but shall be understandable and legible. The TAB Agency shall not instruct or direct the Contractor in any of the work, but will make reports to the appropriate parties.

B. Final Air Balance. When systems are complete and ready for operation, the TAB Agency will perform a final air balance for all air systems and record the results. The volume of air for the supply, return, exhaust, and outside air equipment and terminals will be tested and balanced within the tolerances of the AABC Standard, or as specified, whichever is more stringent. Air handling unit and fan volumes shall be adjusted by changing fan speed. Air distribution device volumes shall be adjusted using the duct dampers and not the grille face. Air distribution devices shall be balanced with air patterns as specified. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown. The general scope of balancing by the TAB Agency will include, but is not limited to, the following:

1. Filters: Check air filters and filter media. Balance systems with essentially clean filters and

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filter media.

2. Fan Speed: Measure and record RPM for each fan. Provide Controls Contractor with drive parameters for variable speed drives.
3. Voltage and Amperage Readings: Measure and record the final operating voltage and amperage for each motor.
4. Static Pressure Profile: Static pressure profiles shall be measured and recorded across each supply fan, cooling coil, heating coil, heat of rejection equipment fans, return air fan, air handling unit filter, exhaust fan, and at the furthest air device or terminal unit from the air handler supplying that device.
5. Equipment Air Flow: Adjust and record supply, return, outside and exhaust air CFM and temperatures, as applicable, at each fan and coil.
6. Coils Temperatures: Set controls for full cooling and for full heating loads. Read and record entering and leaving dry bulb and wet bulb (cooling only) temperatures at each cooling coil, heating coil, or furnace and HVAC terminal unit. At the time of reading, record entering and leaving water temperatures and air pressure drops. In variable flow systems, adjust the air flow to design for all the above readings.
7. Zone Air Flow: Adjust each HVAC terminal unit and each air-handling unit for design CFM.
8. Outlet Air Flow: Adjust each supply diffuser, register and grille, and each exhaust inlet to within the tolerance per the AABC Standard.
9. Pitot Tube Traverses: For use in future troubleshooting by maintenance personnel, all main supply, return, outside air, and exhaust ducts shall have air velocity and volume measured and recorded by the Pitot tube traverse method shown in the AABC Standard. Locations of these traverse test stations shall be described on the sheet containing the data. All Pitot tube traverses shall be clearly identified on the outside of the duct insulation with the traverse identified and duct size. Submit half scale drawings showing the locations of all duct traverses.

C. Final Water Balance. When systems are complete and ready for operation, the TAB Agency will perform a final water balance for each hydronic HVAC system. The general scope of balancing by the TAB Agency will include, but not be limited to, the following:

1. Adjusted System Tests: Adjust balancing valves at each coil and heat exchanger for design flow per the AABC Standard. Adjust balancing valves at pumps to obtain design water flow. Record pressure rise across pumps, and obtain GPM flow from the pump curve. Permanently mark the balanced position for each valve. If discharge valves on the pumps are used for balancing, record the head being restricted by the valves. Test and record autoflow valve differential pressures and adjust pump speed to optimize and minimize autflow differential pressure.
2. Pressure Readings: Water pressure shall be recorded at all gauge connections. Pressure readings at coils and pumps shall be related to coil and pump curves in terms of GPM flow and through flow measuring stations, where provided and installed, at each hydronic unit. The flow of water through all water coils shall be adjusted by balancing valves until the rated pressure drop across each coil is obtained and total water flow is verified by flow measuring station. For coils equipped with three-way valves, the rated pressure drop shall first be adjusted through the coils. The bypass valve shall then be adjusted on each coil until the pressure drop between supply and return connections is the same as with the flow through the coil.
3. Voltage and Amperage Readings: Read and record the final operating voltage and amperage for each pump motor.
4. Pump Speed: Measure and record RPM for each pump. Provide Controls Contractor with drive parameters for variable speed pumps.

D. Testing of Temperature Control Systems as applicable to the project.

1. Air Handling Units

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a. Start each air handling unit; verify and document:
- Dampers modulate properly and in the correct sequence.
- Fan(s) VFD ramps to design speed or proper controlled speed.
- All gas furnaces and electric heating coils shall operate in response to the controlled temperature.
- All interlocked fans and/or devices energize.
- All alarms and safeties are operational and will alarm or shut down the unit.
- All operating scenarios are tested; e.g.: economizer cycle, minimum/maximum airflows, outside airflows at unit minimum/maximum volume, and special sequences.
- All end switches and positioners are properly set.
- All pressure controllers respond to increases or decreases in system pressure.
- All temperature and pressure sensors are calibrated.
- Airflow monitors report the correct airflow and control devices respond correctly to a change in airflow; e.g.: outside air control.
- Reset control sequences operate in response to changes in system temperatures, flows, or pressures.
- Correct operation of fan sequences when multiple fans are installed.
- Test all static pressure sensors and controls and calibrate the same.

b. Shut down each air handling unit; verify and document:
- Dampers respond properly (open, close, or modulate), and in the correct sequence.
- All fan systems ramp down and stop.
- Correct operation of fan sequences when multiple fans are installed.
- Emergency mode operation; e.g.: freeze protection.
- Interlocked devices turn off.
- System starts for setback temperature control.
- System starts on a temporary occupancy override.
- All gas furnace gas valve trains go to their specified position.
- All alarms and safeties remain operational.
- All electric heating coils shall de-energize.

2. Fan Systems

a. Start each fan or fan system; verify and document:
- Interlocks and lockouts operate in accordance with the sequence.
- Fan(s) VFD ramps to design speed or proper controlled speed.
- All alarms and safeties are operational and will alarm or shut down the fan.
- Dampers modulate properly and in the correct sequence.
- All interlocked fans and/or devices energize.
- All end switches and positioners are properly set.
- All pressure controllers respond to increases or decreases in system pressure.
- All temperature and pressure sensors are calibrated.
- Airflow monitors report the correct airflow and that control devices respond correctly to a change in airflow; e.g.: outside air control.
- Correct operation of fan sequences when multiple fans are installed.

b. Shut down each fan or fan system; verify and document:
- Dampers respond properly (open, close, or modulate) and in the correct sequence.
- All fan systems ramp down and stop.
- Correct operation of fan sequences when multiple fans are installed.

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- Interlocked devices turn off.
- All alarms and safeties remain operational.

3. Hydronic Systems

   a. Start hydronic systems; verify and document:
      - Pump(s) ramp to design speed.
      - All interlocked devices energize.
      - All alarms and safeties are operational and will alarm or shut down the system.
      - All temperature and pressure sensors are calibrated.
      - Flow meters report the correct water flow and that control devices respond correctly to a change in water flow.
      - Differential pressure across all flow meters and equipment.
      - Correct operation of pump, HVAC equipment when multiples are installed.

   b. Shut down hydronic systems; verify and document:
      - Pump(s) ramp down to off position.
      - All interlocked devices de-energize.
      - All alarms and safeties remain operational.
      - Correct shutdown of pump.

4. Component Calibration
   All temperature, airflow, fluid flow, pressure, and flow measuring components shall be measured and compared to the control system readout; verify and document:

   - The air temperature sensors for each coil, heat exchanger. If the temperature is not reading within tolerance, the sensor will be reported to the control contractor for calibration.
   - The room temperature, relative humidity, and $C0_2$ sensors. If the sensors are not reading within tolerance, the sensors shall be reported to the control contractor for calibration.
   - The water temperature sensors for each coil, heat exchanger. If the temperature is not reading within tolerance, the sensors shall be reported to the control contractor for calibration.
   - All air and water pressure sensor readouts. If the pressure is not reading within tolerance, the sensor shall be reported to the control contractor for calibration.
   - All flow measuring device readouts. If the flow readout is not recording within tolerance, the sensor shall be reported to the control contractor for calibration.

5. Point Verification

   - Point verification for the digital control system documents that every point is operational and the setpoint, flow, temperature, or pressure is reporting correctly to the graphic interface. Verify and document all points.

6. Dynamic Testing

   - Dynamic testing involves making a change of value at the sensor in order to observe the system's reaction and how it regains the original setpoint. Verify and document the system's response.

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1.13. REPORTS

A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. The report summary is a project narrative describing the outcome of the testing and balancing and shall include a list of items that document all system variations deviating from design tolerances. Information can also be included that suggests possible resolutions.

B. All measurements and recorded readings that appear in the reports shall be certified by the Agency's Test and Balance Engineer.

C. Submit reports on forms approved by the Engineer. Hard and/or electronic copies of the final report shall be submitted in accordance with the Contract Requirements. The report shall indicate a summary of actual operating data and any abnormal operating conditions. The report shall contain all required information as described within this specification, including the information formatted and shown in the AABC Standard.

D. For phased projects, submit a final, complete, and comprehensive TAB report with index for all phases.

E. When the Engineer reviews TAB reports and provides comments, address each comment in writing for all re-submitted TAB reports.

1.14. TAB FINAL ACCEPTANCE INSPECTION

A. At the time of TAB final acceptance inspection, the TAB agency shall recheck, in the presence of the Owner's representative, specific and random selections of data recorded in the certified test and balance report.

B. Points and areas for recheck shall be selected by the Owner's representative.

C. Measurements shall be verified at the same test conditions as the submitted and approved test and balance agenda.

D. Selections for verification shall not exceed 10% of the total number tabulated in the report, except where special air systems require a complete recheck for safety reasons.

E. If 10% of the random verification tests demonstrate a measured flow deviation of 10%, or more from that recorded in the certified test and balance report, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, a new certified test and balance submitted, and a new inspection test made. There shall be no additional cost to the Owner for this work.

F. Final acceptance shall occur after successful completion of the TAB verification process.

1.15. RESPONSIBILITIES OF THE MECHANICAL CONTRACTOR

A. The mechanical contractor shall sufficiently complete the installation and start all HVAC and plumbing 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.

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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. The Contractor shall:

1. Have the building, air conditioning systems, heating systems, and plumbing systems in complete operational readiness for TAB work to begin.
2. The Contractor shall allow sufficient time for the TAB Agency to perform their contracted work within the construction schedule. The Contractor shall complete work by systems or floors, whichever is the most efficient for testing systems. After award of the contract and the completion of the construction schedule by the Contractor, a TAB coordination meeting shall be held with the TAB Agency, the Contractor and primary subcontractors, including but not limited to mechanical, electrical, and building automation subcontractors to develop a testing schedule for the project. The Contractor shall submit copies of the proposed schedule to the TAB Agency two weeks prior to this meeting.
3. Promptly correct deficiencies of materials and workmanship identified as delaying completion of TAB work.
4. Be responsible for any added costs to the Owner resulting from the Contractor's failure to have the building air conditioning systems and plumbing systems ready for TAB when scheduled, or from the Contractor's failure to correct deficiencies promptly.

D. Facility Operational Readiness

1. Complete operational readiness of the building requires that the building envelope be complete. This includes the installation of doors, windows, and ceilings to obtain simulated or projected operating conditions.

E. Air Distribution Systems

1. Verify installation for conformity to design.
2. Terminate all supply, return, outside air, exhaust air, relief air, ventilation air ducts, and pressure test them for leakage. Test pressure and leakage rate shall be as specified in Division 23 Section, HVAC Air Distribution System under Leakage Tests. Pressure testing shall be performed by mechanical contractor and witnessed by Test and Balance Engineer.
3. Ensure that all splitters, extractors, volume dampers, fire dampers, and smoke damper are properly located and functional. Dampers serving requirements of minimum and maximum outside - return - relief, and exhaust air shall provide tight closure and full opening, with a smooth and free operation.
4. Verify that all supply - return - exhaust and transfer grilles; registers, and diffusers are installed, operational, and sealed tightly.
5. 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.
6. 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.
7. Make any necessary changes to the sheaves, belts, and dampers, as required by the balancing agency, at no additional cost to the owner.
8. Install clean filters.
9. Coils shall be clean with fins straightened, bearings shall be properly greased, belts shall be aligned and tightened, and the system shall be completely operational. The Contractor shall verify that all systems are operating within the design pressure limits of the piping and ductwork.
10. All supply, return, exhaust, and relief fans shall be operating and verified for: freedom from

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vibration, proper fan rotation and belt tension; heater elements in motor starters to be of proper size and rating, as the as per the starter manufacturer. Record motor amperage and voltage on each phase at start-up, verifying they do not exceed nameplate ratings.

11. All terminal units shall be installed and functional. Controls commissioning shall be complete.
12. For heat pumps, condensing units provide refrigerant suction and discharge pressure to Test and Balance Engineer for inclusion in the final TAB Report.

F. Water Circulating Systems

1. Verify installation for conformity to design.
2. Check all pumps to verify pump rotation.
3. Ensure that systems are clean, with the proper strainer screens installed for normal operation.
4. Check all pump motors for current on each phase and voltage, to ensure that motors do not exceed nameplate rating.
5. Provide thermal overload protection of proper size per the starter manufacturer and rating. Record thermal overload ratings for all motors. Insert data in Test and Balance Report.
6. Ensure that all water circulating systems shall be full and free of air; that expansion tanks are set for proper water level; and that all air vents were installed at high points of systems and are operating.
7. All piping shall be terminated and pressure tested for leakage as required by the specification. All valves shall be set to their full open position, bypass stop valves shall be closed, and mixing valves shall be set to full-flow through the the system's components. After the system is flushed and checked for proper operation, all strainers shall be removed and cleaned. The Contractor shall repeat the operation until circulating water is clean. The start-up strainers shall then be removed and hung adjacent to the pumps.
8. The operating parameters of the pumps shall be capable of obtaining design requirements.
9. Proper balancing devices shall be installed in the designated locations. These devices include but are not limited to flow meters, pressure taps, thermometer wells, and balancing valves.

G. Notification of System Readiness

1. After completion of the work, the Contractor shall notify the Owner and TAB Agency, in writing, certifying that the work has been accomplished and that the building, air conditioning, and plumbing systems are ready for testing, adjusting, and balancing. The Contractor shall include a copy of the tabulated data of the start-up reports.
2. The Contractor shall notify the TAB Agency of the readiness for balancing and forward copies of the Contractor's certification and the tabulated data.
3. Should the TAB Agency be notified as described above and the inspection reveal the TAB services notification to have been premature, all costs of the inspection by the TAB Agency shall be reimbursed by the Contractor.

1.16. CONTRACTOR SUPPLIED ITEMS

A. As a requirement of the TAB contract, the Contractor's Project Manager shall compile and provide the TAB Agency the following:

1. One set of mechanical specifications.
2. All pertinent change orders.
3. All Request(s) for Information (RFI).
4. One complete set of MEP Drawings.
5. One copy of approved submittal data on equipment installed and controls submittal with sequences of operation.

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6. All HVAC Control Communications software with the appropriate licenses and hardware interfaces.
7. All Addendums and RFI's (Requests for Information).

1.17. RESPONSIBILITIES OF THE TEMPERATURE CONTROL CONTRACTOR

A. The temperature control contractor shall complete the installation of the temperature control system, and operate and test all control systems to ensure they are functioning properly as designed. The temperature control contractor shall assist the balancing agency in testing and balancing the HVAC systems, as described hereinafter.

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, freeze stats, high and low temperature thermostats, safeties, and duct smoke detectors.
2. Verify that all controlling instruments are calibrated and set for design operating conditions.
3. Calibrate temperature sensors after installation, and before the temperature sensors control verification tests are performed. The balancing agency shall prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditional space for each separately controlled zone.
4. The temperature control contractor shall allow sufficient time in the project to provide assistance and instruction to the balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may need set points changed so that the testing and balancing work can be performed.
5. The Control Contractor shall schedule a meeting with the Mechanical Contractor, TAB Agency, and Owner's representative for a pre-submittal review to establish that their interpretation of the control sequence is correct.
6. The Control Contractor shall verify that all controlling instruments are calibrated and set for design operating conditions, with the exception of components that require input from the TAB Agency. A default shall be set for such components. The Control Contractor shall cooperate with the TAB Agency and provide all software and interfaces necessary to communicate with the system.
7. The Automatic Temperature Control Contractor shall thoroughly check all controls, sensors, operators, and sequences before notifying the TAB Agency that the Energy Management System is operational. The Energy Management System Contractor shall provide technical support in the form of technicians and necessary computers to the TAB Agency for a complete check of those systems.
8. The Fire Alarm (FA) Contractor shall thoroughly check all detection devices, sequences, interlocks, and other components before notifying the TAB Agency that the system is operational, including the Fireman's Override Panel. The FA Contractor shall provide all documentation that identifies all fire and smoke detection devices, all smoke zones, and all alarm and event chart devices. The FA Contractor shall certify to the Contractor that the systems are totally operational prior to the start of TAB.

B. All control sequences, software, equipment, and components shall be started-up by a qualified technician. Start-up report shall be submitted to Engineer prior to the commencement of testing and balancing work. Testing and balancing shall not commence until start-up reports are completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

1.18. 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 and plumbing systems are complete and ready for testing and balancing. The

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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.

C. Mechanical Contractor shall notify the Construction Manager of the start date of this portion of the work.

1.19. 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.

C. TAB Agency shall notify Construction Manager or of all deficiencies found during initial survey.

1.20. 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 exterior surface of the duct insulation. For exterior ductwork, the duct traverse locations must be identified with waterproof labels.

PART 2 PRODUCTS (NOT APPLICABLE)

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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 twelve (12) months prior to use and shall be checked for accuracy prior to and during the work. Submit certificate for calibration of all equipment utilized on project with date of calibration clearly identified.

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/plumbing system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when

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installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems – Duct Design". Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens and indicated perforations.

K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

L. Examine system pumps to ensure absence of entrained air in the suction piping.

M. Examine operating safety interlocks and controls on HVAC equipment.

N. 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. Outside Air - Test and adjust system minimum outside air by Pitot-tube traverse. If a Pitot-tube traverse is not practical, the percentage of outside air may be determined by calculations from the return air, outside air, and mixed air temperatures. Make allowances for heat of compression and motor heat where applicable.
5. Static Pressure - Test and record system static pressures, including suction and discharge static pressure of each fan. Record hood static pressure at kitchen hood exhaust taps, canopy hoods, and similar equipment. 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.
6. Air Temperature - Take wet-bulb and dry-bulb air temperatures on the entering and leaving side of each cooling coil and/or heat recovery coil. Dry-bulb temperature shall be taken on the entering and leaving side of each heating coil.
7. Zone Ducts - Adjust zone ducts to within design CFM requirements. At least one zone balancing damper shall be completely open.

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8. Main Ducts - Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
9. Branch Ducts - Adjust branch ducts to within design CFM requirements. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open.
10. Magnahelic Gauges - Static pressure at static pressure tips for Magnahelic gauges shall be recorded in Test and Balance Reports.
11. Tolerances - Test and balance each diffuser, grille, and register to within 10 percent of design requirements. Test and balance all fans to within 5 percent of design requirements.
12. Identification - Identify the location and area of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.
13. Description - Record the size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.
14. Minimizing Drafts - Adjust all diffusers, grilles, and registers to minimize drafts in all areas.
15. 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.
16. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable air volume systems at maximum air flow rate, full cooling, and at minimum airflow rate, full heating.
17. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
18. For heat pumps or condensing units 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.
19. For all equipment specified with condensate overflow safety switches/floats test operation of such device and record results. Verify interlock with ATC system.
20. Outside air and exhaust/relief air measurements must be measured and submitted in all modes of operation including the following:

    a. Min Min Outside Air/Exhaust/Relief air mode (square footage outside air).
    b. Min Max Outside Air/Exhaust/Relief air mode (square footage and people outside air).
    c. Maximum outside air/exhaust/relief mode (full 100% economizer mode).

21. For all outside air modes of operation record and submit full static pressure profiles, amperage, BHP, air flow rates, external static pressure, and internal static pressure. Verify airflow rates with air flow monitoring stations and record results.

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 balancing agency shall perform the following testing and balancing functions in accordance with the AABC National Standards.

C. All domestic re-circulating 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. Pumps - Adjust all domestic hot water re-circulating water pumps to meet design GPM requirements. Check pumps for proper operation. Pumps shall be free of vibration and cavitation. Measure and record operating current and voltage. Check and record thermal

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overloads installed on all pumps. Record in Test and Balance Report.

5. Tolerances - Proceed to balance all pumps, balance valves to within 5 percent of design requirements.
6. Marking - Mark all settings and record all data after completing the flow readings and coil adjustments.
7. Test all A/C condensate pumps for proper operation.
8. Test condensate overflow safety switches and record test results in the Test and Balance Report.

3.5. DOMESTIC HOT WATER RE-CIRCULATING SYSTEMS PROCEDURES

A. The domestic hot water re-circulating system shall be tested and balanced as indicated on the contract documents including:

1. Balance of circuit setters to design quantities indicated on contract documents.
2. Balance of re-circulating pumps to meet design GPM requirements.

B. Domestic Water Heaters:

1. Verify that all domestic water heaters have been filled and started by others and are in operation.
2. Test and record outlet temperature of water heater at approximate design recovery.
3. Current and Voltage: As applicable, test and record voltage and amperage, compare data with nameplate limits to ensure water heater elements or burners do not exceed nameplate data.
4. Test discharge temperature and flow rate at all lavatory/hand sink mixing valves. Also measure time period for fixtures to obtain hot water.

3.6. FIRE AND SMOKE TESTING PROCEDURES

A. The TAB agency shall test fire/smoke damper to assure operation. It shall verify that an access door has been installed for each fire damper. For fire dampers, the TAB agency shall open the access door, disconnect the fusible link, and allow the damper to close. Operation should be smooth and the damper must close completely. The TAB agency shall then reset the damper. For the smoke damper, the TAB agency shall open the access door, activate the damper, and observe operation. The damper must close quickly and completely. The TAB agency shall then reset the damper and observe its complete opening. Record results of tests within TAB report.

3.7. 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.

3.8. 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:

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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.
4. Test and calibrate all air flow monitoring stations for proper air flow.
5. Test and calibrate all differential pressure sensors. Record set point in Record and Information Books.

3.9. 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. Six (6) hardcopies and one (1) electronic copy 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. Construction Manager
10. Mechanical Contractor
11. Commissioning Agent
12. Dates tests were performed
13. Certification
14. Duct Leakage Tests
15. 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.

E. The test and balance report shall include a table of contents with numbered pages.

3.10. 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 air-handling 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.

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4. Suction and discharge static pressure of each fan, as applicable. Include pressure drops across coils, dampers, 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. Pump Test Forms - Submit pump curve showing design, operating, and no-flow points of operation. Also, record the following items on each pump test form:

1. Manufacturer, size, model, service and serial number.
2. All design and manufacturer's rated data.
3. Pump operating suction and discharge pressure and final total dynamic head.
4. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total dynamic head. This procedure is to determine actual impeller size. Record impeller size.
5. Rated and actual operating current, voltage, and brake horsepower of each pump motor.
6. Total operating head pressure.
7. Shutoff, discharge and suction pressures.
8. Shutoff, total head pressure.

C. 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 static pressure drop across each coil.
4. Wet-bulb and dry-bulb temperatures entering and leaving each cooling coil; dry-bulb temperatures entering and leaving each heating coil.
5. Air flow (Design and Actual).
6. For DX-coil, provide design and actual saturated suction temperature.
7. For DX-Coil, provide design and actual discharge pressures.

D. Airflow Monitoring Station Test Forms:

1. Identification /location.
2. Manufacturer.
3. Systems.
4. Size and Model Number.
5. Area.
6. Design Velocity.
7. Design Airflow.
8. Test Velocity.
9. Test Airflow.
10. Static Pressure Drop and Velocity Pressure.
11. Station Calibrated Setting.

E. Electric Duct Heating Coil and Electric Unit Heater Test Forms:

1. Manufacturer.
2. Identification/number.

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3. Location.
4. Model number.
5. Design kW and actual kW.
6. Phase, voltage, amperage.
7. Test voltage (each phase).
8. Test amperage (each phase).
9. Air flow, specified and actual.
10. Temperature rise, specified and actual.

F. 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

G. V-Belt Drive Test Forms:

1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.
5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

H. 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.

I. 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.

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d. Calibrated.

7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

J. Air Distribution Test Forms:

1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

K. Gas Infrared Heater and Gas Furnace Test Forms:

1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Phase, voltage, amperage.
6. Test voltage
7. Test amperage
8. Air flow, specified and actual.
9. Temperature rise, specified and actual.
10. Pressure drop, specified and actual.
11. Delivered Gas Pressure, Specified and Actual.

L. 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.
12. Operation of refrigerant mitigation controls, fan interlock, and refrigerant leak detection sensors.

M. Energy Recovery Ventilators Test Forms: Submit fan curve showing design and operating points of operation. Also, record the following on each air-handling 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

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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, energy wheels, and similar devices.
5. Outside-air, and exhaust air total CFM.
6. Actual operating current, voltage and brake horsepower of each fan motor.
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. Total and external static pressure.
11. Rated and actual static pressure drop across each energy wheel.
12. Wet-bulb and dry-bulb temperatures entering and leaving each energy wheel. Dry-bulb temperatures entering and leaving each heating coil.
13. Record carbon dioxide set points and actual readings for exhaust air stream at each ERV and global CO2 sensor.
14. Record the supply fan and exhaust fan maximum hertz/speed and minimum hertz/speed. Provide measurements to ATC subcontractor for fan tracking control.
15. Test minimum air flow rate and maximum air flow rate. Submit amperage, air flow rates, RPM, hertz, and static pressure profile in all modes of operation.

N. Energy Recovery Modules Test Forms:

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. Outside-air, and exhaust air total CFM.
5. Actual operating current, voltage and brake horsepower of each wheel motor.
6. Final RPM of each wheel.
7. Wheel and motor sheave manufacturer, model, size, number of grooves, bore, and center distance.
8. Belt size, quantity and make.
9. Rated and actual static pressure drop across each energy wheel.
10. Wet-bulb and dry-bulb temperatures entering and leaving each energy wheel.
11. Test minimum air flow rate and maximum air flow rate. Submit amperage, air flow rates, RPM, hertz, and static pressure profile in all modes of operation.

O. Gas Unit Heater Test Forms: - awaiting confirmation from DMB

1. Manufacturer.
2. Identification/number.
3. Location.
4. Model number.
5. Phase, voltage, amperage.
6. Test voltage
7. Test amperage
8. Air flow, specified and actual.
9. Temperature rise, specified and actual.
10. Pressure drop, specified and actual.
11. Delivered Gas Pressure, Specified and Actual.

P. Air Cooled Heat Pump Test Forms:

1. Manufacturer

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2. Model Number
3. Location
4. Size/Capacity
5. Fan RPM (Min and Max)
6. Compressor and Heat Pump Fan Electrical Characteristics
7. Heat Pump Fan RPM
8. Amp Draw of all Components
9. Refrigerant Suction/Discharge Pressures
10. Thermal Overload Sizes

Q. Gas Fired Radiant Heaters Test Forms

1. Manufacturer, Model Number, Service Number
2. Location
3. All design and actual capacity information.
4. Electrical Characteristics
5. Discharge Air Temperature

R. Thermostatic Mixing Valve Test Forms

1. Manufacturer, Model Number, Series, Arrangement
2. All manufacturer data.
3. Verify all strainers are clean.
4. Leaving temperature actual and design.

S. Water Heater Test Forms

1. Manufacturer, Model Number, Series
2. All manufacturers' data.
3. Verify all safeties.
4. Record leaving water temperature actual and design.
5. Verify operation in all modes of operation.
6. Verify combustion air damper interlock.
7. Record electrical characteristics

T. Condensate Over Flow Switches/Floats Test Forms

1. Manufacturer
2. Type
3. Location
4. Equipment shut down verification
5. ATC interlock verification

U. Ceiling Paddle Fans Test Forms (Record the following on each ceiling paddle fan)

1. Manufacturer, Model Number, Serial Number
2. Voltage, Phase, Amps, Hertz
3. Fan RPM
4. Test and record fan rotation speed in both directions.

V. Electric Radiant Heat Panels Test Forms:

1. Manufacturer.
2. Identification/number.
3. Location.

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4. Model number.
5. Design kW and actual kW.
6. Phase, voltage, amperage.
7. Test voltage (each phase).
8. Test amperage (each phase).
9. Air flow, specified and actual.
10. Temperature rise, specified and actual.

END OF SECTION

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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.

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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.

1.7. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

1.8. SHORT CIRCUIT CURRENT RATINGS

A. Unless otherwise noted, all HVAC equipment shall include a nameplate that identifies the short circuit current rating (SCCR). Unless otherwise noted the SCCR rating for all HVAC equipment shall be a minimum of 65 KA.

1.9. PACKAGED EQUIPMENT BACNET CARDS

A. For all packaged units, furnish and install Bacnet cards for interface to the automatic temperature control system. Map over all Bacnet points and alarms and show on ATC system graphics. All alarms must be identified on ATC graphic.

PART 2 PRODUCTS

2.1. CONVENTIONAL DUCTLESS SPLIT SYSTEM HEAT PUMP (INVERTER TYPE) (WALL MOUNTED)

A. The heat pump air conditioning system shall be a Mitsubishi Electric Series split type Sanyo, LG, Daikin, Samsung, or approved equal. The system to consist of a slim silhouette, compact wall mounted packaged evaporator section with 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 Electrical Code (N.E.C.). The units shall be rated in accordance with ARI Standard 240 and bear the ARI label. A full charge of R-410A for 25 feet of refrigerant tubing shall be provided in the condensing unit. A 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 one (1) year 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.

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D. The indoor unit shall be completely factory assembled and wired. The casing shall have a white finish. The evaporator fan shall be a high performance, forward curve line flow fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings. A manually adjustable change vane shall be provided. The vane shall have the ability to direct the air from horizontal to vertical. An adjustable guide vane shall be provided to manually change the air direction from lift to right. The evaporator coil 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 with drain shall be provided under the coil. Split system heat pump manufacturer shall furnish condensate lift pumps for field installation within the indoor unit. Condensate pumps shall be complete with float switch sensor, alarm, reed switch, relay, contact, adapters, and detection block etc., for a completely operational system. Contractor shall mount, pipe, and wire condensate pump per split system heat pump manufacturer's recommendations. Condensate pump shall be model EE as manufactured by Sauermann or approved equal. The units' electrical power requirements shall be as scheduled on the contract drawings.

E. 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 a 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. The 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 accumulator and internal thermal overloads. The variable speed compressor shall be mounted so as to avoid the transmission of vibration. The refrigeration system shall have the capability to operate with a maximum height difference of 25 feet and overall refrigerant tubing length of 100 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 of nonferrous construction with smooth plate fins bonded to copper tubing. The coil shall be protected with an integral metal guard. The unit shall be controlled by the microprocessor located in the matching indoor unit. The unit electrical power requirements shall be as scheduled on the contract drawings. The outdoor heat pump unit shall be placed on vibration isolators and mounted on rooftop equipment rail or concrete pad as indicated. Inverter type compressor shall allow defrost without the need for auxiliary electric heat.

F. The control system shall consist of two (2) microprocessor section. One microprocessor section shall be factory wired and located within the indoor unit. It shall have the capability of sensing indoor coil temperature; receive and process commands from the hardwired remote controller; control the booster heater; and control the outdoor unit. The microprocessor within the wall mounted remote monitor and hardwired remote controller shall display set point; provide two (2) manually selected modes of cooling, normal and economy operation at 2 degrees above set point; provide manual heating selection; with set back operation of 4 degrees above set point for cooling and 4 degrees below set point for heating; and manual or automatic fan speed control. Automatic fan speed control shall be based upon the temperature difference between set point and room temperature maintaining lowest speed possible. The heating system shall be controlled so that only warm air is discharged whenever the indoor fan operates above the very low (VLO) speed. Heating shall be switched back to the heat pump only when the difference drops back to less than 3.6 degrees. The control voltage between the indoor unit and the outdoor unit shall be 12 volts D.C. The hardwired remote controller shall be wireless, using infrared line of sight for system control and shall include automatic ON/OFF timer; liquid crystal display; "I FEEL" control mode which adjusts temperature by tapping the button that describes the present condition "Too Cool", "Too Warm", or "OK". The optimum temperature set this way is memorized for immediate recall whenever the system is used again. The system shall be capable of automatic restart when power is restored after power interruption.

G. High condensate water safety shutdown: Each indoor unit's detection unit shall be interlocked to

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alarm and stop the outdoor unit if a high condensate water level is sensed.

H. Refrigeration Mitigation Controls: Furnish units with listed refrigeration mitigation controls, fan interlocks, and refrigeration leak detection equipment per ASHRAE 15 requirements.

I. Furnish low ambient kits to ensure units shall be capable of cooling down to 0°F ambient. Furnish wind baffles.

2.2. WALL MOUNTED (ARCHITECTURAL) HEATERS

A. General: Provide electric wall mounted heaters as indicated of type and minimum capacity as scheduled, and as specified herein.

B. Architectural design grille shall be 16 gauge steel, with closely spaced downflow discharge bars. Finish shall be duronodic brown baked enamel, with satin finished aluminum frame. Grille attachment screws shall be at bottom of grille frame to discourage tampering.

C. Build-in comfort thermostat shall have adjustment range between 55 degrees F and 85 degrees F, with manually set "no heat" position. Thermostat shall be tamper-resistant; adjustment accomplished by inserting narrow blade screwdriver through front bar grille.

D. Heating elements shall be Emerson-Chromalox or approved equal steel finned metal sheath elements.

E. Fan motor shall be totally enclosed and permanently lubricated for long life and low maintenance.

F. Heater shall contain automatic reset thermal overheat protector to disconnect power in event of overheating due to accidental blockage.

2.3. ELECTRIC RADIANT HEATERS

A. Electric Radiant Ceiling Panel

1. General: Provide electric radiant ceiling panels as indicated on the drawings. The electric ceiling heating panel shall be AZTEC, as manufactured by Berko, a Division of Marley Electric Heating, CP series as manufactured by Qmark or as approved equal. The construction and design shall permit it to be: recessed ceiling-mounted with the use of Recessed Mounting Kit, fit into standard or custom designed modules of a T-bar suspended ceiling, surface-mounted with the use of a Surface Mounting Kit, or exposed with the use of a surface mounting kit and duct strap attached to roof structure. In finished spaces with hard ceilings, install units recessed. Panels shall be UL listed. Panels shall include the custom features listed below.
2. Heating Assembly: The heating assembly shall be UL and CSA approved and shall consist of powdered graphite encapsulated in a plastic laminate with heavy duty copper buss bars running the entire length, backed by 1-inch, 1-pound density high temperature fiberglass insulation to insulate against heat loss to the ceiling and separated from the inside of the panel by a dielectric insulation to assure uniform heat transfer throughout the entire radiating surface of the heater.
3. Thermal Cutout: A thermal cutout shall be built into all high density panels to automatically shut off the heater in the event of overheating and reactivate the heater when temperatures return to normal.
4. Wiring: For connection to the main power supply, the heater shall be completely prewired, with the lead wires housed in a 40-inch length of flexible metal conduit and connector for J-Box mounting. Appropriate diagrams shall appear on the back of the

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panel. Provide modular connectors, pre-wired system for unit mounted end to end. Coordinate with Division 26.

5. Panel Assembly: The metal heating panel, containing the completely prewired heating assembly, shall be of 22 gauge formed galvanized steel front and 24 gauge formed galvanized steel back. Sides are overlapping front and back panels riveted together.
6. Finish: The front of the heating panel shall be multi-faceted cystalline type surface finished with high temperature silicone paint.
7. Controls: All radiant heaters shall be thermostatically controlled. When more than one radiant heater is shown in a space, provide the minimum number of thermostats required to control the total quantity of heating panels in the space. Thermostats, control transformers and associated controls shall be provided by the Manufacturer. Coordinate requirements with Division 26 and ATC Subcontractor.
8. Features: Radiant heating panels shall be provided with the following features:

    a. Painted frame to match heater.
    b. Factory silicone scaled for shower rooms.
    c. Seal tight flexible conduit and connectors for shower rooms.

9. Temperature sensors shall be furnished and installed by the ATC subcontractor. Provide and install stainless steel thermostat guards over all temperature sensors. Relays shall be enclosure mounted. Provide and install low voltage transformers as required.

2.4. HORIZONTAL ELECTRIC UNIT HEATERS

A. General: Provide horizontal electric unit heaters as indicated, of type and minimum capacity as scheduled, and as specified herein.

B. Furnish and install Emerson-Chromalox type MUH, Trane, Qmark, Markel, Marcor, Indeeco, or approved equal horizontal unit heaters with heating and air delivery capacities as shown on the heating schedule. The cabinet shall be made of 18 gauge die formed, furniture grade steel. Individual adjustable louvers with 30 degree downward stops shall be furnished to provide desire control of discharge air. All metal surfaces of the casing shall be phosphate coated to resist corrosion and finished in a decorative two toned neutral grey-bronze brown baked enamel. Mounting brackets designed for either ceiling or wall swivel mounting shall be furnished. Heater to be of the draw-through air flow design to eliminate element hot spots and extend design life.

C. For safety, the electric heating bank shall consist of Chromalox or equal metal sheath heating elements. The elements shall have a copper clad steel sheath for strength and corrosion resistance and aluminum fins for faster heat transfer. Automatic reset thermal over-heat protection, shall be of the linear capillary type wired for instantaneous de-energizing in case of thermal overload. Heating bank to have protective air inlet louvers.

D. All heaters drawing in excess of 48 amperes shall be provided with factory installed subdivided circuits of 48 amps or less.

E. Motors shall be of the totally enclosed continuous heavy-duty all-angle operation equipped with built-in thermal overload protection.

F. Fans shall be aluminum, directly connected to fan motor, designed specifically for unit heater application.

G. Low voltage control transformers shall be provided allowing safer more precise temperature control. Space temperature sensors to be provided and installed by the ATC subcontractor including relays, as necessary to accomplish specified sequence.

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H. Individual optional field installable control kits shall be provided with all models. All controls shall have pig tails and spade terminals for ease of wiring to centrally located terminal board. All heaters of 63 amperes or less shall be provided with power disconnect switches.

I. Furnish and install the following accessories for operation:

1. Wall/ceiling mounting bracket.

J. All heaters shall be U.L. listed and meet the requirement of the National Electrical Code.

K. All units shall have built-in contactors and control circuit transformers to provide single source power connection. Built-in fuse blocks and factory supplied fuses shall be installed on all models. A wiring diagram and grounding LUG shall be included in each control compartment.

L. Space temperature sensors with stainless steel guards shall be furnished and installed by the ATC subcontractor.

2.5. FANS

A. General

1. Provide fans as indicated on the drawings. All fans shall have been tested and their performance rated in accordance with Air Movement and Control Association, Inc., Bulletin 210-85 Test Code and shall be licensed to bear the AMCA Seal. All fans shall carry the AMCA Certified Rating Seal for air and sound. Sound power levels shall be submitted for approval. Fan curves shall be submitted with all fan shop drawings.
2. Fan manufacturer shall submit under what duct configuration (unducted, partially ducted, or ducted) the manufacturer certified the performance of a particular fan or group of fans.
3. When indicated on Contract Drawings provide inverter duty rated motors for all variable speed fans.
4. For fans utilized in corrosive environments provide fans with polyester or epoxy coating on all surfaces exposed to air stream.

B. In-Line Centrifugal Fans

1. Belt Drive

a. Furnish and install in-line centrifugal belt drive fans of the size, capacity and electrical characteristics as shown on contract drawings.
b. Duct mounted fans shall be of the centrifugal belt driven in-line type. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
c. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. All in-line fans shall be factory insulated. The housing interior shall be insulated with 1-inch acoustical insulation.
d. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
e. Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream. Motors shall be readily accessible for maintenance. Motors shall be high efficiency type.
f. Precision ground and polished fan shafts shall be mounted in permanently

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sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.

g. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

h. Motor pulleys shall be adjustable for final system balancing.

i. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

j. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

k. Fans shall be Model BSQ as manufactured by Greenheck Fan Corporation, ACME Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

2. Direct Drive

a. Furnish and install in-line centrifugal direct drive fans of the size, capacity, and electrical characteristics as shown on the contract drawings.

b. Duct mounted in-line shall be of the centrifugal, direct driven in-line type.

c. The fan housing shall be of the square design, constructed of heavy gauge galvanized steel and shall include square duct mounting collars.

d. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components. All in-line fans shall be factory insulated. The housing interior shall be insulated with 1-inch acoustical insulation.

e. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

f. Motors shall be permanently lubricated and carefully matched to the fan loads. Motors shall be readily accessible for maintenance. Motors shall be high efficiency type.

g. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance.

h. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

i. Fans shall be complete with backdraft damper, and unit mounted solid state speed controller.

j. Fans shall be Model SQ as manufactured by Greenheck, Acme Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

C. In-line Cabinet Fans

1. Furnish and install in-line centrifugal direct drive cabinet fans of the size, capacity, and electrical characteristics as shown on the contract drawings.

2. Duct mounted cabinet fans shall be of the centrifugal, direct drive type. The fan housing shall be constructed of heavy gauge galvanized steel and shall include prepunched mounting brackets. The housing interior shall be lined with 2-inch acoustical insulation. The outlet duct collar shall include an aluminum backdraft damper and shall be adaptable for horizontal or vertical discharge. The access for wiring shall be external. The motor disconnect shall be internal and of the plug-in type. The motor shall be mounted on vibration isolators. The fan wheel(s) shall be of the forward curved centrifugal type, constructed of galvanized steel and dynamically balanced. Fans shall be licensed to bear the AMCA Certified Ratings Seals for sound and air performance and shall be U.L. Listed and C.S.A. approved.

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3. Fans shall be complete with backdraft damper, unit mounted solid state speed controller, and plug-in disconnect switch.
4. Duct mounted in-line cabinet fans shall be Model CSP as manufactured by Greenheck, ACME Engineering, Penn Ventilator, Cook or approved equal.

D. Ceiling Mounted Exhaust Fans with Integral Grille.

1. Furnish and install low sone ceiling mounted exhaust fans with integral grilles of the size, capacity, and electrical characteristics as shown on the contract drawings.
2. Ceiling mounted fans shall be of the centrifugal, direct drive type. The fan housing shall be constructed of heavy gauge galvanized steel. The fan housing interior shall be lined with ½-inch acoustical insulation. The outlet duct collar shall include an aluminum backdraft damper and shall be adaptable for horizontal or vertical discharge. The grille shall be constructed of aluminum and painted with a baked enamel white finish. The access for wiring shall be external. The motor disconnect shall be internal and of the plug in type. The motor shall be mounted on vibration isolators. The fan wheels shall be of the forward curved centrifugal type and shall be dynamically balanced.
3. Fans shall be completed with backdraft damper, unit mounted solid state speed controller, and plug-in disconnect switch.
4. Ceiling mounted exhaust fans with integral grilles shall be Model SP as manufactured by Greenheck, Acme Engineering, Cook, Penn Ventilator, or approved equal.

E. Sidewall Propeller Fans

1. Belt drive

a. Furnish and install belt driven propeller fans of size, capacity and electrical characteristics as shown on contract drawings.
b. All sidewall fans shall be belt driven axial type.
c. Propellers shall be constructed with die formed galvanized steel blades riveted to a steel hub. Propellers shall be statically and dynamically balanced.
d. Motors shall be of heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Two speed motors shall be furnished where indicated.
e. Ground and polished steel fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks. Propellers shall be attached to fan shafts with a standard square key and set screws or tapered bushings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speeds. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor sheaves shall be adjustable for final system balancing.
f. Drive frame assemblies shall be formed galvanized steel construction. Fan panels shall have prepunched mounting holes, formed flanges with welded corners and a deep formed inlet venturi.
g. The axial exhaust or supply fans shall bear the AMCA Certified Ratings Seals for both air and sound performance.
h. All steel parts shall be protected with thermally fused polyester urethane. Fan shafts shall be coated with a zinc phosphate corrosion resistant coating.
i. Fans shall be provided with OSHA Safety Guard. Supply fans shall be of the reverse flow configuration. Provide wall mount collars, and 2-inch aluminum birdscreen with each fan as indicated on contract drawings. Motor operated dampers shall be provided by ATC subcontractor and installed by mechanical contractor.
j. Fans shall be Model SBE for exhaust and SBS for supply as manufactured by Greenheck, ACME Engineering, Penn Ventilator, Cook, Twin City Fan and

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Blower or approved equal.

2. Direct Drive

a. Furnish and install direct driven propeller fans of the size, capacity, and electrical characteristics as shown on contract drawings.
b. Sidewall fans shall be direct driven axial type.
c. Propeller construction shall be of die-formed aluminum blades riveted to a steel hub. Hubs shall be securely attached to motor shafts with set screws.
d. Motors shall be permanently lubricated, heavy-duty type carefully matched to the fan load and furnished of the specified voltage, phase and enclosure.
e. The fan panel shall be steel construction with prepunched mounting holes, formed flanges and a deep spun venturi. All steel panels shall be coated with thermally fused polyester urethane to provide a lasting finish. Motor supports shall be heavy gauge welded wire, zinc plated. Four (4) neoprene vibration isolators shall be installed between the motor support and the motor mounts.
f. The axial exhaust fans shall bear the AMCA certified rating seal for air performance.
g. Fans shall be provided with OSHA safety guard. Supply fans shall be of the reverse flow configuration. Provide wall mount collars and 2-inch aluminum birdscreen with each fan as indicated on contract drawings. Motor operated dampers shall be provided by Mechanical Contractor and installed by ATC Contractor. Provide unit mounted solid state speed controller with each fan for balancing.
h. Fans shall be model SDE for exhaust and SDS for supply as manufactured by Greenheck, ACME Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

F. Power Roof Ventilators

1. Belt Drive

a. Furnish and install belt driven power roof ventilators of the size, capacity, and electrical characteristics a shown on contract drawings.
b. Roof fans shall be centrifugal belt driven type.
c. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
d. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength.
e. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motor and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Motors shall be two (2) speed type where indicted on drawings.
f. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
g. Precision ground and polished fan shaft shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulley shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

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h. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.
i. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance.
j. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
k. Provide 12-inch high, fully insulated, aluminum roof curbs with each ventilator. Fan and roof curb shall be provided by the same manufacturer.
l. Provide 2-inch aluminum birdscreen with each fan.
m. Motor operated dampers shall be provided by ATC subcontractor and installed by mechanical contractor.
n. Fans shall be Model GB as manufactured by Greenheck Fan Corporation, ACME Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

2. Direct Drive

a. Furnish and install direct driven power roof ventilators of the size, capacity, and electrical characteristics as shown on contract drawings.
b. Roof fans shall be centrifugal direct drive type.
c. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing and shroud shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength.
d. Motors shall be mounted out of the airstream on vibration isolators. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge containments. Motors shall be readily accessible for maintenance.
e. A disconnect switch shall be factory installed and wired from the fan motor to a junction box within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.
f. All fans shall bear the AMCA Certified Rating Seal for sound and air performance.
g. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
h. Provide 12- inch high, fully insulated, aluminum roof curbs with each ventilator. Fan and roof curbs shall be provided by the same manufacturer.
i. Provide 2-inch aluminum birdscreen with each fan.
j. Motor operated dampers shall be provided by ATC subcontractor and installed by mechanical contractor. Provide unit mounted solid state speed controller with each fan for balancing.
k. Fans shall be model Gas manufactured by Greenheck Fan Corporation, ACME Engineering, Cook, Penn Ventilator, Twin City Fan and Blower or approved equal.

G. Variable Speed Ceiling Paddle Fans

1. The facility shall be equipped with variable speed ceiling paddle fans, mounting hardware and variable speed fan controls as manufactured by Big Ass Fan Co., Marco Air, Technologies, Sky Blade Fan Company, Entrematic, or approved equal.
2. Complete Unit: The fan shall be designed to move the maximum amount of free air contained within a given space with the least amount of electrical power. Free air is defined as that air within a given space at a constant static pressure.

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3. Airfoils: Each fan shall have low speed airfoils of precision extruded aluminum alloy, weighing no more than 1.52 pounds per foot of length. Each airfoil shall be of the high performance blade design. The foils shall be connected to the hub section of the fan by means of locking bolts. Locking bolts are to be SAE grade 8 only, 5/16" diameter with 150,000 psi tensile strength. Additionally, the airfoils shall be interlocked with a safety strap 14 A36 steel with clear zinc chromate finish to prevent an individual airfoil from becoming accidentally disconnected from the hub.
4. Motor: The fan motor shall be Reliance, 1750 RPM, Inverter rated with Class F Insulation, 40 degrees Celsius ambient-continuous.
5. Gear Reducer: The gear reducer shall be Inline Helical Gear Reducer or equivalent hardened to 58-62 Rockwell C. The gear reducer shall be precision finished for low noise and long service life with double lip seals to keep oil in and contaminants out, and be lubricated for life. The gear reducer shall have a standard backlash of less than 20 arc minutes and be equipped with a 17-4 stainless steel shaft of 1.25" diameter conditioned to 1150.
6. Motor Frame: The fan motor frame and mount shall be constructed of ¼" powder coated steel. The mount shall be designed to allow safety cables to be easily and securely attached.
7. Hub: The fan hub assembly shall be constructed of a precision cast of prime 713 aluminum zinc magnesium ally. The hub shall incorporate six (6) safety clips made of ¼ steel that will restrain the hub/airfoil assembly in case of shaft failure.
8. Mount: The fan mount shall be designed for quick and secure mounting of the fan from a structure's support beams. The mounting system of the fan shall allow easy removal and relocation. The fan mount shall be lightweight and constructed of ¼ " power coated steel.
9. Safety Wire Rope: The safety wire rope shall consist of a 7 x 19 stranded galvanized steel of ¼ inch diameter with 4 dropped forged wire rope slips to secure the motor frame to the lower portion of the extension tube and the upper portion of the extension tube to the building framework. The safety wire rope shall have a breaking strength of not less than 7,000 pounds.
10. Fan Controller: Each fan controller will be UL listed as Industrial Control Panels and built pursuant to construction guidelines set forth by Underwriters Laboratories Article 508A, and the National Electrical Code. Each fan controller shall include a factory programmed Variable Frequency Drive (VFD) to provide a soft-start for the fan as well as infinite speed control capability for the fan(s). The VFD shall be sized per the motor's full load amp rating.
11. Fan Controller Program: Controllers and VFD shall be factory programmed to minimize starting and braking torques.
12. Fire Control Panel Integration: Include a pilot relay for fire control system integration, such relay shall be wired normally open or normally closed in the field.

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2.6. 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 counterflasing and lag screws. Units shall be internally reinforced. Minimum height shall be 12-inches above the finished roof or as shown on the detail(s) on the drawing(s).

2.7. NON PENETRATING EXERIOR DUCT SUPPORT

A. Exterior duct supports shall be non-penetrating roof duct supports suitable for roof construction as manufactured by RTS – Rooftop Support Systems, Eberl, Iron Works, Inc. Duct supports shall be constructed of 18 gauge galvanized steel, unitized construction with integral base plate. Units shall be internally reinforced. Minimum height shall be 12-inches above the finished roof or as shown on the detail(s) on the drawing(s). Provide all stainless steel hardware. Duct support shall

be “double support” type with adjustable height and width. Base shall be non-penetrating type, heavy duty rubber, manufactured from 100% recycle crumb rubber.

2.8. EXTERIOR PIPE ROLLER SUPPORTS

A. Furnish and install pipe roller supports for all exterior 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, RTS, or approved equal.

2.9. ROOF CURBS (DUCT PENETRATIONS)

A. Furnish and install roof curbs at all penetrations of roof by ductwork and where indicated on contract drawings. Roof curbs shall be Model PC as manufactured by Pate, Greenheck, or approved equal.

B. Roof curbs shall be constructed of heavy gauge galvanized steel, unitized, full material corners, all seams welded, 1 ½ -inch thick rigid fiberglass insulation, pressure treated wood nailer strip. Curbs shall be minimum 12-inch height unless otherwise noted and have inner diameter equal to indicated duct diameter.

2.10. EXTERIOR ROOFTOP PIPING SUPPORT (NON-PENETRATING)

A. Exterior Piping Supports shall be non penetrating roof piping supports suitable for roof construction as manufactured by RTS – Rooftop Support Systems, Eberl Iron Works, Inc., Miro Industries. Pipe supports shall be constructed of 18 gauge stainless steel, unitized construction with integral base plate. Units shall be internally reinforced. Minimum height shall be 12-inches above the finished roof or as shown on the detail(s) on the drawing(s). Provide all stainless steel hardware. Duct support shall be “double support” type with adjustable height and width. Base shall be non-penetrating type, heavy duty rubber, manufactured from 100% recycled crumb rubber.

B. Pipe Supports: The pipe supports shall be elevated pipe roller supports. To allow for expansion and contraction the supports shall include pipe rollers, threaded rods, and supporting hardware. All supports shall be type 304 stainless steel with stainless steel hardware. Furnish with pipe straps to restrain pipes on the rollers.

2.11. VARIABLE SPEED DRIVES

A. Provide variable speed drive controllers for Air Handling Units and associated Return Air Fans as indicated on contract drawings.

B. Energy recovery ventilation units, variable speed drives shall be furnished by ERV unit manufacturer.

C. The adjustable frequency controller (AFC) shall convert three phase 60 Hertz utility power to adjustable voltage and frequency, three phase, AC power for stepless motor control from 5 percent to 110 percent of base speed.

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D. The AFC shall be a voltage source type with a PWM output utilizing power transistor semi-conductors.

E. The AFC together with all options and modifications shall mount within a standard NEMA 1 enclosure suitable for continuous operation at ambient temperature of 0 to 40 degrees C. with relative humidity to 95 percent non-condensing. All high voltage components within enclosure shall be isolated with steel covers. The complete unit shall be UL approved and UL labeled.

F. Circuits shall provide DV/DT and DI/DT protection for semi-conductors. AFC shall be capable of starting into a rotating load without delay. Protective circuits shall cause instantaneous trip (IET) should any of the following faults occur:

1. Motor overload.
2. Short circuit.
3. Motor overtemperature fault.
4. Reverse phase.110 percent of controller maximum sine wave current rating is exceeded.
5. Output phase to phase and phase to ground short circuit condition.
6. High input line voltage.
7. Low input line voltage.
8. Loss of input phase.
9. External fault. This protective circuit shall permit, by means of the terminal strip, wiring of remote NC safety contacts such as high static, firestat, etc., to shut down the drive.

G. The following adjustments shall be available in the controller and retained in non-volatile memory:

1. Maximum frequency (15 to 400 Hz) factory set at 60 Hz.
2. Minimum frequency (3 to 60 Hz) factory set at 6 Hz.
3. Acceleration (.1 to 360 seconds) factory set at 20 seconds.
4. Deceleration (.1 to 360 seconds) factory set at 20 seconds.
5. Volts/Hertz ratio factory set for 460V at 60 Hz.
6. Voltage offset or boost factory set at 100 percent torque.
7. Current limit (50 percent to 110 percent sine wave current rating) factory set at 100 percent current.

H. The AFC shall have the following basic features:

1. Door-mounted operators controls consisting of a membrane command center which allows manual stop/start and speed control, local/remote indication and manual/or automatic speed control selection. In addition, the command center shall serve as a means to configure controller parameters such as min speed, max speed, acceleration and deceleration times, Volts/Hz ratio, torque boost etc. Potentiometers shall not be allowed for these settings.
2. Main input disconnect to provide a positive disconnect between the controller and all phases of the incoming A-C line. This disconnect shall be mounted inside the controller enclosure and have through-the-door interlocking toggle with provisions for padlocking.
3. Electronic motor overload relay.
4. Automatic restart after power outage, drive fault or external fault, with drive in automatic mode. The circuit shall allow the user to select up to (10) restart attempts as well as the dwell time between attempts. The reset time between fault occurrences shall also be selectable. All settings shall be via the membrane command center.
5. Door-mounted LED display for digital indication of:

    a. Frequency output
    b. Voltage output

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c. Current output
d. First fault indication
e. Equipment Speed (RPM)

6. Relay contacts for remote indication of drive fault and motor finning.
7. Three critical frequency avoidance bands, field programmable via the membrane command center. Each critical frequency avoidance band shall have a bandwidth adjustable via keypad entry of up to 10 Hz.
8. Three programmable preset speeds which shall force the AFC to a preset speed upon a user contract closure.
9. Isolated process follower to enable VFC to follow a 4-20 mA signal.
10. The AFC shall have the capability to ride through power dips up to 500 msec without a controller trip depending on load and operating condition.
11. Line reactor to minimize line surges, line notching, and voltage distortions.

I. Manual bypass-to-line with magnetic contactors to transfer motor from the variable frequency controller to full speed operation on utility supplied input power while the motor is at any speed. Two motor contactors, electrically interlocked shall be utilized, one contactor between the controller output and the motor and the other between the bypass power line and the motor, providing across-the-line starting.

J. Motor protection per National Electrical Code shall be provided in both the "controller" mode and the "bypass" mode by a motor overload relay. The 115 volt A-C relay control logic, allowing common start/stop commands in the "controller" mode and the "bypass" mode shall also be included within the enclosure.

K. The bypass shall include a door interlocked, main power input circuit breaker providing positive shutdown of all power to both the bypass circuitry and the VFC. The bypass circuit shall also include a second input disconnect to the VFC. This disconnect shall provide the ability to safely troubleshoot and test the controller, both energized and de-energized, while operating the bypass mode.

L. The VFC and all components shall be supplied within a single NEMA 1 enclosure, and shall be U.L. Listed as a single unit. Furnish all components necessary to provide a minimum lead length between motor and drive of 400 ft. The VFC shall not generate damaging transistor pulses greater than the limits set by NEMA MG-1 at 400 Ft lead length.

M. The VFC manufacturer shall maintain and staff nationwide service centers. These service engineers shall be employed by the manufacturer and provide start-up service including physical inspection of drive and connecting wiring and final adjustments to meet specified performance requirements.

N. The VFC shall carry a full parts and labor warranty for two years from date of substantial completion.

O. The variable speed drive manufacturer shall be the manufacturer of the motors supplied with the associated equipment. Coordinate with equipment manufacturers.

P. The variable speed drive shall be Reliance VTAC V, or approved equal of Accutrol, Cutler Hammer, Graham, York, Baldor, AC Tech, ABB, Emerson, Yaskawa, Toshiba, or as approved equal.

Q. The variable speed drive manufacturer shall coordinate with the ATC contractor and provide all necessary devices whether optional or not to perform complete and automatic operation as described in the sequence of operation. All safeties and duct smoke detectors shall be enabled

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when variable speed drives are in manual or bypass.

R. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

1. Network Communications Ports: Ethernet and RS-422/485.
2. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet; protocols accessible via the communications ports.

S. Variable speed drives shall be carefully selected for the duty required. Variable speed drives shall be specifically designed for the specified equipment to be controlled. Pump drives shall be selected for pumps and fan drives shall be selected for fans.

2.12. ENERGY RECOVERY VENTILATOR (FIELD HOUSE)

A. Provide and install ERV's (Energy Recovery Ventilators) as shown on contract drawings. ERV's shall be Greenheck (RVE); Model RN as manufactured by Aaon, Venmar, Valent, or approved equal.

1. Energy Recovery Ventilator shall be as manufactured by Aaon or approved equal provided all specifications are met. Aaon Model AAONAIRE equipment is used as the basis of design. Units shall be listed per UL 1812 and bear the UL label. Energy transfer ratings shall be in accordance with ASHRAE Standard 84 and ARI 1060. Wheels shall be ARI 1060 certified. Performance to be as scheduled on plans. Exhaust discharge and outside air intake shall not be located on the same side on rooftop units.
2. Unit shall be of internal frame type construction of galvanized steel. All frame and panel shall be G90 galvanized steel. Where top panels are joined there shall be a standing seam to insure positive weather protection. All metal-to-metal surfaces shall be sealed, requiring no caulking at job site. Unit base to be designed for roof mounting.
3. Unit casing to be insulated with 1 in - 3 lb. fiber-glass with Foil-Scrim-Kraft facing. Insulation in accordance with NFPA 90A and tested to meet UL 181 erosion requirements and secured to unit with water proof adhesive and permanent mechanical fasteners.
4. Wheel shall be of the enthalpy type for both sensible and latent heat recovery and be designed to insure laminar flow. Efficiency ratings shall be based on tests conducted in accordance with ASHRAE 84 and laminar flow. Efficiency ratings shall be based on tests conducted in accordance with ASHRAE 84 and ARI 1060 standards. Desiccant shall be silica gel for maximum a latent energy transfer. Wheel shall be constructed of light weight polymer or aluminum media to minimize shaft and bearing loads. Polymer or aluminum media shall be mounted in a stainless steel rotor for corrosion resistance. Wheel design shall consist of removable segments for ease of service and/or cleaning. Segments shall be removable without the use of tools. Silica gel desiccant shall be permanently bonded to wheel media to retain latent heat capability after cleaning. Energy recovery device shall transfer moisture entirely in the vapor phase.
5. All components shall be easily accessible through removable hinged doors for both exhaust fan, supply fan, filter and damper compartments. Energy recovery wheels (smaller than 54 in.) shall be mounted in a slide-out track for ease of inspection, removal and cleaning.
6. Refer to Division 23 Section, “Common Work Results for HVAC” for VFD motor bearing protective rings.

B. Fans

1. Centrifugal blowers shall be backward inclined and housed in a scroll to maximize fan

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efficiency. Fans shall be AMCA certified for air performance. All blower wheels shall be statically and dynamically balanced. Ground and polished steel fan shafts shall be mounted in permanently sealed ball bearing pillow blocks. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speeds. Blowers shall enable independent balancing of exhaust and supply airflow with adjustable sheaves for motors 10 horse power and below. Fans shall be located in draw-through position in reference to the energy recovery wheel.

2. Motors shall be premium efficient, inverter duty rated variable speed complying with EPACT standards, for ODP and TE enclosures. Motors shall be permanently lubricated, heavy duty type, matched to the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150 percent of driven horsepower. Pulleys shall be fully machined cast. Energy wheel motors shall have integral overload protection.
3. All internal electrical components shall be pre-wired for single point power connection. All electrical components shall be UL listed, approved or classified where applicable and wired in compliance with the National Electrical Code. The control center shall include a weatherproof disconnected switch, variable speed drives with bypass, control circuit fusing, control transformer for 24 VAC circuit and motor starters.
4. Energy recovery ventilators housings shall be factory primed and painted in color as selected by the Architect.
5. Both the supply and exhaust air streams shall be filtered to protect the enthalpy wheel. Furnish and install MERV 13 pleated filters, filter racks and access panels. Provide one (1) set of additional filter media to Owner for each unit.
6. Furnish exhaust and outside air intakes with hoods provided with bird screens and sound lining.

C. Gas Furnace:

1. Indirect Stainless steel heat exchanger furnace shall carry a 10 year non-prorated warranty.
2. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
3. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
4. Unit shall include a single gas connection and have gas supply piping entrances in the outside cabinet wall. Refer to Contract Drawings for gas piping routing.
5. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heating assemblies shall be capable of operating at any firing rate between 100% and 6.25% of their rated capacity.
6. Indirect Gas Furnace shall include the following:

    a. ETL Certified as a component of the Energy Recovery Air Unit
    b. Integral exhaust gas blower
    c. Fault sensors to provide fault conditions to building controls.
    d. 4-pass tubular heat exchangers, constructed of 409 stainless steel. Heat exchanger tubes shall be installed on the vest plate by means of swaged assembly, welded connections are not acceptable. Heat exchanger tubes shall be supported by a minimum of two fabricated assemblies that support the tubes and also permit expansion and contraction of the tubes.

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7. Furnace control shall be HighTurndown 16:1 Modulating. Shall have solid state controls permitting stand-alone operation or control by building controllers.
8. Shall be encased in a weather-tight metal housing with intake air vents. Large, metal lift-off or hinged door shall provide easy access to the enclosed vest plate, control circuitry, gas train, burner assembly, and exhaust blower.
9. Furnish each energy recovery ventilator with the following:

    a. Supply air fan combination starter/disconnect.
    b. Exhaust air fan combination starter/disconnect.
    c. Protective circuits (safeties).
    d. All motor operated dampers and actuators.
    e. All other unit and space sensors/control, control wiring shall be furnished under Division 23 Section “Instrumentation and Controls for HVAC and Plumbing Systems”.

D. Extra Materials:

1. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
2. Filters: Furnish one set of each type of filter.
3. Fan Belts: Furnish one set of belts for each belt drive fan in energy recovery ventilator.
4. Wheel Belts: Furnish one set of belts for each belt driven energy wheel.

E. Field Installed Controller

1. The unit shall include a field installed microprocessor based unit controller as provided by ATC contractor which controls the operation of the unit including the compressor(s), condenser fan motor(s), supply fan motor, enthalpy wheel, gas furnace, and modulating hot gas reheat.
2. Factory mounted and wired suction pressure transducer. Field wired for field installation is a supply air temperature sensor. Furnished with the unit for field installation are a space air temperature sensor with temperature set point reset and unoccupied override and a space relative humidity sensor shall be furnished and installed by the ATC contractor.
3. Field Installed Controller

    a. Field installed controller shall be capable of independent standalone operation and have the ability to communicate and integrate with widely-used building automation systems. Controller shall be IP addressable and be able to reside on a TCP/IP network. Controller shall have 2 RJ-45 Ethernet ports, 1 RS-232 port, and 1 RS-485 port.
    b. Controller shall have a full calendar schedule for occupied, unoccupied, and holiday scheduling.
    c. Controller shall retain all programmed values in non-volatile memory in the event of a power failure.
    d. Configuration tool software, when connected to unit controller, shall indicate unit status, set points, and faults.
    e. Furnish controls with necessary interfaces to communicate via BACNET/IP to a Building Automation System.
    f. ERV manufacturer shall be responsible for providing all required input and output terminals to accomplish sequence of operation.

2.13. ENERGY RECOVERY UNIT (BARN)

A. General

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1. Coordinate requirements with the buildings direct digital control system to perform the required sequence of operation.
2. The unit(s) shall be installed in strict accordance with the specifications. Unit(s) shall be complete with all components and accessories as specified. All units shall be factory assembled, internally wired, and 100% run tested to check operation, fan and blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance with ANSI-UL 1995/CAN/CSA C22.2 No. 236.
3. Units shall be manufactured by Aaon, Reznor, or approved equal.
4. Unit shall consist of rooftop heating and ventilating unit with indirect gas heater; supply /exhaust fan, economizer controls, controls, filter housing, and enthalpy wheel.
5. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
6. Unit components shall be labeled, including electrical and controls components.
7. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
8. Installation, Operation and Maintenance manual shall be supplied within the unit.
9. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
10. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

B. Quality Assurance

1. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
2. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
3. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.
4. Unit and components shall be designed, manufactured, and independently analyzed, rated and certified to meet with the seismic compliance standards of the International Building Code, 2009 edition, Section 1621. If requested, unit shall be provided with Certificate of Compliance indicating that the unit and components meet seismic design requirements.

C. Warranty

1. Manufacturer shall provide a "parts only" warranty for a period of 24 months from the date of substantial completion. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

D. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the

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midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, heaters, exhaust fans, energy recovery wheels, electrical, and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
8. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
9. Unit shall include lifting lugs on the top of the unit.

E. Electrical

1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
2. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

F. Supply Fans

1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.
2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

G. Exhaust Fans

1. Exhaust dampers shall be sized to relieve minimum outside air flow.
2. Fans and motors shall be dynamically balanced.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
4. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable handles.
5. Unit shall include belt driven, unhoused, backward curved, plenum exhaust fans.

H. Gas Heating

1. Stainless steel heat exchanger furnace shall carry a 25 year non-prorated warranty.
2. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.
3. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
4. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.
5. Natural gas furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller.

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Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the controls compartment. Gas heating assemblies shall be capable of operating at any firing rate between 100% and 30% of their rated capacity.

6. Furnace control shall be high turndown 16-1 modulating type shall have solid state controls permitting stand-alone operation on control by the ATC system.

I. Filters

1. Unit shall include 2 inch thick, pleated panel filters with an MERV rating of 13, upstream of the cooling coil.

J. Outside Air/Economizer

1. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return enthalpy activated fully modulating.

K. Energy Recovery

1. Unit shall contain a factory mounted and tested energy recovery wheel. The energy recovery wheel shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. Frame shall slide out for service and removal from the cabinet.
2. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.
3. Wheel shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop-to-efficiency ratios. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.
4. Wheel shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.
5. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
6. The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.
7. Energy recovery wheel cassette shall carry a 5 year non-prorated warranty.
8. Unit shall include 4 inch thick, pleated panel outside air filters and MERV rating of 13, upstream of the wheels.

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9. Hinged service access doors shall allow access to the wheel.
10. Total energy recovery wheels shall be coated with silica gel desiccant permanently bonded by a process without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

L. Controls

1. Field provided and installed.
2. Unit shall modulate heating with constant airflow to meet space temperature heating loads. Modulating heating capacity shall modulate based on supply air temperature.

a. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network.

2.14. ENERGY RECOVERY MODULE (HEAD HOUSE)

A. General

1. Energy Recovery Module shall be as manufactured by Greenheck ("minivent"), Annexair, McQuay-Vision, Venmar, or approved equal, provided all specifications are met. Units shall be UL listed and bear the UL label. Energy transfer ratings shall be tested in accordance with ASHRAE Standard 84. Performance to be as scheduled on Contract Drawings.

B. Casing and Access

1. Unit shall be constructed of G90 galvanized steel. All components shall be easily accessible through removable access panels. Access to filters and energy wheel shall not require tools. Energy recovery wheel shall be mounted in a slide-out track for ease of inspection, removal and cleaning. Housing shall be insulated with 2 inch insulation. Outdoor air and exhaust air discharges shall have integral backdraft dampers. Duct adaptors shall be factory installed on all four intake/discharge ports.

C. Intake Location

1. Both the outdoor air and exhaust air intakes shall be designed to be relocated in the field. Alternate intake location on adjacent side of the unit enables duct installation flexibility.

D. Energy Recovery Wheel

1. Energy recovery wheel shall be of the enthalpy type for both sensible and latent heat recovery, and be designed to ensure laminar flow. Desiccant shall be silica gel for maximum latent energy transfer. Silica gel desiccant shall be permanently bonded to wheel media to retain latent heat recovery after cleaning. Wheel shall be constructed of

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light weight polymer or aluminum media to minimize shaft and bearing loads.

E. Fans and Motors

1. Fans shall be double width, double inlet centrifugal forward curved type. Fans shall be statically and dynamically balanced. Fan motors shall be 115 volt, single phase, thermally protected and be compatible for use with speed controller.

F. Filters

1. The outdoor air and exhaust air shall be filtered with a 2 in. deep, MERV 13 disposable filter. Filter rack shall be internal to the unit and factory installed.

G. Electrical

1. All internal electrical components shall be factory wired for single point power connection. All electrical components shall be UL listed, approved or classified where applicable and wired in accordance with the National Electrical Code.

H. Furnish fans with solid state speed controllers.

I. Furnish unit with factory vibration isolation kit.

J. Extra Materials:

1. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
2. Filters: Furnish one set of each type of filter.
3. Fan Belts: Furnish one set of belts for each belt drive fan in energy recovery ventilator.
4. Wheel Belts: Furnish one set of belts for each belt driven energy wheel.

K. Field install a duct mounted electric coil in the supply air duct as detailed/scheduled and interlock with the energy recovery module.

2.15. ELECTRIC DUCT HEATING COILS (INDOOR TYPE)

A. Furnish and install standard slip-in type electric duct heating coils of the size, performance, and electrical characteristics as indicated on the contract drawings. Electric duct heating coils shall be Model QUA as manufactured by INDEECO, Brasch, Thermolic, or approved equal.

B. Heaters and panelboards shall meet the requirements of the National Electrical Code and shall be listed by Underwriters' Laboratories for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment.

C. Heating elements shall be open coil, 80 percent nickel 20 percent chromium, type A resistance wire. Type C alloys containing iron or other alloys are not acceptable. Coils shall be machine crimped into stainless steel terminals extending at least 1-inch into the airstream and all terminal hardware shall be stainless steel. Coils shall be supported by ceramic bushings staked into aluminized steel supporting brackets. Frames and terminal boxes shall be fully insulated to prevent condensation.

D. Heater frames and terminal boxes shall be aluminized steel. Unless otherwise indicated, the terminal box, shall be NEMA 1 construction and shall be provided with a hinged, latching cover and multiple concentric knockouts for field wiring.

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E. All heaters shall be furnished with a disc type, automatic reset thermal cutout for primary over temperature protection. All heaters shall also be furnished with disc type, load carrying manual reset thermal cutouts, factory wired in series with heater stages for secondary protection. Heat limiters or other fusible over temperature devices are not acceptable.

F. Heaters shall be rated for the voltage, phase and number of heating stages indicated in the schedule. All three phase heaters shall have equal, balanced, three phase stages. All internal wiring shall be stranded copper with 105 degrees C insulation and shall be terminated in crimped connectors or box lugs.

G. Terminal blocks shall be provided for all field wiring and shall be sized for installation of 75 degrees C copper wire rated in accordance with NEC requirements.

H. Heaters shall be furnished with Option "K" control system including thermal cutouts, air flow switch, Solitect SCR proportional control, fuses, control circuit transformer, built-in snap acting door interlocked fused disconnect switch and single point power connection.

I. Temperature sensors and safeties for each electric duct heating coil shall be furnished, wired, and interlocked by ATC sub-contractor. Furnish and install stainless steel thermostat wire guard.

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. Water heater minimum clearances shall be provided per the State Requirements.

B. Coordinate vibration isolation requirements with all equipment in accordance with Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment.

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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.

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. Furnish and installed lintels as required.

J. Arrange for equipment such as air handling units, energy recovery units, heat pumps, and kitchen make-up air units 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. 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.

E. Verify refrigerant mitigation controls including fan interlocks, control interlocks, and refrigerant leak detectors.

3.4. DEMONSTRATION

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A. 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, troubleshooting 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 prescence 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. CONVENTIONAL 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 or on roof curbs 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.

H. For wall mounted units, locate condensate pumps above ceiling. Install all piping, tubing between indoor unit, adapter, detection block, and condensate pump.

I. For wall mounted units field wire power wiring, alarm circuits, control cable, safety circuit connection, alarm, and condensate pump. Condensate pump shall be powered from indoor unit power wiring. Coordinate condensate pump electrical characteristics with indoor unit electrical

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characteristics.

J. Install wind baffles when required for low ambient operation. Locate wind baffles facing the predominant wind direction in winter.

K. Test refrigeration mitigation controls including fan interlocks, refrigerant leak detection devices, and refrigeration system shutdown controls.

3.7. ELECTRIC HEATING EQUIPMENT INSTALLATION REQUIREMENTS

A. Examine heating units for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Connect heating units 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.

C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris; repair damaged finishes, including chips, scratches, and abrasions.

D. Install and mount electric radiant heat panels from building structure as required to accommodate ceiling type. Field furnish all accessories necessary to mount radiant heat panels.

E. Install and interlock all electric duct heating coil air flow proving switches and high limit temperature safeties with the ATC system.

3.8. FAN INSTALLATION REQUIREMENTS.

A. Install fans with resilient mounting and flexible electrical leads.

B. Install flexible connections and vibration isolators as specified in Division 23 Section, Common Work Results for HVAC and Division 23 Section Vibration Controls for HVAC, Plumbing and Fire Protection Equipment. Ensure metal band of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Provide safety screens/guards on all fans and permanently mount after final testing and balancing.

D. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fans have been test run under operation.

E. Provide sheave required for final air balance.

F. Install fans according to manufacturer's written instructions.

G. Adjust damper linkages for proper damper operation.

H. Adjust belt tension.

I. Lubricate bearings.

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J. Replace fan and motor pulleys and belts as required to achieve design conditions.

K. Mount, install, and wire speed controllers for direct drive fans. Speed controllers for direct drive fans shall be mounted adjacent to fan and wired in accordance with the NEC.

3.9. EXTERIOR ENERGY RECOVERY VENTILATOR INSTALLATION REQUIREMENTS (FIELDHOUSE)

A. Examine areas to receive energy recovery units for compliance with requirements for installation tolerances and other conditions affecting performance of energy recovery units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Install energy recovery units as indicated, according to manufacturer's written instructions.

C. Install CO2 sensor/control/interlock wiring to variable frequency drives and to ATC system. Install global CO2 sensor to monitor ambient outside air CO2 level.

D. Install and interlock space CO2 sensors.

E. Install heat wheels so supply and exhaust flow in opposite directions and rotation is from exhaust side to purge section to supply side.

1. Provide access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Provide removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.

F. Install and interlock air flow monitoring stations as indicated on the contract drawings.

G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

H. Ducts and fan installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

I. Ground Equipment

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.

J. After completing system installation, including outlet fittings and devices, inspect and clean exposed finishes. Remove dirt and construction debris and repair damaged finishes.

K. Startup Services: Engage a factory-authorized service representative to commission units as specified below.

1. Energize and verify correct rotation of heat wheels and fans.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
4. Verify sequence of operation.
5. Verify and record minimum and maximum air flow rates for the supply and exhaust air fan.
6. Verify and record the minimum and maximum supply/exhaust fan speeds/ hertz and

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incorporate into the fan tracking sequence of operation.
7. Verify and record the minimum and maximum supply/exhaust fan speeds/hertz and incorporate into the fan tracking sequence of operation.
8. For gas units, test gas furnace operation and all safeties.

L. Training

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.
2. Review data in the operation and maintenance manuals. Refer to Division 01 Section, Demonstration and Training.
3. Schedule training with Owner, through Architect, with at least 7 days advance notice.

3.10. ENERGY RECOVERY MODULE WITH ELECTRIC HEAT INSTALLATION REQUIREMENTS (BARN)

A. Examine areas to receive energy recovery modules for compliance with requirements for installation tolerances and other conditions affecting performance of energy recovery modules. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Install energy recovery modules as indicated, according to manufacturer's written instructions.

C. Install heat wheels so supply and exhaust flow in opposite directions and rotation is from exhaust side to purge section to supply side.

1. Provide access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Provide removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

E. Ground Equipment

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.

F. After completing system installation, including outlet fittings and devices, inspect and clean exposed finishes. Remove dirt and construction debris and repair damaged finishes.

G. Startup Services: Engage a factory-authorized service representative to commission units as specified below.

1. Energize and verify correct rotation of heat wheels.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
4. Verify sequence of operation.

H. Training:

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.

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2. Review data in the operation and maintenance manuals.
3. Schedule training with Owner, through Owner, with at least 7 days advance notice.

I. Test electric duct heating coil, fan interlock and all safeties.

3.11. FILTRATION EQUIPMENT INSTALLATION REQUIREMENTS

A. Duct mounted filter housings shall be supported independent of adjacent ductwork. Hang filter housings using galvanized steel rods.

B. Where filter housing are not factory insulated, externally insulate to prevent surface condensation.

C. Install static pressure gauges, tubing, vents, etc., across all filter banks.

D. Transition ductwork to filter housings as indicated on drawings.

E. Where indicated, field test all filters in an installed condition.

F. Install air cleaning devices in accordance with manufacturers instructions.

G. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

H. Do not operate fan system until filters are in place. Replace temporary filters used during construction and testing, with clean set.

I. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

J. Coordinate filter installations with duct and air handling unit installations.

K. After completing system installation and testing, adjusting, and balancing air handling and air distribution systems, clean filter housings and install new filter media.

3.12. INTERIOR ENERGY RECOVERY VENTILATOR WITH GAS HEAT INSTALLATION REQUIREMENTS (HEADHOUSE)

A. Examine areas to receive energy recovery units, H & V unit for compliance with requirements for installation tolerances and other conditions affecting performance of energy recovery units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Install units as indicated, according to manufacturer's written instructions.

C. Install CO2 sensor/control/interlock wiring to variable frequency drives and to ATC system. Install global CO2 sensor to monitor ambient outside air CO2 level.

D. Install and interlock high density space CO2 sensors.

E. Install heat wheels so supply and exhaust flow in opposite directions and rotation is from exhaust side to purge section to supply side.

1. Provide access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Provide removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.

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F. Install and interlock outside air flow monitoring station.

G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

H. Ducts and fan installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

I. Ground Equipment

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.

J. After completing system installation, including outlet fittings and devices, inspect and clean exposed finishes. Remove dirt and construction debris and repair damaged finishes.

K. Test all gas fired equipment.

L. Startup Services: Engage a factory-authorized service representative to commission units as specified below.

1. Energize and verify correct rotation of heat wheels and fans.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
4. Verify sequence of operation.

M. Training

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.
2. Review data in the operation and maintenance manuals. Refer to Division 01 Section, Demonstration and Training.
3. Schedule training with Owner, through Architect, with at least 7 days advance notice.

N. Where specified field install and interlock air flow monitoring stations

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3.13. ELECTRIC HEATING EQUIPMENT INSTALLATION REQUIREMENTS

A. Examine heating units for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Connect heating units 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.

C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris; repair damaged finishes, including chips, scratches, and abrasions.

D. Install and mount electric radiant heat panels from building structure as required to accommodate

ceiling type. Field furnish all accessories necessary to mount radiant heat panels.

E. Install and interlock all electric duct heating coil air flow proving switches and high limit temperature safeties with the ATC system.

F. Coordinate with the ATC Subcontractor for all temperature sensors which should be furnished and installed under Division 23 specification Section “Instrumentation and Controls of HVAC & Plumbing Systems.”

END OF SECTION

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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 E 96, “Standard Test Methods for Water Vapor Transmission of Material”.
   e. ASTM C 585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe Insulation for Nominal Sizes of Pipe and Tubing (NPS System)".
   f. ASTM C 612, "Standard Specification for Mineral Fiber Block and Board Thermal Insulation".
   g. ASTM C 1136, "Standard Specification for Barrier Material, Vapor, "Type 1 or 2 (Jacket only).

2. ASHRAE 90.1 "Energy efficient design of new buildings except low-rise residential buildings", latest edition.
3. International Energy Conservation Code, latest edition.

B. Insulation materials, including all weather and vapor barrier materials, closures, hangers, supports,

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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
4. ASTM E 96, “Standard Test Methods for Water Vapor Transmission of Materials”.

C. Calcium silicate products shall include a visual identification system to permit positive field determination of their asbestos-free characteristics.

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

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mechanical damage.

1.8. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

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 poly-encapsulated jacket. Pipe insulation shall be fiberglass ASJMax 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 Foster 85-20/85-60 or Childers CP-82 (5 gal cans only) adhesive. Jacket and butt strips shall be off-white color and shall be equivalent to Owens-Corning Fiberglass 25-ASJ.

D. Indoor pipe insulation shall be ASJ Max with SSL-II closure system pipe insulation as manufactured by Owens Corning or approved equal. Pipe insulation shall be composed of heavy density fiberglass insulation with an organic binder. The insulation shall include a white, factory jacketed, resilient, tough, soil resistant polymer facing that matches standard PVD fitting covers. Furnish all accessories and matching butt joints sealing tape for system closure. Insulation shall be suitable for operating temperatures between 32 degrees Fahrenheit and 220 degrees Fahrenheit. Flame spread rating of 25 or less, and smoke development rating of 50 or less to comply with building codes for installation in return air plenums. The maximum thermal conductivity (K-value) at a mean temperature of 50 shall be .22 BTU-in/hr-Ft²-degress Fahrenheit.

E. 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. Cold piping: Apply a tack coat of vapor barrier coating and reinforcing mesh. After ½ hour, apply second coat of same vapor barrier coating, UL labeled, Type C, for cold water piping, Hot piping Type H for hot water piping: Apply tack of breather mastic. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of breather mastic over the reinforcing cloth, working it to a smooth finish.

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1. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeanie shall be 0.03 perms or less at 45 mils dry as test by ASTM E96.
2. Breather mastic: Foster 46-50; Childers CP-10/11 or Vimasco WC-5
3. Reinforcing Mesh: Foster Mast a Fab; Childers Chil Glas #10 or Vimasco Elastafab

F. 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.

G. 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.

H. For piping located outside of the building, a 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 with metal jacketing sealant. Sealant shall be Foster 95-44 or Childers CP-76. 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.

I. On cold systems such as refrigerant piping, cooling coil drain piping, etc. vapor barrier performance is extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a 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. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeance shall be 0.03 perms or less at 45 mils dry as test by ASTM E96.

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

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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. Install oversized hangers to prevent penetrations of pipe insulation vapor barrier.

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. For hot or cold piping systems larger than 3-inches (7.5 cm) in diameter, operating at temperatures less than +200 degrees F (93 degrees C) and insulated with fiber glass, high density inserts such as foam or wood blocks with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +_200 degrees F (93 degrees C), Owens-Corning Pink Calcium Silicate, IIG, or approved equal pipe insulation shall be used for high density inserts.
3. Owens-Corning Pink Calcium Silicate pipe insulation may be used to support the entire weight of the piping system provided the hanger saddle is designed so the maximum compressive load does not exceed 100 psi (7kg/cm).
4. 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.
5. 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.
6. On vertical runs, insulation support rings shall be used.

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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
All Drain Piping from Cooling Coils/Evaporators	1-inch thickness
All Above Grade Floor Drain Piping Serving AHU Condensate Drains include Drain Sumps and Auxiliary Drain Pipes from Auxiliary Pans	1-inch thickness
All Refrigerant Piping	1-inch thickness

2.4. EQUIPMENT INSULATION MATERIALS AND THICKNESSES

A. Boards shall be scored to allow them to conform to curved or irregular surfaces.

B. Mechanical fasteners shall be utilized to hold insulation to surface with bands as required to hold the curvature of the material.

C. Support rings shall be provided to support the top head insulation where required.

D. Outdoor installations require a weather barrier for protection of the insulation jacketing.

E. Insulation types materials shall be suitable for temperatures encountered by each item of equipment.

2.5. DUCTWORK INSULATION MATERIALS AND THICKNESSES

A. Insulate all supply, return, relief, combustion air, plenums, exhaust, (for ERV projects) and outside air intake ductwork with fiberglass exterior duct insulation with factory-applied foil facing. All exposed fiberglass duct insulation shall be 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. max, polymer coating vapor barrier facing. All concealed fiberglass duct insulation shall be 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. Unless otherwise noted, the minimum installed R-value shall be 6.0 HR x ft2 x ºF/btu.

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 energy recovery units, heat pumps, and energy recovery modules, 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 exhaust ducts carrying moisture-laden air dishwasher exhaust, shower exhaust, etc. are routed in unconditioned spaces, insulation is required as described above. Insulation shall be continuous through the unconditioned area. The vapor barrier shall be tightly sealed to prevent condensation. Exhaust ducts located within conditioned spaces do not require insulation unless otherwise noted.

D. 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 coating reinforced with 3-inch (7.5cm) glass scrim tape.

E. Exposed dual wall ductwork located in finished areas shall not require additional exterior insulation. Exposed dual wall supply ductwork located in mechanical room, fan rooms, penthouse, mezzanines and boiler rooms shall require additional rigid exterior insulation as hereinafter specified.

F. Contractor-applied internal linings shall be as specified and installed as hereinafter specified.

G. For exposed Fiberglass duct insulation, tightly butt all edges and seams. Secure insulation with flush mechanical fasteners spaced not less than one per square foot. Insulation may be secured with 100 percent coverage of adhesive with mechanical fasteners on the underside of the duct only, in addition to adhesive. Adhesive shall be water based Foster 85-60 or Childers CP-127. Cover all seams, joints and fasteners with not less than 3-inch wide tape matching the insulation facing. Pre-finished white fastener caps may be left exposed if the spacing and pattern is uniform in appearance. Staples will not be permitted.

H. All dual wall exterior ductwork shall be insulated with 2-inch rigid type 6.0 pcf minimum density,

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.25 max "K" factor with white vinyl A.S.J. vapor barrier facing. Insulation shall be sandwiched between inner galvanized ductwork and exterior aluminum ductwork.

I. All supply air diffusers and supply air registers shall be fully insulated on the rear exposed surface to prevent condensation. Insulation shall be 1 ½" inch flexible blanket type 1 ½ pcf minimum density with reinforced foil-scrim-Kraft vapor barrier facing, .25 max "k" factor.

J. All airflow monitoring stations shall be externally insulated similar to adjacent ductwork as hereinbefore specified.

2.6. 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."

2.7. EXTERIOR DUCTWORK INSULATION SYSTEM

A. Insulate all exterior ductwork with an interlocking, four-piece, Techna-Duc insulation panel system as manufactured by P.T.M. Manufacturing, L.L.C., Fabrite as manufactured by County Group, or Flex Clad – 400 jacketing system as manufactured by Tri-State Insulation, Foster Vapor Fas 62-05 as manufactured by MFM Building Products, Weatherguard as manufactured by MKT Metal Manufacturing, or an approved equal. Insulation system shall be constructed of glass-reinforced polyisocyanurate foam insulation encased in 1.25 mil aluminum foil vapor barrier facing. All insulation shall be a combined minimum thickness of 2-inch rigid or non-flexible board type, 2.0 pcf minimum density, .25 max "K" factor at 75 degrees Fahrenheit mean temperature. Exterior weather barrier shall be fabricated of embossed aluminum sheeting, minimum 0.032-inches in thickness, and laminated to insulation foil facing. Total installed R-value shall be R-16 at 2 inch thickness.

B. Refer to Division 23 Section, HVAC Air Distribution and contract drawings for location of all exterior mounted ductwork.

C. All exterior mounted ductwork shall meet the specifications set forth in Division 23 Section, HVAC Distribution before installation of the insulation system, to include sealing of joints, testing and duct leakage and installation of duct accessories.

D. All vapor barrier joints, seams, tears, punctures, and other penetrations shall be closed with 3-inches by 1.25 mil minimum aluminum foil faced tape, and/or non-setting vapor barrier coating as applicable. Material shall be fitted so that the vapor barrier seal is continuous and does not allow for water vapor infiltration.

E. Insulation panel system shall be fitted into place on the ductwork. Each insulation panel shall be

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constructed so that all vertical and horizontal insulation seams shall have an interlocking and overlapping shiplap style joint to provide a thermal seal. The overlap shall be a minimum of 2-inches thick. Fasten panel system together at overlapping joints using #10 self tapping, stainless steel, vapor seal screws with weather seal washers on a maximum of 12-inches center. For ducts wider than 48-inches, a bottom fastener should be utilized.

F. At all circumferential joints, apply butyl compound putty using a laminate roller. The butyl compound shall be covered with a 3-inch wide cap of embossed aluminum sheeting, minimum 0.032-inches in thickness. All seams of the aluminum cap and all weather barrier abutments shall be sealed with a bead of RTV caulk, colored to match the panel system.

G. Insulation and jacketing shall cover all duct flanges to prevent collection of water or leaks.

H. All exterior access doors shall be covered with removable insulation system and shall be labeled.

I. All exterior air flow monitoring stations and duct smoke detectors shall be installed so as to be waterproof.

J. At all static pressure measurement points and pitot tube traverse points install inspection plugs as manufactured by Inspection Plug Strategies. Inspection plugs shall be installed in ductwork per manufacturer's requirements and shall be located where indicated by the Test/Balance Engineer. The inspection plugs shall comply with the following:

1. 50 Durometer EPDM Rublen rated for 340°F.
2. Temperature resistant range= -67°F to 340°F.
3. U.V. resistant.
4. Ozone resistant.
5. Comply with ASTM D470 0624 D2132 D865 D395. Furnish each inspection plug with EPDM sealing flange, EPDM cap, and stainless steel attached lanyard.
6. Provide waterproof label identifying all inspection plugs.

2.8. 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: High gloss white.
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.

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

2.9. HANGER BLOCKS

A. For all pipes larger than 3 inches in diameter the hanger blocks shall be high compressive strength foam or wood blocks. Wood blocks shall be precision cut thickness to match specified insulation and shall include flared edge hanger saddle as manufactured by Buckaroo.

B. The wood blocks shall be suitable for temperatures from -120 degrees Fahrenheit to 200 degrees Fahrenheit. Do not utilize the wood blocks for piping systems operating outside of the indicated temperature range.

C. Wood blocks are not acceptable for use at refrigerant pipe hangers.

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.

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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 coating.
   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, drain valves, strainers, blowdowns, backflow preventers, autoflow valves, flow measuring stations, 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. Cold pipe fittings: Apply a tack coat of vapor barrier coating and reinforcing mesh to produce a smooth surface. After ½ hour, apply a second coat of same vapor barrier coating, UL labeled, Type C, for cold water piping.
   c. Hot pipe fittings and Type H for hot water piping: Apply tack of breather mastic. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of Type C or Type H breather mastic over the reinforcing cloth, working it to a smooth finish.
   d. Insulation cement equal in thickness to the adjoining insulation.
   e. 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.

5. Indoor piping shall be ASJ max with SSL-II closure system as manufactured by Owens Corning, Johns Manville, Knauf or approved equal.
6. Exterior above ground piping shall be insulated with ASJ max SSL-II closure system insulation. Fiberglass insulation with aluminum jacketing shall be utilized for exterior above ground applications. Seal all aluminum jacketing laps with 1/8” bead of metal jacketing sealant to prevent water entry.
7. All floor drain piping that is indicated to receive A/C condensate shall be fully insulated to prevent condensation.

B. Equipment Insulation:

1. General:

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a. Install insulation in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
b. Install insulation on equipment after installation of heat tracing, painting, testing, and acceptance tests.
c. Install insulation materials with smooth, even surfaces. Rework poorly fitted joints. Do not use joint sealer or mastic as filler for joint gaps and excessive voids resulting from poor workmanship. Apply insulation using staggered joint method for both single and double layer installation, applying each layer of insulation separately.
d. Coat insulated surfaces where specified on contract drawings with layer of insulating cement, troweled in a workmanlike manner, leaving a smooth and continuous surface. Fill in seams, broken edges, and depressions. Cover over wire mesh and joints with cement sufficiently thick to remove surface irregularities.
e. Maintain the integrity of factory-applied vapor barrier jacketing on all insulation, protecting it against puncture, tears or other damage. Seal all tears, punctures and other penetrations of equipment insulation facing.
f. Where specification calls for field-applied all-service vapor barrier jacketing, it shall be neatly fitted and tightly secured. Lap seams 2-inches (5cm) (min.). Seal all joints with adhesive. Tape with 3-inches (7.5cm) matching pressure-sensitive tape or 3-inch (7.5cm) glass fabric and vapor barrier coating.
g. On exposed equipment, locate insulation and cover seams in least visible location.

2. Removable Insulation: Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance, such as vessel covers, fasteners, flanges, frames accessories, manholes, handholes, cleanouts ASME stamp, and manufacturer nameplates.
3. Areas Left Uninsulated: Items such as manholes, handholes, clean-outs, ASME stamp, and manufacturers' nameplates should be left uninsulated unless omitting insulation would cause a condensation problem. When such is the case, provide removable insulation and appropriate tagging to identify the presence of these items. Provide neatly beveled edges at interruptions of insulation.
4. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather barrier mastic protective finish or jacketing as recommended by the jacketing manufacturer.

C. 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 and vapor barrier coating as specified.
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

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"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) and glass fabric and vapor barrier coating. 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. Ductwork Exposed to Weather: Protect outdoor insulation from weather by installing outdoor weather barrier mastic or jacketing as recommended by the insulation manufacturer.

4. Rigid Insulation:

   a. Rigid duct insulation may be impaled over welded pins and secured with insulation caps and washers matching the color of the vapor barrier facing. All seams shall be firmly butted and sealed with pressure-sensitive vapor barrier tape matching the facing and vapor barrier coating.

   b. Corner angles shall be installed on all external corners of rigid duct insulation in exposed finished areas before jacketing, except oven and hood exhaust duct insulation, which shall have no corner angles.

5. 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 24inches (60cm) wide with mechanical fasteners on 16-inch (40 cm) (approx.) centers to prevent sagging.

6. Duct Lining Insulation: Duct liner insulation shall be applied with all joints tightly butted

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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 duct insulation shall have a field applied PVC jacket cover neatly cut and pasted over ductwork insulation. PVC shall be high gloss white and shall be 20 mils thick.

B. 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.

C. Exposed areas include, but are not limited to, all mechanical equipment rooms/fan rooms, mezzanines, penthouses, kitchens, electric rooms, storage rooms, janitor closets, and IDF rooms, and piping and ductwork exposed in an occupied space.

D. 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.

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E. Exterior exposed pipe insulation required to be insulated shall be jacketed with a corrugated aluminum jacketing system as previously described. Seal all laps with 1/8" bead metal jacketing sealant.

END OF SECTION

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SECTION 230900 - INSTRUMENTATION AND CONTROLS OF HVAC AND PLUMBING SYSTEMS

PART 1 GENERAL

1.1. SUMMARY

A. For General Mechanical Requirements, see Division 23 Section, Common Work Results for HVAC, and Division 01 Sections.

B. Comply with all code requirements and fire safety requirements as specified in Division 23 Section, Common Work Results for HVAC.

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

D. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory wired controls.

E. The automatic temperature control system ATC and central control and monitoring system (CCMS) shall be electric/electronic direct digital control (DDC), Johnson Controls FX (Facility Explorer) as installed by Modern Controls. All work associated with the automatic temperature control system shall be performed by personnel regularly and directly employed by the Automatic Temperature Controls Contractor. Control System shall be web based, allowing the client access via a standard web browser.

F. Coordinate controls with controlled equipment. Upon completion of the work, calibrate and adjust all controls for proper function. Electric wiring, including interlock wiring for all equipment shall be furnished and installed under this section. All electrical work shall conform to the applicable requirements of Division 26.

G. All automatic temperature control dampers, valves and separable wells for immersion elements furnished by the Control Manufacturer shall be installed by the Mechanical Contractor or his sheet metal subcontractor under the Control Manufacturer's supervision.

H. Reference is hereby made for this contractor to become familiar with Division 26 of these specifications. Familiarization is for coordination purposes only. The control contractor shall provide all necessary relays, contactors, interlock wiring etc. not provided under Division 26 for the automation of the ATC and CCMS systems as required by the sequence of operation and input/output schedule. The control contractor shall coordinate all requirements with the building Fire Alarm System. The control contractor shall provide all additional devices and interlock wiring required for the automation of the ATC system and monitoring of the CCMS system.

I. Furnish all labor, materials, software, equipment and services necessary for and incidental to furnishing and installing a complete direct digital control, automatic temperature control system to meet the requirements of the sequence of operation described on the Drawings.

J. Unless the necessary items are specified to be provided with mechanical equipment by Division 23, the ATC contractor shall coordinate with Division 23, Mechanical, and shall furnish and install all items necessary to meet the requirements of the Sequence of Operation and the Central Control and Monitoring System (CCMS) indicated on the drawings and as required in this specification.

K. The control system shall include all necessary and specified control equipment properly installed in

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accordance with the specifications and drawings and shall include, but not be limited to the automatic temperature control and energy management system of the following:

1. Airflow Monitoring Stations
2. Building Facilities
3. Building Demand and Energy Consumption
4. Carbon Dioxide Sensors
5. Carbon Monoxide Sensors
6. Condensate Overflow Safety Switches
7. Dampers and Actuators
8. Domestic Hot Water Systems
9. Domestic Water Consumption Meters
10. Ductless Units
11. Duct Detector Fan Interlocks
12. Energy Recovery Ventilators
13. Electric Radiant Heat Panels
14. Electric Heating Equipment
15. Electric Duct Coils
16. Emergency Fixture Alarms and Interlocks to the ATC Sytem
17. Exterior Lighting Systems
18. Fire Fighters Manual Shut-Off Switch
19. Gas Furnaces/Gas Fired Infrared Heaters
20. General Exhaust Systems
21. Heating System
22. High Temperature Alarms
23. Lighting Systems (Interior and Exterior)
24. Mechanical Room Heat and Ventilation Control
25. Miscellaneous interlocks required for gas systems, ventilation systems, etc.
26. Plug Load Management
27. Plumbing Systems
28. Pumps
29. Refrigerant Mitigation Controls Monitoring
30. Radiant Heat Panels
31. Relative Humidity/Temperature Sensors
32. Sensors (i.e., temperature, relative humidity, CO_2, CO, etc.)
33. Static Pressure Controllers
34. Unit Heater Control
35. Variable Speed Drives
36. Ventilation Systems
37. Water Heaters

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L. All labor, material, equipment and software to meet the functional intent of the system, as specified herein and as shown on the drawings, shall be included. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the owner.

M. Where equipment is specified to be provided by equipment manufacturer or where packaged controls are specified map out all points provided by the manufacturer so the same can be viewed by ATC system. As a minimum all points indicated in the point list and control diagram must be viewable and adjustable from the ATC system. Coordinate with equipment manufacturer.

1.2. DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Main tracking/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

H. UPS: Uninterruptible Power Supply.

I. NAE: Network Automated Engine.

1.3. SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
2. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
3. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
4. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
5. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
6. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
7. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
b. Water Pressure: Plus or minus 2 percent of full scale.
c. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
d. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
e. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
f. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
g. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
h. Relative Humidity: Plus or minus 5 percent.
i. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
j. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
k. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
l. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
m. Carbon Monoxide: Plus or minus 5 percent of reading.
n. Carbon Dioxide: Plus or minus 50 ppm.
o. Electrical: Plus or minus 5 percent of reading.

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1.4. DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.5. COORDINATION

A. Coordinate location of temperature sensors, relative humidity sensors, CO_2 sensors, dewpoint temperature sensors, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section, “Fire Alarm System” to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Division 26 Section, Electricity Metering to achieve compatibility of communication interfaces.

E. Coordinate equipment with Division 26 Section, Panelboards to achieve compatibility with starter coils and annunciation devices.

1. Coordinate equipment with Division 26 Section, Motor-Controllers to achieve compatibility with motor starters and annunciation devices.

1.6. WORK BY OTHERS

A. Automatic temperature control valves, air flow stations, pipe taps, flow meters, and separable wells for immersion elements furnished by the control manufacturer shall be installed by the mechanical contractor under the control manufacturer's supervision. The control contractor shall deliver to the mechanical contractor valves and wells for installation within the various systems.

B. All automatic dampers furnished by the control manufacturer shall be installed by the mechanical contractor under the control manufacturer's supervision.

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1.7. QUALITY ASSURANCE

A. Supplier shall have an in-place support facility with technical staff, spare parts inventory and all necessary test and diagnostic equipment. The fully staffed and equipped office shall be within a 60 mile radius of the job site.

B. The systems shall be complete in all respects, and shall be installed by skilled personnel. The Control Contractor shall have a successful history in the installation and maintenance of automatic temperature control systems similar in size and performance to that specified herein.

C. Refer to Contract Drawings for sequences of operations, control diagrams, and points lists.

D. All electrical wiring in connection with the Automatic Temperature Control System shall be furnished and installed by the ATC Contractor. This shall include all interlock wiring between the air handling units, fans, pumps, heating systems, switches, dampers, heat pumps, energy recovery ventilators, ductless units, condensing units, static pressure controllers, and energy recovery

modules, H&V units, gas fired units, and airflow monitoring stations, etc.

E. Bids by wholesalers, contractors or franchised dealers or any other firm whose principal business is not that of manufacturing or installing automatic temperature control systems, shall not be acceptable. Bid documents that are not complete in their response to these documents or take exception to any of the capabilities defined within these documents shall not be acceptable.

F. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

H. Comply with ASHRAE 135 for DDC system components.

1.8. GUARANTEE AND INSTRUCTION

A. The control system including all components, system software, parts and assemblies herein specified shall be free from defects in workmanship and materials under normal use and service. After completion of the installation, the Control Manufacturer shall regulate and adjust all thermostats, control valves, control motors, and other equipment provided under this contract. If within two (2) years from the date of acceptance by Owner any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired at no additional cost to the Owner. The Control Manufacturer shall, after completion, provide any service incidental to the proper performance of the Control System under guarantees outlined above for a period of two (2) years. Normal maintenance of the system is not to be considered part of the guarantee. All corrective modifications made during warranty service periods shall be updated on all user documentation including "as-built" shop drawings and on user and manufacturer archived software disks.

B. The control contractor shall completely check out, calibrate and test all connected hardware to insure that the system performs in accordance with the approved specifications and sequences of operation submitted.

C. Upon completion of the work, the control drawings encased in heavy plastic shall be provided where directed. Layout shall show all control equipment and the function of each item indicated.

D. The temperature control contractor's office shall be within a 100 mile radius of the job site.

E. The contractor shall respond to the job site with qualified technicians within a 4 hour period for any emergency relating to the control system or energy management systems.

F. This agreement shall include emergency service during normal working hours.

1.9. SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves,

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relays/switches, control panels, and operator interface equipment.

2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing equipment, fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
9. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks or Bacnet.

D. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

F. Qualification Data: For Installer and manufacturer.

G. Field quality-control test reports.

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H. Submit screen shots of ATC system graphics at substantial completion.

I. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section, Operation and Maintenance Data, and Division 23 Section, Common Work Results for HVAC include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

J. Upon completion of the work, provide a complete set of “as-built" drawings and application software on CD, USB, or other type of electronic storage device. Drawings shall be provided in format as acceptable to the Owner’s files. Submit as-built drawings and specification to Owner's representative for review and approval prior to final project closeout.

1.10. SOFTWARE LICENSE AGREEMENT

A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All software and hardware upgrades shall be included in two (2) year warranty period.

B. Software license agreement shall not apply on projects where existing ATC system is being extended.

C. Minimum of four (4) software license seats shall be provided. Storage of all software shall be coordinated with the Sussex Technical High School I.T. Manger.

1.11. ELECTRICAL SURGE PROTECTION

A. It is the responsibility of the ATC/FMS contractor to provide adequate surge protection for all wall mounted control panels required for this project.

1. Devices under surge protection shall be of design that loss of memory will not occur in the event of the surge protection device being activated due to surge/spike conditions.
2. Surge protection devices will be required to be hard wired, with the exception of peripheral devices that use standard 110VAC plugs for connections (i.e. Modems).
3. Surge protection devices are to be rated for 120 VAC single phase, 20 (or greater) amps capacity.
4. Surge Protection devices to include internal fuse protection, audible surge alarm & LED indicators.
5. Surge protectors to have clamping voltage of 480V peak, maximum surge current rating of 50,000 amps. Unit to have NEMA 12 enclosure with wall mounting bracket and conduit connection.

1.12. TRAINING

A. The training time period shall be coordinated with the school system's facility Engineer. The

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schedule training period shall be arranged at the owner's convenience.

B. Cost shall include all training material, instruction books, and two copies of video tape with sound DVD of training session.

C. Upon completion of the work, the Control Contractor shall have completely adjusted the entire control system. All training shall be by the control contractor and shall utilize specified manuals and as-built documentation.

D. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 8 hours' dedicated instructor time on-site.
3. Review data in maintenance manuals. Refer to Division 01 Section, Contract Closeout.
4. Review data in maintenance manuals. Refer to Division 01 Section, Operation and Maintenance Data.
5. Schedule training with Owner, with at least seven days' advance notice.
6. Control Contractor shall also attend and participate in separate HVAC equipment systems training in addition to ATC training.

1.13. ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.14. SUSSEX TECHNICAL HIGH SCHOOL SPECIFIC REQUIREMENTS

A. The ATC Subcontractor shall include in his bid all costs associated with incorporating the following specific requirements:

1. All holiday schedules shall incorporate a 12 month block. Coordinate exact holidays, schedules, calendars, occupied, unoccupied periods with Owner prior to writing software. All schedules shall be reviewed and approved by the Owner.
2. Relays for ATC equipment shall not be located in ceilings. All relays shall be located in equipment control panels and/or mechanical rooms.
3. All exhaust fans shall be assigned a designated point. Utilizing relays to provide digital point for exhaust fans shall not be acceptable.
4. Graphics on ATC computer shall in addition to basic requirements indicate the percentage open or closed on all dampers.
5. The ATC Computer Graphics shall incorporate the final room numbers actually utilized in the fieldhouse, greenhouse, head house and barn. All room names utilized in the graphic display shall be reviewed and approved by the Owner.
6. The ATC Computer Graphics shall indicate for each item of equipment the “on” or “off” status and command shall be “run” or “stop”.
7. The ATC Computer Graphic shall indicate for each duct smoke detector the “on” or “off” status and command.
8. All temperature sensors, equipment, relative humidity sensors, current sensors, CO2 sensors, CO sensors, differential pressure sensors, etc. indicated on ATC Control Diagrams and point list shall be displayed on the ATC Computer Graphic. Measured value or status shall be displayed.

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9. For any multi-stage HVAC units, the quantity of compressor stages and the quantity of gas heating stages shall be displayed on the Computer Graphics.
10. The exact space temperature set points, relative humidity set points, changeover set points. etc., shall be coordinated with Owner prior to final data entry. All items indicated in sequences of Operation as "adjustable" shall be reviewed and approved by Owner prior to implementation of the same.
11. The outside air relative humidity and outside air temperature shall be monitored on ATC system and reported on ATC Computer Graphics. See Floor plans for exact locations.
12. Provide a graphic of all floor plans indicating location of all equipment interlocked with ATC System including all control panels.
13. Graphic shall also indicate area of building served by each item of equipment. Graphics shall indicate all global sensor readings.
14. All equipment shall be labeled with name of equipment, area served, and area location (room name/number).
15. Scheduling of HVAC equipment/zones shall be such that for afterhours use the ATC system shall allow a temporary override of the pre-set occupied/unoccupied schedule by zone and for specific equipment in a zone. This must allow the school staff the ability to operate as few or many zones as desired without operating entire portions of the building.
16. Provide "Loss of Heat" monitoring and alarm on ATC system if any space temperature sensor in the building drops below 50 degrees Fahrenheit (Adjustable).
17. Provide additional software package and license so that Owner can install software on Owner provided laptop. Assist owner with installation of software.
18. Provide a "demand toggle control" switch on ATC system to automatically reduce HVAC electric demand (power) by automatically modifying setpoints to pre-determined values. Coordinate pre-determined setpoint values with Owner and document in the As-Built Documents.
19. Scheduling of HVAC equipment/zones shall be such that for afterhours use the ATC system shall allow a temporary override of the pre-set occupied/unoccupied schedule by zone and for specific equipment in a zone.
20. Alarms shall be delayed during optimal start stop to avoid nuisance alarm triggers.
21. Position of all H-O-A switches and other switches shall be reported on ATC graphic with equipment.
22. All text alarms shall clearly identify what they are within the body of the text. i.e. "ERV XX-", "Duct smoke detector trip", etc. Coordinate all text alarms and verbiage with Owner.

1.15. GLOBAL SENSORS

A. General

1. Furnish and install global sensors and report the same on the automatic temperature control system.
2. Global sensors shall monitor and trend the following conditions:

a. Outside air temperature.
b. Outside air relative humidity.
c. Outside Air CO_2 level in ppm.
d. All ventilation fan speeds where variable frequency drives are specified.
e. Outside air carbon dioxide level.
f. All ventilation fan amperage where variable frequency drives are specified.
g. All fan speeds where variable frequency drives are specified.
h. All fan amperages where variable speed fans are indicated. Graphic shall also indicate area of building served by each item of equipment.
i. I.T. server room space temperature sensor.
j. Global holiday schedules:
i. Provide all interlock wiring and programming to allow a global holiday

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schedule for all equipment except the administration equipment. Global holiday schedule shall allow the Owner to shut down the entire building's HVAC systems if an unscheduled event occurs when school is cancelled.

ii. System shall also be capable of individual scheduling of equipment as specified or all can be globally modified at once.

k. All equipment interlocked with ATC system shall be able to be turned on/off via ATC system as specified. Changing temperature set point alone is not acceptable method for turning equipment on/off.

l. Where damper position is indicated ATC graphic shall indicate percentage open or percentage closed.

PART 2 PRODUCTS

2.1. BUILDING MANAGEMENT SYSTEM

A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Management System shall consist of the following:

1. Standalone Network Automation Engine(s)
2. Field Equipment Controller(s)
3. Input/Output Module(s)
4. Local Display Device(s)
5. Distributed User Interface(s)
6. Network processing, data storage and communications equipment
7. Other components required for a complete and working BMS

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Automation Network

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
3. Network Automation Engines (NAE) and/or system controllers shall reside on the automation network.
4. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

F. Control Network

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1. Network Automation Engines and/or system controllers shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:

    a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
    b. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
    c. The Johnson Controls N2 Field Bus or equivalent.
    d. Tridium FX-40
    e. Honeywell Webs
    f. TAC Controls by Schneider Electric
    g. Siemens P1/P2 Serial

2. Control networks shall provide either "Peer-to-Peer," Main-Tracking, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (main or tracking) that will communicate on the BACnet MS/TP Bus.
6. The Conformance Statements shall be submitted with the BAS Submittals.

G. Integration

1. Hardwired

    a. Analog and digital signal values shall be passed from one system to another via hardwired connections.
    b. There will be one separate physical point on each system for each point to be integrated between the systems.

2. BACnet Protocol Integration – BACnet

    a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
    b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
    c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

H. Dedicated Web Based User Interface

1. Where required by the Owner, the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability. Coordinate with Owner to determine computer type (i.e. PC (Windows based) or Macintosh (Apple)).
2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

    a. Microsoft Edge Internet Explorer for user interface functions

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b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries.

3. Computer Hardware – The personal computer(s) shall be configured as follows:

a. Description: A tower or all-in-one computer designed for normal use at a single, semipermanent location.
b. Performance Requirements:
   i. Performance requirements may dictate equipment exceeding minimum requirements indicated.
   ii. Energy Star compliant.
c. Personal Computer:
   i. Minimum Processor Speed: 3 gigahertz (GHz). Dual Core Processer.
d. RAM:
   i. Capacity: 16GB.
   ii. Speed and Type: 1333 MHz, SDRAM.
e. Hard Drive:
   i. Media: Solid state.
   ii. Number of Hard Drives: One.
   iii. Capacity: 250GB.
f. Optical Read and Write Drive:
   i. Include with at least 2 MB of data buffer.
   ii. Type: SCS1 CD-ROM Drive with Read/Write Capability.
   iii. Average access time of 150 ms or less.
g. At least four expansion slots.
h. Video Card:
   i. Resolution: 1920 by 1200 pixels.
   ii. RAM: 4 GB.
   iii. Controller Speed: 4GHz.
i. Sound Card:
   i. At least 128 voice wavetable synthesis.
   ii. Capable of delivering three-dimensional sound effects.
   iii. High-resolution 16-bit stereo digital audio recording and playback with user-selectable sample rates up to 48,000 Hz.
j. Two (2) Network Interface Cards: Include cards with connection, as applicable.
   i. 10-100-1000 base TX Ethernet with RJ45 connector port.
   ii. 100 base FX Ethernet with SC or ST port.
k. Wireless Ethernet, 802.11 a/b/g/n.
l. Optical Modem: Full duplex link for connection to optical fiber cable provided.
m. I/O Ports:
   i. Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.
   ii. One serial port.
   iii. One parallel port.
   iv. Two PS/2 ports.
   v. One RJ-45.
   vi. One stereo line-in and headphone/line-out on back panel.
   vii. One microphone and headphone connector on front panel.
   viii. One IEEE 1394 on front and back panel with PCI-e card.

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ix. One ESATA port on back panel.

n. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.

o. Keyboard:
   i. 101 enhanced keyboard.
   ii. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.
   iii. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

p. Pointing Device:
   i. Either a two- or three-button mouse.
   ii. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

q. Flat Panel Display Monitor:
   i. Display:
      1. Color display with 21 inches diagonal viewable area.
      2. Digital input signal.
      3. Aspect Ratio: 16 to 9.
      4. Antiglare display.
      5. Tilt adjustable base.
      6. Energy Star compliant.
      7. Resolution: 1920 by 1200 pixels at 60 Hz.
      8. Number of Displays: One.

r. Speakers:
   i. Two, with individual controls for volume, bass and treble.
   ii. Signal to Noise Ratio: At least 65 dB.
   iii. Power: At least 4 W per speaker/channel.
   iv. Magnetic shielding to prevent distortion on the video monitor.

s. I/O Cabling: Include applicable cabling to connect I/O devices.

t. Uninterruptable Power Supply.

I. User Interface Application Components

1. Operator Interface

a. An integrated browser based client application shall be used as the user operator interface program.

b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3 or on the drawings, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.

c. The user interface software shall provide help menus and instructions for each operation and/or application.

d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
   i. User access for selective information retrieval and control command execution
   ii. Monitoring and reporting
   iii. Alarm, non-normal, and return to normal condition annunciation
   iv. Selective operator override and other control actions
   v. Information archiving, manipulation, formatting, display and reporting

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vi. FMS internal performance supervision and diagnostics
vii. On-line access to user HELP menus
viii. On-line access to current FMS as-built records and documentation
ix. Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications.
x. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Navigation Trees

a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
c. The navigation trees shall be "dockable" to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

3. Alarms

a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
i. Log date and time of alarm occurrence.
ii. Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.
iii. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
iv. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
v. Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
vi. Any attribute of any object in the system may be designated to report an alarm.
b. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions
c. The FMS shall annunciate application alarms as required.

4. Reports and Summaries

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a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
   i. All points in the BMS
   ii. All points in each BMS application
   iii. All points in a specific controller
   iv. All points in a user-defined group of points
   v. All points currently in alarm
   vi. All points locked out
   vii. All BMS schedules
   viii. All user defined and adjustable variables, schedules, interlocks and the like.
b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
   i. Weekly schedules
   ii. Exception Schedules
   iii. Monthly calendars
b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
e. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.
f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Password

a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.
c. The system shall allow each user to change his or her password at will.
d. When entering or editing passwords, the system shall not echo the actual

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characters for display on the monitor.

e. A minimum of five levels of access shall be supported individually or in any combination as follows:
   i. Level 1 = View Data
   ii. Level 2 = Command
   iii. Level 3 = Operator Overrides
   iv. Level 4 = Database Modification
   v. Level 5 = Database Configuration
   vi. Level 6 = All privileges, including Password Add/Modify

f. A minimum of 100 unique passwords shall be supported.

g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.

h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.

8. Dynamic Color Graphics

   a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.

   b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.

   c. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

   d. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
      i. All graphics shall be fully scalable
      ii. The graphics shall support a maintained aspect ratio.
      iii. Multiple fonts shall be supported.
      iv. Unique background shall be assignable on a per graphic basis.
      v. The color of all animations and values on displays shall indicate the status of the object attribute.

   e. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device

   f. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.
      i. The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
      ii. In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

   g. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various

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variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

9. Historical trending and data collection

a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
   i. Any point, physical or calculated, may be designated for trending. Two (2) methods of collection shall be allowed:
      1. Defined time interval
      2. Upon a change of value.
   ii. Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis. Trend data shall be available for a minimum of twelve (12) months.

10. Trend data viewing and analysis

a. Provide a trend viewing utility that shall have access to all database points.
b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

J. Network Automation Engine (NAE)/ System Controllers

1. The Network Automation Engine (NAE)/ System Controllers or approved equal shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.

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b. The NAE shall support up four (4) concurrent users.
c. The web based user shall have the capability to access all system data through one NAE.
d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
h. The web based UI shall support the following functions using a standard version of Microsoft Edge Internet Explorer:
   i. Configuration
   ii. Commissioning
   iii. Data Archiving
   iv. Monitoring
   v. Commanding
   vi. System Diagnostics
i. Systems that require workstation software or modified web browsers are not acceptable.
j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
5. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock – The NAE shall include an integrated, hardware-based, real-time clock.
7. The NAE shall include troubleshooting LED indicators to identify the following conditions:

   a. Power - On/Off
   b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
   c. Ethernet Connection Speed – 10 Mbps/100 Mbps
   d. FC Bus – Normal Communications/No Field Communications
   e. Peer Communication – Data Traffic Between NAE Devices
   f. Run – NAE Running/NAE In Startup/NAE Shutting Down/Software Not Running
   g. Bat Fault – Battery Defective, Data Protection Battery Not Installed
   h. Fault – General Fault
   i. Modem RX – NAE Modem Receiving Data
   j. Modem TX – NAE Modem Transmitting Data

8. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

   a. Up to two (2) USB port
   b. Up to two (2) URS-232 serial data communication port
   c. Up to two (2) RS-485 port

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d. One (1) Ethernet port

9. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification – The NAE shall be listed by Underwriters Laboratories (UL).
12. Controller network – The NAE shall support the following communication protocols on the controller network:

    a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
        i. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (main or tracking) that will communicate on the BACnet MS/TP Bus.
        ii. The Conformance Statements shall be submitted 10 day prior to bidding.
        iii. The NAE shall support a minimum of 100 control devices.
    b. The NAE shall support the Johnson Controls N2, Tridium FX-40, or Honeywell Webs or approved equal Field Bus.
        i. The NAE shall support a minimum of 100 N2 control devices.
        ii. The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
        iii. The Bus shall employ a main/tracking protocol where the NAE is the main.
        iv. The Bus shall employ a four (4) level priority system for polling frequency.
        v. The Bus shall be optically isolated from the NAE.
        vi. The Bus shall support the Metasys Integrator System.

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2.2. WIRING

A. The multi-conductor cable for field wiring of electronic analog sensors shall be minimum No. 22 AWG, 300 volt, thermoplastic with stranded copper wire and 100 percent shield coverage. The number of conductors in each sensor cable shall be as determined by the Contractor. 2/c #22 shielded cables shall be Belden Cat. #8451 3/c #20 shielded cables shall be Belden Cat. #9770 or approved equal.

B. Conductors for digital sensors or contact control shall be the same as for the analog sensors, except the grounded shield is not required.

C. Individual conductors shall be color coded and in addition shall be numbered in the field to identify the particular terminal to which attached. Field numbering shall be performed with Brady or approved equal markers wrapped around the wire near the terminal connection. All wires shall be

terminated with pressure type connectors suitable for wire size, material and terminal connection.

D. All exposed wiring or wiring concealed in partitions shall be installed in a designated conduit raceway. The conduit shall conform to Division 26 of the specification. Where wiring is installed in an air plenum the same shall be plenum rated cable.

E. All junction boxes shall have covers painted safety green, and be rigid steel.

F. All wiring between static pressure controllers and/or air flow monitoring stations and variable frequency drive fan controllers shall be shielded and grounded at the fan controller end. Directly route the variable frequency drive fan controller to the static pressure controller(s) and/or air flow monitoring stations.

G. Where a motor disconnect is indicated downstream of a variable frequency drive (VFD) provide interlock wiring from the auxiliary contacts on the disconnect to the VFD to de-energize when the disconnect is turned “off”.

2.3. CONTROLLERS

A. Temperature, relative humidity, carbon monoxide, and CO2 sensor covers shall be stainless steel wire guard type with vandal proof screws. All room relative humidity, CO2, carbon monoxide, and temperature sensors shall be mounted 4'-0 inches above the finished floor, except in stairways, corridors and toilets, which shall be 7'-0 inches. Provide insulating bases where temperature sensors are located on exterior or unconditioned walls. Each temperature sensor shall have adjustable limit stops and adjustable sensitivity. User adjustment shall be 2 degrees F above and below set points or as determined by the Owner. Room temperature sensors shall include range of 55 degrees F to 85 degrees F set point adjustment. Temperature sensors shall include set-point adjustors, U.L. approved for mounting base in air plenums, and RJ-11 jack for communications. Room temperature sensors shall be fully adjustable and shall display set point and actual temperature.

B. Space sensor wiring shall be installed concealed where possible. Should the Division 23 Contractor be unable to do so then surface metal raceway shall be utilized as specified in Division 26.

C. Room temperature sensors shall be accessible to ADA occupants.

D. All global sensors shall be monitored in accessible locations. Exterior sensors shall be provided with sun shield and be installed to prevent bird nesting.

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2.4. DAMPERS

A. Control Dampers

1. The temperature control contractor shall provide all automatic control dampers of the types indicated on the plans and not specified to be integral with other equipment. Frames shall be not less than 16 gauge galvanized steel. Blades shall not be over 6 inches wide airfoil shaped double skin construction of 14 gauge equivalent thickness. Bearings shall be stainless steel sleeves with 2 inch shafts. Blade edge seals shall be vinyl blade with flexible metal compressible jamb seals of the tight-seal spring type. Dampers and seals shall be suitable for temperature ranges of -40 to 250 degrees F.
2. All proportional or modulating control dampers shall be opposed blade type and all two-position dampers shall be parallel blade type.
3. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6 inches.

4. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage and flow characteristic data for all control dampers with the temperature control submittal. Maximum leakage shall be 3 CFM/Sq. Ft. at static pressure of 1 inch W.C. for a damper width of 48 inches.
5. Ultra-low leakage dampers shall have blade edges shall to be fitted with replaceable, snap-on, inflatable seals to limit damper leakage to 2 percent at applied static pressure.
6. Low pressure rectangular control dampers shall be Type CD60 airfoil low leakage damper as manufactured by Ruskin or as approved equal of American Warming and Ventilating, Air Balance and Arrow.
7. Round control dampers shall be Type CERS25 with blade edge seals as manufactured by Ruskin or as approved equal.
8. Provide damper end switch for all control dampers where indicated. Damper end switch shall provide “proof of open” prior to allowing fan to energize. Damper end switch shall be Model TS-475 Mechanical Damper Arm Switch (no-mercury) as manufactured by MDI, Inc. or approved equal. Install per manufacturer’s recommendations on control damper. End switch shall have the following features:

    a. Housing Material: Glass filled PBT (polybutylene terephthalate).
    b. Bracket Material: Plated steel.
    c. Operation: Steel ball actuated sub-miniature snap action switch.
    d. Operating angle: 15 degrees. (Contact closes at 10 degrees above horizontal and contact opens at 5 degrees below horizontal).

B. Duct Smoke Detectors

1. Duct Smoke detectors shall be provided by the Electrical Contractor and installed by the Mechanical Contractor. All wiring, interlocks, etc., to be provided by Electrical Contractor. Wiring from duct smoke detectors to fans shall be by ATC Contractor. Duct smoke detectors shall be tested by the Test and Balance Engineer as specified in Division 23 Section, Testing Adjusting & Balancing for HVAC and Plumbing.

C. Damper Operators

1. Electric damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range.
2. Use devices which are quiet in operation and which in the event of power failure, will "fail safe" by spring action in either the normally open or normally closed position as required for freeze, moisture, smoke, or fire protection.
3. Electric actuators requiring a 24 VAC power supply will be utilized. Motors shall be specifically designed and sized with proper torque according to requirements of the device it is to be used on (i.e.: valve, damper). Each actuator will accept the proper control input as the system is designed, (i.e.: floating, 0-10VDC, 4-20Ma etc.) without the need for any additional interface devices.
4. For all exterior damper operators provide NEMA 4X stainless steel corrosion resistant enclosure. Damper operator enclosure shall be model ZS-300 as manufactured by Belimo or approved equal.

2.5. CONTROL PANELS

A. Furnish and install local panels for ATC devices. Control panels shall be fully enclosed cabinets, all steel construction and shall meet the requirements of NEMA 1 enclosures. Cabinet shall have piano hinged door with a locking latch. All cabinet locks shall use common key. Provide means of storing control system instructions and drawings inside cabinet for future reference. Panel shall be wall mounted or free standing and located where directed by the Contract Drawings or Engineer.

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1. Each panel shall have all internal devices factory wired to a numbered terminal strip. Controllers and associated devices shall be mounted within the panel, accessible through a hinged door.
2. All ATC panels shall be provided with integral disconnect, wiring, and control transformers.
3. Any ATC control panel that is serving equipment on the emergency generator must be powered by an emergency generator fed circuit/electrical panel. Refer to electrical contract documents for all emergency powered equipment.

2.6. MISCELLANEOUS ELECTRICAL DEVICES

A. Electric Actuators. All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with electric actuators which shall be sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close off as specified.

B. Aquastats shall be line voltage strap on type with single pole, single throw switching. Switches shall have an adequate rating for the applied load. All wiring from aquastats to domestic recirculating pumps shall be by ATC contractor.

2.7. UNINTERRUPTIBLE POWER SUPPLY

A. Furnish, size and install uninterruptible power supplies (UPS's) at all ATC panels.

B. Provide all interlock and power wiring from U.P.S. to control panels as required such that all components are powered via the UPS. For hard-wired equipment furnished with pigtails/wire leads, e.g. control power transformers, splice pigtails/wire leads in junction box to a flexible cord with NEMA 5-15P Plug, which shall be plugged into the UPS.

C. UPS's shall be sized for the ATC panel load and shall provide at least 10 minutes of full load power in the event of a power outage.

D. UPS shall be furnished with plug and cord and shall be powered from power receptacle(s) in ATC panels.

2.8. DESKTOP WORKSTATIONS

A. Description: A tower or all-in-one computer designed for normal use at a single, semipermanent location.

B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.

C. Personal Computer:

1. Minimum Processor Speed: 3 gigahertz (GHz).
2. RAM:

a. Capacity: 16GB.
b. Speed and Type: 1333 MHz, SDRAM.

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3. Hard Drive:

   a. Media: Solid state.
   b. Number of Hard Drives: One.
   c. Capacity: 250GB.

4. Optical Read and Write Drive:

   a. Include with at least 2 MB of data buffer.
   b. Type: SCS1 CD-ROM Drive with Read/Write Capability.
   c. Average access time of 150 ms or less.

5. At least four expansion slots.
6. Video Card:

   a. Resolution: 1920 by 1200 pixels.
   b. RAM: 4 GB.
   c. Controller Speed: 4GHz.

7. Sound Card:

   a. At least 128 voice wavetable synthesis.
   b. Capable of delivering three-dimensional sound effects.
   c. High-resolution 16-bit stereo digital audio recording and playback with user-selectable sample rates up to 48,000 Hz.

8. Two (2) Network Interface Cards: Include cards with connection, as applicable.

   a. 10-100-1000 base TX Ethernet with RJ45 connector port.
   b. 100 base FX Ethernet with SC or ST port.

D. Wireless Ethernet, 802.11 a/b/g/n.

1. Optical Modem: Full duplex link for connection to optical fiber cable provided.
2. I/O Ports:

   a. Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.
   b. One serial port.
   c. One parallel port.
   d. Two PS/2 ports.
   e. One RJ-45.
   f. One stereo line-in and headphone/line-out on back panel.
   g. One microphone and headphone connector on front panel.
   h. One IEEE 1394 on front and back panel with PCI-e card.
   i. One ESATA port on back panel.

3. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.

E. Keyboard:

1. 101 enhanced keyboard.
2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.

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3. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

F. Pointing Device:

1. Either a two- or three-button mouse.
2. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

G. Flat Panel Display Monitor:

1. Display:

a. Color display with 21 inches diagonal viewable area.
b. Digital input signal.
c. Aspect Ratio: 16 to 9.
d. Antiglare display.
e. Tilt adjustable base.
f. Energy Star compliant.
g. Resolution: 1920 by 1200 pixels at 60 Hz.
h. Number of Displays: One.

H. Speakers:

1. Two, with individual controls for volume, bass and treble.
2. Signal to Noise Ratio: At least 65 dB.
3. Power: At least 4 W per speaker/channel.
4. Magnetic shielding to prevent distortion on the video monitor.

I. I/O Cabling: Include applicable cabling to connect I/O devices.

2.9. CENTRAL CONTROL AND MONITORING SYSTEM (CCMS) (HARDWARE DESCRIPTION)

A. General

1. The Facilities Management Control System (FMCS) shall be comprised of a network of various independent, Stand-alone Digital Controllers (SDC'S), Mechanical System Digital Controllers (MSDC's), Air Handler Digital Controllers (AHDC's), Unitary Digital Controllers (UDC's); together with Centralized Control Stations (CCS), and Centralized Host Stations (CHS) as specified, to provide centralized access and facility wide control functions. The AHDC's and UDC's shall be interconnected in a communicating network to provide facility wide access and sharing of information. A Gateway Digital Controller (GDC's) shall be provided to allow interface with third party microprocessor based control systems that are specified for integration within specification. A Local Area Network (LAN) shall be provided to interconnect SDC's for high-speed data transmission.
2. Specification Nomenclature

a.	FMCS	Facility Management Control System
b.	MSDC	Mechanical System Digital Controller
c.	AHDC	Air Handler Digital Controller
d.	UDC	Unitary Digital Controller
e.	HHOT	Hand Held Operator Terminal
f.	GDC	Gateway Digital Controller
g.	GP	Graphical Programmer
h.	CHS	Central Host Station
i.	CCS	Central Control Station
j.	RPTR	Communications Repeater

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B. Centralized Host Stations (CHS)

1. The FMCS shall include Centralized Host Stations. CHS's shall, in conjunction with the full compliment of Digital Controllers, provide the performance requirements within this specification. Each CHS shall include all hardware and software components to serve as a centralized facility operator station, providing color graphics, facility wide access, operator initiation of global control strategies, and centralized documentation.
The CHS shall be capable of simultaneously interfacing with the following:

a. -mouse pointing device
b. -two parallel printers
c. -high resolution VGA color graphics monitor
d. -seven auto answer/auto dial modems
e. -color inkjet printer
f. -two serial printers
g. -three FMCS LAN interface
h. -Alarm Graphic and Report FAX dial out service interface
i. -Mass storage tape system

As a minimum, the temperature control contractor shall provide the types and quantities of CHS, CCS, AHDC, GDC and UDC as required.

2. Computer

a. The existing FMS computer located in the School Districts Central Maintenance Office shall be utilized with the new CCMS System. Provide modem terminal, and wiring as required to interface buildings CCMS system with FMS computer. I/P data drop shall be provided adjacent to the network panels.
b. Coordinate IP address with Owners' I.T. Department for network connection. The CCMS must be fully networkable.
c. Provide fiber optic cable as required.
d. Extend Existing Building Management System (BMS) as required to accommodate all equipment on this project.

3. Operator Workstation: One PC-based microcomputer with minimum configuration as follows:

a. Uninterruptible Power Supply: 2 kVa.
b. Operating System: Microsoft Windows – Latest Version.
   i. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
   ii. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

C. Centralized Control Stations (CCS)

1. The FMCS shall include Centralized Control Stations, as required. CCS's shall, in conjunction with the network of SDC's and additional CCS components as required, provide the performance requirements within this section of the specification. Each CCS shall include all hardware and software components to serve as a centralized facility operator station, providing facility wide access, for review and modification of global control strategies, real time system monitoring, controller database editing or creation, and centralized documentation.

D. Local Area Networks

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1. The LAN shall utilize packetized transmissions, CRC 16 error checking, and distributed error recovery. Single or multiple SDC failures shall not cause loss of communication between other LAN-connected SDC's.
2. LAN connected SDC's shall be provided with a communications watchdog to assure that an individual SDC cannot permanently occupy the LAN. If an SDC is determined to be monopolizing communications, it shall be automatically shut down and an exception reported to annunciate this fact.
3. The LAN shall employ a token passing, peer-to-peer convention, same as or similar to the industry standard format IEEE 802.4. The content of messages shall be the manufacturer's standard. The Local Area Network components shall be manufacturer's standard or available from third party vendors which utilize the same chip implementation as used by the manufacturer.
4. Industry standard ANSI, RS-485 Network Communication System, Lon, or Bacnet, or Equivalent shall be utilized.
5. Trunk Wiring Practices - General

    a. The distributed communication network system shall consist of a multi-drop RS-485 bus architecture connecting AHDC's, GDC's and UDC's. The trunk shall consist of:
        i. A twisted pair of wires (24 awg) completely encased in continuous metallic conduit.
        ii. A twisted shielded pair of wires (24awg) with the shield grounded in accordance with the manufacturer's wiring practices.
        iii. Or a dual channel, 62.5 micron fiber cabling system with ST type connectors.

    There shall be no power wiring, in excess of 30 VAC rms voltage, run in conduit with communications trunk wiring. In cases where power or signal wiring is run in conduit with trunk wiring, all communications trunk wiring and power wiring shall be run using separate twisted shielded pairs (24awg) with the shields grounded in accordance with the manufacturer's wiring practices.

    b. Communication Transient Protection
        i. The manufacturer's catalog data sheet shall provide evidence that all FMCS products offered by the manufacturer are tested and comply with the standard for Transient Surge withstand capabilities for electrical devices ANSI C62.41, IEEE-587-1980, Categories A and B. Such testing shall have included power and communication trunk wiring. Compliance with IEEE-587 shall imply conformance with IEEE-472 transient standards based on the stated position of ANSI and IEEE regarding applicability of the rated standards.
        ii. In addition, at each building entry and exit point, the wire communications trunk wiring shall be protected with a transient surge protection device providing the minimal protection specifications of the General semiconductor, Model #422E device. Transient surge protection is not necessary if the communication trunk, external to the building, is fiber optic in nature.
        iii. The communications circuitry and input/output circuitry, of the AHDC's, shall provide protection against a 1000 volt, 3 amp transient signal, directly applied to the communication or input/output terminations. The manufacturer's catalog data sheet shall provide evidence of conformance with this requirement. Systems not complying with this requirement shall provide equivalent protection external to the FMCS controller. Protection shall be provided for the individual communications and input/output terminations for each FMCS controller. Submittal documentation shall clearly define how this requirement will be met and how the external protection will not affect the performance of the

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controllers.

c. RS-485 Trunk Distance and Topology
The manufacturer's RS-485 trunk shall provide operation over end to end linear distances of 4000 feet for wire connections and 6,500 feet for fiber optic connections, without repeaters, at communication data rates of up to 64 kbps. The trunk may be extended up to 20,000 feet through the use of wire repeaters or 80,000 feet through the use of fiber optic repeaters.
At data rates of up to 19.2 kbps, the trunk distance shall be extendible to distances of up to 20,000 feet using RS-485 communication wire or fiber optic repeaters. A repeater shall be used each 4,000 feet of linear distance for wire or every 6,500 feet for fiber optics. Repeating devices shall contain separate LED indication for each communication interface trunk to indicate proper operation of the repeater as well as the communications trunks.
Contractors shall provide devices which are of FMCS control system manufacturer's design.

d. It shall be possible for the trunk to be "T" eed or "starred", at any location using a repeater, to facilitate the installation. Systems which do not provide this capability shall provide a trunk riser diagram showing end to end distances and locations of system topology necessary to meet the trunk diagram shown on the plans.

e. Fiber Optic Communication Trunk
The temperature control contractor shall provide a dual channel fiber optic data link, as required, to minimize the effects of transient surges caused by lightning or external EMI generating equipment. The data link shall be comprised of a single duplex cable containing two fibers (transmit and receive), of 62.5 micron construction, to accommodate data rates of up to 64 kbps.
The fiber optic trunk shall be connected to SDC devices using manufacturer's standard RS-485 to fiber optic data link modem. Repeating devices shall contain separate LED indication for each communication interface and the fiber modem, to indicate proper operation of all aspects of the device. Fiber modem devices shall be tested and conform with transient surge withstand tests for electrical devices, ANSI C62.41 IEEE-587 Categories A and B. Manufacturer's data sheet shall provide evidence of compliance with this requirement. Manufacturer's products which do not meet this minimum performance requirement shall not be acceptable.
Systems which require a special gateway controller to accommodate the fiber optic trunks, shall provide such a controller per point where the fiber optic cable enters and leaves the building. Gateway controllers shall not inhibit transfer of point data values between SDC controllers throughout the LAN. Such inhibitive systems shall not be acceptable.
In lieu of the above two options, the contractor may provide a fiber optic link to each SDC controller within the LAN. All controllers shall have access to the fiber optic link for LAN.
Fiber optic cable shall be fully tested and terminated by the temperature control contractor.

E. Air Handler Digital Controller (AHDC)

1. General

a. Controls shall be microprocessor based, Air Handler Digital Controllers (AHDC's). AHDC's shall be provided for air handling units, H & V units, kitchen vent units, rooftop units energy recovery ventilators, energy recovery modules, and other applications as required. AHDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the AHDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates the sensor

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signals. All input/output signal conversion shall be performed through a minimum of a 10 bit A to D converter. All input points shall be universal in nature allowing their individual function definition to be assigned through the application software. All unused input points must be available as universally definable at the discretion of the owner. If the input points are not fully universal in nature, unused points must be equal in quantity between Analog Inputs and Digital Inputs. Contractor shall provide a minimum of one AHDC controller per air handling system as shown on the drawings.

The BAS contractor shall provide and field install all AHDC's specified under this section. Mechanical equipment manufacturers desiring to provide AHDC type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BAS/Temperature control contractor.

b. All input/output signals shall be directly hardwired to the AHDC. Troubleshooting of input/output signals shall be easily executed with a volt-ohm meter (VOM). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be utilized.

c. AHDC's shall be in continuous direct communication with the network which forms the facility wide Building Automation System. The AHDC's shall communicate with the SDC at a baud rate of not less than 19,200 baud.

2. Non-Volatile Memory

a. All control sequences programmed into the AHDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the AHDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The AHDC shall allow for the creation of unique application control sequences. Systems that only allow selection of sequences from a library or table, are not acceptable.

b. All control sequences shall be fully programmable at the AHDC, allowing for the creation and editing of an application control sequence, while at the unit.

c. The AHDC shall be provided with an interface port for the HHOT. The interface port shall allow the HHOT to have full functionality as described. From the interface port, the HHOT shall be able to directly access any AHDC or UDC in the network.

d. The AHDC shall provide an input/output point trending utility that is capable of accumulating 48 analog point samples and 10 digital point samples, per Input/Output point. Each sample shall be taken on a user defined interval, ranging from 1 second to 255 hours per sample. The digital readings shall be on a change of state occurrence for the digital points. All samples shall be recorded with the engineering units for the value, along with a time and date identifier for each sample taken. The samples shall be protected against loss due to power interruptions through a battery or capacitor backup method for a minimum of 30 days.

Systems unable to provide the above capability shall provide for the individual Input/Output point trending at the SDC. Specifics as to how each AHDC point will be trended, at the SDC, shall be provided in the submittal documents. Included in the explanation shall be the sample intervals, the memory allocation in the SDC and the number of AHDC's per SDC that can be expected.

e. The AHDC shall provide LED indication of transmit/receive communications performance, as well as for the proper/improper operation of the controller itself.

f. The AHDC shall be provided with a battery backed time clock that is capable of maintaining the time of day and calendar for up to thirty days, upon loss of power to the AHDC, without loss of setting. The battery for the time clock shall be

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replaceable by the customer. The AHDC shall be provided with integral time schedules; as a minimum, two seven day schedules with eight on/off periods per day shall be provided. Holiday override of weekly schedules shall be provided for pre-scheduling of holidays, for the year in advance.

3. Controller Location

a. To simplify controls and mechanical service troubleshooting, the AHDC shall be mounted directly in or on the controls compartment of the air handling system. The AHDC shall be provided in a NEMA 1 enclosure to accommodate direct mounting on the equipment to be controlled. The AHDC shall be constructed in a modular orientation such that service of the failed components can be done quickly and easily. The modular construction should limit the quantities of printed circuit boards to a maximum of two. All logic, control system, power supply and input/output circuitry shall be contained on a single plug-in circuit board. When required to replace a printed circuit board, it shall not be necessary to disconnect any field wiring. This shall allow all controls maintenance and troubleshooting to be made while at the air handling unit. The AHDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

b. For compatibility to the environment of the air handling unit, AHDC's shall have wide ambient ratings. AHDC's shall be rated for service from -40 Deg F (Degrees Fahrenheit) to 140 Deg F.

c. Contractor shall submit description of location of AHDC's on all mechanical and air handling equipment.

F. Unitary Digital Controller (UDC)

1. General

a. Controls shall be microprocessor based Unitary Digital Controllers (UDC's). UDC's shall be provided for equipment as necessary. UDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the UDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates the sensor signals. All input/output signal conversion shall be performed through a minimum of a 10 bit A to D converter.

Contractor shall provide a minimum of one UDC controller per unitary system as required.

The BAS contractor shall provide and install all UDC's specified under this section. Mechanical equipment manufacturers desiring to provide UDC type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BAS/Temperature control contractor.

b. All input/output signals shall be directly hardwired to the UDC. Troubleshooting of input/output signals shall be easily executed with a volt-ohm-milli-amp meter (VOMA). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be utilized.

c. UDC's shall be in continuous, direct communication with the network which forms the facility wide building automation system. The UDC's shall communicate with the SDC at a baud rate of not less than 9,600 baud.

2. Non-Volatile Memory

a. All control sequences programmed into the UDC shall be stored in non-volatile

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memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the UDC memory to be lost, nor shall there be any need for batteries to be recharge or replaced to maintain the integrity of the controller database. The UDC shall allow for the creation of unique application control sequences. Systems that allow only selection of sequences from a library or table are not acceptable.

b. All control sequences shall be fully configurable at the AHDC, allowing for the creation and change of a sequence while at the unit.

c. The UDC shall be provided with the ability to interface with the HHOT. The interface port shall be provided at the wall sensor or within the unitary equipment, as specified on the plans. The interface port shall allow the HHOT to have full functionality as described hereinbefore of this specification. From the interface port, the HHOT shall be able to directly access any AHDC or UDC in the network.

d. The UDC shall provide an input/output point trending utility that is capable of accumulating 48 analog point samples and 10 digital point samples per Input/Output point. Each sample shall be taken on a user defined interval, ranging from 1 second to 255 hours per sample. The digital readings shall be on a change of state occurrence for the digital points. All samples shall be recorded with the engineering units for the value, along with a time and date identifier for each sample taken.

Systems unable to provide the above capability shall provide for the individual input/output point trending at the SDC. Specifics as to how each UDC point will be trended, at the SDC, shall be provided in the submittal documents. Included in the explanation shall be the sample intervals, the memory allocation in the SDC and the number of UDC's per SDC that can be expected.

e. The UDC shall provide LED indication of transmit/receive communication performance, as well as for the proper/improper operation of the controller itself.

3. Controller Location

a. To simplify controls and mechanical service troubleshooting, the UDC shall be mounted directly in the controls compartment of the unitary system. The UDC shall be provided with a sheet metal or polymeric enclosure that is constructed of material allowing for the direct mounting within the primary air stream, as defined by UL-465. The direct mounting shall allow all controls maintenance and troubleshooting to be made while at the unitary equipment. The UDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

b. For compatibility to the environment of the unitary equipment, UDC's shall have wide ambient ratings. UDC's shall be rated for service from 32 Deg F (Degrees Fahrenheit) to 140 Deg F.

c. Contractor shall submit description of location of UDC's on all mechanical and unitary equipment.

G. Gateway Digital Controller (GDC)

1. General

a. Controls shall be microprocessor based, Gateway Digital Controllers (GDC's). GDC's shall be provided for the purpose of integrating microprocessor based, communicating, direct digital control systems from vendors other than the primary, selected controls manufacturer. GDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the GDC. All communications interface control programs shall be resident within the GDC.

The BAS contractor shall provide and field install all GDC's specified under this

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section. Any interface requirement beyond a two wire communications wire link, shall be provided by the equipment manufacturer supplying the non-primary or third party microprocessor based, communicating, direct digital controllers.

b. All GDC's shall exist at the LAN level with the SDC's. The GDC's shall possess all capabilities described under the SDC section while additionally providing the interface to the third party systems described above. The GDC's shall communicate with the third party controllers at the highest possible baud rate offered by the third party system. As a minimum, 9,600 baud communications shall be utilized.

c. All control sequences programmed into the GDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the GDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The GDC shall allow the standard database information from the third party system to be integrated in standard FMCS data formats, allowing for the creation of unique application control sequences. Systems that only allow selection of data and sequences from a library or table, are not acceptable.

d. Each GDC shall be provided with manufacturer's standard built-in operator interface.

The GDC shall provide Alarming, point trending and Energy report generation capabilities. Alarming points shall be uniquely definable, with multiple alarms assignable to a single point. Such alarm shall be provided with a unique 80 character message. Systems utilizing an alarm message library, shall describe the size of the library and verify how all alarming within the GDC will be guaranteed unique 80 character messages.

The quantities of trended point values shall be limited only by total controller memory space. If necessary, a GDC may be dedicated fully to a trending task, allowing all controller memory to be available for the trend storage. Each unique trend report shall contain a minimum of 4 different points and a minimum of 128 samples per point. Trending frequency for each report shall be operator definable from a sample once a second to a sample once every 24 hours. Trend reports shall be internally formatted by the GDC and shall be reportable directly to a serial printer, a VT-100 display terminal, a CCS, CHS or any other device capable of receiving a formatted ASCII data file.

e. The energy reports shall not be limited in quantities only by available memory within the GDC. Each Energy Report shall be fully formatted and reportable to a serial printer, a VT-100 display terminal, a CCS, a CHS or any other device capable of receiving a formatted ASCII data file. As a minimum, each Energy Report shall provide a daily report and a monthly report with summary information such as outside air temperature, outside air humidity, total energy consumed and degree day calculations.

f. The GDC shall be provided with a battery backed clock that is capable of maintaining the time of day and calendar for up to thirty days, upon loss of power to the GDC, without loss of setting. The battery for the time clock shall be field replaceable by the customer.

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2.10. SYSTEM SOFTWARE DESCRIPTION

A. General

1. Contractor shall provide all software for a complete and operational system as described herein. Software shall include manufacturer's standard multi-tasking, multi-user operating system for operator consoles and controllers, network communication software for dial-up and hard trunk applications, operator man-machine interface software, control application software and all other software necessary to provide the functions specified herein.

2. System software shall be as manufactured by Johnson Controls Facility Explorer or approved equal.

2.11. EXCEPTION REPORTING SEQUENCES

A. Alarm/COS Reports

1. For those digital points indicated on the drawings, the Contractor shall provide a unique change-of-state alarm message of up to 70 characters. The message shall report to all devices assigned to the alarm class.
2. For those points indicated on the drawings which are designated as interrupt priority, the Contractor shall provide an interrupting process display at the CHS location which displays the current conditions for the operator.
   In addition, the CHS computer shall automatically send a picture of the process graphic display to the remote locations via e-mail.
3. For those points designated in paragraph 3 above, the FMCS shall also send a history log to the system report printer of the immediate prior history of the points causing the interrupt priority. This log shall contain 1 minute samples of the previous 15 minutes of operation.
4. For those points on the drawings designed as Hard Facts points, the Contractor shall provide an alarm message to a remote facsimile location designated by the Owner. The FMCS system shall provide at the remote location, a facsimile print-out showing location, time/date of alarm and alarm message of the point. For interrupt priority fax alarms, the remote facsimile machine shall receive a hard copy of the interrupt process screen showing on-line dynamic data values of the current conditions.

B. Off Hours Exception Reporting

1. The Owner shall specify up to five sites to which off hours exceptions shall be auto-dialed and reported. This shall allow the owner to assign off hours exception responses to various facility personnel as necessary. Selection of the site to be dialed can be programmed by the Owner, and set to change automatically per time of day and day of week.

2.12. MONITORING SYSTEM, SENSORS AND WIRING

A. Sensors and other Devices for Input/Output Summary Schedule:

1. Provide all necessary sensors, relays, panels, conduits and wire for the points indicated in the input/output summary as shown on the contract drawings.
2. Analog sensing elements for remote indication shall be independent of local sensors used for local control loops.
3. Temperature sensors shall be Resistance Temperature Detector (RTD) type of 1000 ohm balco. Space (60-90 degrees F); Duct/Well (-30-250 degrees F); Averaging Duct (-30-225 degrees F) or as required under Division 26.

   a. Space temperature sensors shall be provided with blank commercial type locking satin chrome covers.
   b. Duct temperature sensors shall be rigid stem or averaging type as specified in the sequence of operation. Water sensors shall be provided with a separable copper, monel or stainless steel well. Outside air wall mounted sensors shall be provided with a sun shield.
   c. The dew point temperature sensor shall employ a non-reactive organic bobbin material to give precise dew point temperature readings with accuracy of not more than + 1.5 degrees F. The dew point temperature sensor shall incorporate an integral draft shield as part of the instrument for air velocities in excess of 50 feet

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per minute. The dew point temperature sensor shall operate over a minimum dew point temperature range suitable to application.

4. Relative humidity sensors shall be capacitance type with 10 percent to 90 percent range. Duct mounted relative humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with covers identical to temperature sensors. Space 10 percent -90 percent RH; Duct 10 percent - 90 percent RH.
5. All wall mounted temperature sensors, dew point temperature, relative humidity sensors, CO sensors, and CO2 sensors shall be installed with stainless steel wire guard. Set point adjustment shall be achievable without removing the wire guard.
6. Differential and Static Pressure Sensors and Switches

    a. Fan proof-of-flow switches shall be U.L. listed adjustable set point and differential pressure type. Switches shall be piped to fan discharge except where fans operate at less than one inch WG, they shall be piped across the fan. For fractional horsepower and non-ducted fans, relays or auxiliary contacts may be used. Maximum pressure rating shall be at least 10 inches WG. with .05-12 inch W.C. range.
    b. Pump proof-of-flow switches shall be U.L. listed adjustable differential pressure or flow type as specified in the sequence of operation or data point summary. Devices shall be 150 psi rated except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 300 psi body. Differential pressure switches shall have valved manifold for servicing, and a range of 3 psi-150 psi.
    c. Air flow and static pressure analog sensors shall be high accuracy suitable for the low velocity pressures to be encountered, be selected for approximately 50 percent overrange, and have a 4 to 20 ma output. These differential pressure sensors shall be connected to the air flow measuring station with valved lines for testing and calibration, and shall have adjustments for zero and span. 5 inch W.C. range.

7. Overall system accuracy, including electronic analog sensing elements, shall be as follows:

    a. Air: Plus or minus 1.0 degrees F temperature, plus or minus 2.5 percent r.h., plus or minus 2.0 percent static pressure.
    b. Water: Plus or minus 0.7 degrees F over full scale range for water points, plus or minus 1.0 degree F for others.
    c. Proof of fan or pumps operating status, or alarm conditions shall be through positive feedback from differential pressure switches across fan or pump. Auxiliary dry contacts may be used for proof of fans or pumps if the motors are fractional H.P., and other non-ducted fans.

8. Digital inputs from devices with isolated, dry type contacts (no grounds, no voltage) of either normally open (N.O.) or normally closed (N.C.) configuration shall be provided. Live contact inputs, those that have voltage present, shall be provided with isolating devices to meet dry contact requirements.
9. Start-stop relay module shall contain relays for start-stop function at the remote point, with relays mounted and factory wired to numbered terminal strips.
10. Outage Devices:

    a. Control Relays: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life-span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression limiting transients to nondamaging levels.

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b. Time Delay Relays: Time delay relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels. Delays contact opening or closing shall be adjustable from one to 60 seconds with a minimum accuracy of plus or minus 2 percent of setting.

c. Latching Relays: Latching relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life-span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.

d. Reed Relays: Reed relays shall be encapsulated in a glass-type container housed in a plastic or epoxy case. Contacts shall be rated for the application. Operating and release times shall be one millisecond or less. Reed relays shall have a minimum life span rating of 10 million operations.

e. Contactors: Contactors shall be of the single-coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contacts shall be double-break silver-to-silver type protected by arcing contacts. Number of contacts and ratings shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.

f. Solid-State Relays: Input-output isolation shall be greater than 1000 megohms with a breakdown voltage of 1500 V rms or greater at 60 Hz. The contact life shall be 10 million operations or greater. The ambient temperature range shall be minus 20 degrees to plus 140 degrees F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the application. Operating and release times shall be one millisecond or less. Transient suppression shall be provided as an integral part of the relay to limit transients to nondamaging levels.

11. Audible Alarm:

a. All alarms shall annunciate on the ATC system front end computer and via pagers.

2.13. DUCT MOUNTED CARBON MONOXIDE SENSORS

A. Furnish and install duct mounted carbon monoxide (CO) sensors in the discharge ducts of all indirect fired gas heating equipment and where shown on the contract drawings.

B. Duct mounted carbon monoxide sensors shall be Model KCOC as manufactured by Kele or approved equal. Accuracy shall be +2.5% of scale, with a range of 0-200 ppm.

C. Furnish units with control transformer, calibration kit, low voltage power supply, audible alarm, LCD display and SPST relay as required.

D. Analog output shall be 4-20MA or 0-10V as required.

E. Monitor on the automatic temperature control system and display on the BMS computer graphic.

2.14. FIELD INSTALLED CONDENSATE OVERFLOW SWITCHES

A. Condensate overflow switches must be tested to comply with U.L. 508.

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B. Interlock condensate overflow switches to shut-down cooling equipment and alarm on ATC system where overflow condition exists.

2.15. CO2 SENSORS/TRANSMITTER

A. Furnish and install wall mount CO2 sensor/transmitters at locations indicated on floor plans. CO2 sensor/transmitter shall be model CD-W00 as manufactured by Johnson Controls or approved equal.

B. Measuring Range: 0 to 2,000 ppm CO2.

C. Response Time: 1 minute

D. Output Signal: As required by ATC system

E. Max power consumption: Less than 2 watts.

F. Listing: U.L. Listed

G. Accessories: Mounting Kit, Transformer required.

H. Where installed in toilet rooms, fieldhouse, and corridors install heavy duty stainless steel guards.

2.16. WALL-BOX TIMER SWITCHES

A. Digital Preset Timer

1. Description: Solid state interval time switch with backlit LCD display.

2. Features:
   a. Adjustable Time Delay: 10, 20, 40, 60, 90 minutes/ 2, 4, 6, 8, hours.
   b. Single button timer selection
   c. LED indication
   d. Silent operation
   e. Requires neutral conductor
   f. UL listed.
   g. BAS/ATC system interface.
   h. Override on/off.

3. Ratings:
   a. 1 Amp at 30V maximum.

4. Electronic time switch shall be interlocked with ATC system and associated HVAC equipment.

5. Basis of Design: Tork Model SSA200R-24 (finish to match other wiring devices specified herein).

2.17. TOGGLE SWITCHES

A. 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. Switches shall have the following basic features:

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1. Heavy-gauge one-piece copper alloy contact arm.
2. Fast "make" and positive "break" to minimize arcing.
3. Heavy-duty bumper pads for quiet operation.
4. High strength thermoplastic polycarbonate toggle.
5. Oversized silvery alloy contacts for long life and heat dissipation.
6. Nickel-plated steel strap with integral ground.
7. Auto-ground clip to assure positive ground.

B. Hubbell HBL1221 (single-pole), HBL1222 (two-pole), HBL1223 (three-way), HBL1224 (four-way), Pass & Seymour PS20AC1 (single-pole), PS20AC2 (two-pole), PS20AC3 (three-way), PS20AC4 (four-way), or approved equal by acceptable manufacturer.

C. Manual toggle switches shall be interlocked with ATC system and associated HVAC equipment.

2.18. CO2 SENSORS/TRANSMITTER

A. Furnish and install wall mount CO2 sensor/transmitters at locations indicated on floor plans. CO2 sensor/transmitter shall be model CD-W00 as manufactured by Johnson Controls or approved equal.

B. Measuring Range: 0 to 2,000 ppm CO2.

C. Response Time: 1 minute

D. Output Signal: As required by ATC system

E. Max power consumption: Less than 2 watts.

F. Listing: U.L. Listed

G. Accessories: Mounting Kit, Transformer required.

H. Install heavy duty stainless steel guards.

2.19. CO SENSORS/TRANSMITTER

A. Furnish and install wall mount CO sensor/transmitters at locations indicated on floor plans. CO sensor/transmitter as manufactured by Johnson Controls or approved equal.

B. Measuring Range: 0 to 1,000 ppm CO.

C. Response Time: 1 minute

D. Output Signal: As required by ATC system

E. Max power consumption: Less than 2 watts.

F. Listing: U.L. Listed

G. Accessories: Mounting Kit, Transformer required.

H. Install heavy duty stainless steel guards.

I. Install and mount CO sensors 5 feet above the finished floor.

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PART 3 EXECUTION

3.1. GENERAL

A. The Automatic Temperature Control System and Central Control and Management System, shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner.

3.2. BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each new **[and existing]** system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. Custom Reports:

1. Provide custom reports as required for this project.

3.3. WORKSTATION INSTALLATION

A. Desktop Workstations Installation:

1. Install workstation(s) at location(s) directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on workstation(s) and verify software functions properly.
4. Develop Project-specific graphics, trends, reports, logs and historical database.
5. Power each workstation through a dedicated UPS unit. Locate UPS adjacent to workstation.

B. Color Graphics Application:

1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Submit sketch of graphic layout with description of all text for each graphic for Owner's and Architect's review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing shall be done on-site with Owner's and Architect's review and feedback.
7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

3.4. INSTALLATION & SUPERVISION

A. All wiring and tubing shall be properly supported and run in a neat and workmanlike manner. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the

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building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent restriction to devices and terminals.

B. The control contractor shall be responsible for all electrical installation required for a fully functional control and automation system and not shown on the electrical plans or required by the electrical specifications. All wiring shall be in accordance to all local and national codes.

1. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications.
2. All electric and electronic wiring shall be minimum #20 AWG minimum THHN and shielded if required.
3. All wiring in the central control room shall be concealed in an approved manner.

C. Verify locations of temperature sensors, CO2 sensors, CO sensors, and other exposed control sensors with plans and Owner prior to installation.

D. The installation and supervision of this project shall be carried out by factory trained personnel who are employed by the Contractor and licensed for this type of work.

E. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

F. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.

G. Install in accordance with manufacturer's instructions.

H. Check and verify location of space temperature sensors, relative humidity sensors, CO2 sensors, CO sensors, and other exposed control sensors with plans and room details before installation. Align with lighting switches and relative humidity sensors, and dewpoint temperature sensors.

I. Mount outside air temperature sensors under a sunshield.

J. Provide separable sockets for liquids and flanges for air bulb elements.

K. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

L. Install equipment plumb and level.

M. Install all equipment to be accessible for service and maintenance.

3.5. ACCEPTANCE TESTING

A. Point Verification

To verify end-to-end operation of the system the Contractor shall provide a hard copy of an All Points Summary Listing to the Owner of each part or system to be placed in warranty by the Owner. For CHS systems, the Contractor shall additionally provide a print screen of the process display showing real time dynamic point information for all points on the subsystem(s) to be accepted.

B. Sequence Verification

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1. The Contractor shall notify the Owner's representative of systems which perform all specified sequences.
2. The warranty acceptance test shall be of 5 days duration and the system shall perform as follows:

    a. During the five days, the FMCS system shall not report any system diagnostics from the subsystem under test.
    b. The subsystem shall be performance verified as operational using temporary trends of each control loop located in the SDC or MSDC.
    c. During the occupied periods, BAS control loops, under test, shall maintain control of the process variable within the following scales:
        i. Duct Static Pressure +/-0.3 inch WC
        ii. Pump Head Pressure +/-10 percent of control range
        iii. Duct Temperature Loops +/-2 degrees F
        iv. Room Temperature Loops +/-1degrees F
        v. Pipe Temperature Loops +/-2 degrees F
        vi. Duct Relative Humidity +/-2x rated error of Humidity Transmitter
    d. The contractor shall provide a hard copy printout of the process variable, process variable set point and control loop output percent for the period of 2 hours prior to occupancy to 2 hours after occupancy with samples taken every 15 minutes.

3.6. COORDINATE WITH TAB AGENCY

A. 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, freeze stats and duct smoke detectors.

B. Verify that all controlling instruments are calibrated and set for design operating conditions prior to commencement of TAB work.

C. Calibrate sensors after installation, and before the sensor control verification tests are performed. Prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditional space for each separately controlled zone.

D. Allow sufficient time in the project to provide assistance and instruction to the balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may need set points changed so that the testing and balancing work can be performed.

E. All control sequences, software, equipment, and components shall be started-up by a qualified technician. Start-up report shall be submitted to Engineer prior to the commencement of testing and balancing work. Testing and balancing shall not commence until start-up reports are completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

3.7. EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

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E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and tubing is installed prior to installation proceeding.

3.8. INTERLOCK REQUIREMENTS

A. The fan and equipment interlock requirements are as scheduled on the contract drawings.

B. Furnish and install all necessary relays, transformer, contactors, wiring, conduit, and accessories to perform fan, pumps, equipment, and damper interlocks.

C. Unless otherwise noted, fan interlocks shall be arranged such that dampers associated with fan shall be open when fan starts and close when fan stops.

D. In projects with condensing units/heat pumps, the evaporator fans shall be hard wired interlocked with the condensing unit/heat pumps so that if evaporator fan fails, the condensing unit/heat pump shall de-energize.

3.9. SUBMITTALS AT PROJECT CLOSEOUT

A. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

3.10. CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

C. Connect hand-off-auto selection switches to override automatic interlock controls when switch is in hand position.

3.11. FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating

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operation with compatible signal generator.

4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.
8. Test all end switches and verify status is reported on the ATC system.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

E. All temperature control and interlock wiring shall be installed in conduit unless otherwise noted on the plans. Power or interlock wiring shall be run in separate conduit from sensor and communications wiring.

3.12. ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using volt-ohm-milli-amp meter (VOMA) at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

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5. Flow:

   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 0, 50, 90, and 100 percent of span.

6. Pressure:

   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust dampers.
9. Provide diagnostic and test instruments for calibration and adjustment of system.
10. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial CO_2, CO, temperature, and static pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.13. ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.14. SCHEDULING

A. Submit spreadsheet to Owner indicating occupied/unoccupied times for each item controlled by ATC system. Incorporate all scheduling requirements into sequence of operation.

3.15. STAGING

A. Coordinate staging requirements with equipment being controlled. Where multistage units are scheduled or specified, provide all devices, controllers, wiring to control, monitor, and sequence all stages.

END OF SECTION

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SECTION 230923 – AIRFLOW MONITORING STATIONS

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. Airflow measurement stations and sensors.
2. Airflow switches.
3. Airflow transmitters.

B. Related Requirements:

1. Section 230900 "Instrumentation and Controls of HVAC and Plumbing Systems" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

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1.3. DEFINITIONS

A. Ethernet: Local area network based on IEEE 802.3 standards.

B. FEP: Fluorinated ethylene propylene.

C. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.

D. PEEK: Polyetheretherketone.

E. PTFE: Polytetrafluoroethylene.

F. PPS: Polyphenylene sulfide.

G. RS-485: A TIA standard for multipoint communications using two twisted pairs.

H. RTD: Resistance temperature detector.

I. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.
5. Product certificates.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for air and process signal tubing.
5. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Delegated-Design Submittal:

1. Schedule and design calculations for flow instruments, including the following.

a. Flow at Project design and minimum flow conditions.
b. Pressure drop at Project design and minimum flow conditions.

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1.5. INFORMATIONAL SUBMITTALS

A. Product Certificates: For each product requiring a certificate.

B. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Documentation of NIST traceability.

1.6. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

1.7. MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Provide parts, as indicated by manufacturer's recommended parts list, for product operation during two-year period following warranty period.

PART 2 PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

A. Delegated Design: Select and size products to achieve specified performance requirements.

B. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2. GENERAL REQUIREMENTS FOR FLOW INSTRUMENTS

A. Air sensors and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions and to provide flexibility for changes in operation.

B. Source Limitations: For flow instruments, obtain products from single source from single manufacturer.

2.3. AIRFLOW MEASUREMENT

A. General Requirements:

1. Adjustable for changes in system operational parameters.
2. Airflow Sensor and Transmitter Range: Extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions.
3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.

    a. Product certificates are required.

4. System Accuracy: The total system accuracy, including array averaging error, transducer error, etc., when installed in accordance with the manufacturer's recommendations and without field adjustment shall be as follows throughout the entire operating range.

    a. Ducts and plenums: +/- 3% of reading
    b. Outside air intakes +/- 5% of reading
    c. Fan inlets +/- 10% of reading

5. Recalibration:

    a. If the technology provided requires recalibration, the contractor shall be responsible for recalibrating the system on a semi-annual basis during the construction phase through the end of the project warranty period.

6. Product Applications

    a. Select from instrument types to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
        i. The contractor will be required as part of the submittal process to provide a working demo that demonstrates that the unit will operate at the lowest air flows possible on the project. If the manufacture is unable to provide a working demo than their submittal will not be reviewed by the design team.

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b. Duct-Mounted Airflow Sensors:
   i. Measured Velocities 500 fpm and Less:
      1) Thermal dispersion airflow station.
   ii. Measured Velocities Greater than 500 fpm:
      1) Thermal dispersion airflow station

B. Duct Mounted Thermal Dispersion Airflow Measuring Station:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Ebtron: Gold Series. (Basis of Design)
   b. Air Monitor Corporation: Electra-Flo

2. Source Limitations: Obtain airflow and temperature measuring sensors and transmitters from single manufacturer.
3. Description: Airflow station shall consist of one or more sensor probes and a remotely mounted microprocessor-based transmitter.
4. Performance:

   a. Capable of independently processing up to 16 independently wired sensor assemblies.
   b. Airflow rate of each sensor assembly shall be equally weighted and averaged by transmitter prior to output.
   c. Temperature of each sensor assembly shall be velocity weighted and averaged by transmitter prior to output.
   d. Listed and labeled by an NRTL as successfully tested as an assembly according to UL 873, "Temperature-Indicating and Regulating Equipment."
   e. Components shall be interconnected by exposed NRTL-listed plenum-rated cable or non-listed cable placed in conduit.
   f. Each flow station shall be factory calibrated at a minimum of 16 airflow rates and three temperatures to standards that are traceable to NIST.
   g. Airflow Accuracy: Within 2 percent of reading over the entire operating airflow range, with 0.25 percent repeatability.

      i. Devices whose accuracy is combined accuracy of transmitter and sensor probes must demonstrate that total accuracy meets the performance requirements throughout the measurement range.

   h. Temperature Accuracy: Within 0.15 deg F over entire operating range of minus 20 to plus 160 deg F.
   i. Sensor Ambient Operating Temperature Range: Minus 20 to plus 160 deg F.

   j. Transmitter Ambient Operating Temperature Range: Minus 20 to plus 120 deg F.
   k. Sensor and Transmitter Ambient Operating Humidity Range: Zero to 99 percent, non-condensing.
   l. Instrument shall compensate for changes in air temperature and density throughout calibrated velocity range for seasonal extremes at Project location.
   m. Pressure Drop: 0.05-inch wg at 2000 fpm across a 24-by-24-inch area.
   n. Instruments mounted in throat or face of fan inlet cone shall not negatively influence fan performance by reducing flow more than 1 percent of Project design flow or negatively impact fan-generated sound. Losses in performance shall be documented with submittal data, and adjustments to compensate for performance impact shall be made to fan in order to deliver Project design airflow indicated.

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5. Sensor Assemblies:

   a. Each sensor probe shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
   b. Mount thermistors in sensor using a marine-grade, waterproof epoxy.
   c. Thermistor leads shall be protected and not exposed to the environment.
   d. Each sensor assembly shall independently determine airflow rate and temperature at each measurement point.
   e. Each sensor probe shall have an integral cable for connection to remotely mounted transmitter.
   f. Sensor Probe Material: Gold anodized, extruded 6063 aluminum tube or Type 316 polished stainless steel.
   g. Probe Assembly Mounting Brackets Material: Type 304 stainless steel.

6. Transmitter:

   a. Integral digital display capable of simultaneously displaying total airflow and average temperature, individual airflow, and temperature readings of each independent sensor assembly.
   b. Capable of field configuration and diagnostics using an onboard push-button interface and digital display.

      i. Include an integral power switch to operate on 24-V ac (isolation not required) and include the following:

         1) Integral protection from transients and power surges.

         2) Circuitry to ensure reset after power disruption, transients, and brownouts.

         3) Integral transformer to convert field power source to operating voltage required by instrument.

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2.4. AIRFLOW TRANSMITTERS

A. Airflow Transmitter with 0.10 Percent Accuracy and Auto-Zero Feature:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Ebtron
   b. Air Monitor Corporation: Veltron Mass-tron II

2. Transmitter shall receive total- and static-pressure signals from a primary element, amplify signals, extract the square root, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
3. Transmitter shall have built in capability for both process temperature and pressure compensation.
4. NEMA 250, Type 1 enclosure.
5. Construct assembly so that shock, vibration, and pressures surges of up to 1 psig will neither harm transmitter, nor affect its accuracy.
6. Transmitter shall include automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
7. Performance:

a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
b. Calibrated Span: Field adjustable, minus 40 percent of the range.
c. Accuracy: Within 0.10 percent of natural span.
d. Repeatability: Within 0.15 percent of calibrated span.
e. Linearity: Within 0.2 percent of calibrated span.
f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.

8. Integral multi-line digital LED or digital display for continuous indication of airflow.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Provide the services of an independent inspection agency to confirm that proposed mounting locations comply with requirements indicated and approved submittals.

1. Indicate dimensioned locations with mounting height for all surface-mounted products to walls and ceilings on shop drawings.
2. Do not begin installation without submittal approval of mounting location.

E. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

F. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION, GENERAL

A. Furnish and install products required to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to force.

D. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

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F. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

   a. Laboratory exhaust airstreams.
   b. Process exhaust airstreams.

3. When conduit is in contact with a corrosive environment, use Type 316 stainless steel conduit and fittings or conduit and fittings with a corrosive-resistant coating that is suitable for environment.
4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3. ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Refer to Division 26.

C. Furnish and install power wiring. Refer to Division 26.

D. Furnish and install raceways. Refer to Division 26.

3.4. INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

A. Mounting Location:

1. Rough-in: Outline instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
2. Install switches and transmitters for air and liquid flow associated with individual air-handling units and connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
3. Install airflow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Mounting Height:

1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Unless indicated otherwise, mount switches and transmitters, located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements, within a range of 42 to 72 inches (1050 to1800 mm) above the adjacent floor, grade, or service catwalk or platform.

   a. Make every effort to mount at 60 inches (1500 mm).

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3. Where indicated for rooftop equipment, mount display within rooftop equipment.

C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

3.5. FLOW INSTRUMENTS INSTALLATION

A. Airflow Sensors:

1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.

B. Transmitters:

1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.

3.6. IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Division 26.

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.7. CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

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3.8. CHECKOUT PROCEDURES

A. Description:

1. Check out installed products before continuity tests, leak tests, and calibration.
2. Check instruments for proper location and accessibility.
3. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

B. Flow Instrument Checkout:

1. Verify that sensors are installed correctly with respect to flow direction.

2. Verify that sensor attachment is properly secured and sealed.
3. Verify that processing tubing attachment is secure and isolation valves have been provided.
4. Inspect instrument tag against approved submittal.
5. Verify that recommended upstream and downstream distances have been maintained.

3.9. ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

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3.10. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION

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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 air handling equipment, 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. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE/SMACNA Table of equivalent rectangular and round ducts.

E. Smoothly transition all ductwork to prevent excessive or unnecessary turbulence or pressure loss.

F. All exposed ductwork in finished areas shall be painted in color as indicated by Architect. All ductwork requiring paint shall be constructed of paint grade galvanized sheet steel with a paintable finish. All ductwork exposed to chemicals or shall be corrosion resistant and shall include a corrosion resistant finish.

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 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

D. ASTM C 916 Type II – Standard Specification for Adhesives for Duct Thermal Insulation

E. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality

F. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

G. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

H. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality

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I. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled

J. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

K. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

L. AWS D9.1 - Welding of Sheet Metal

M. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

N. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

O. SMACNA - HVAC Air Duct Leakage Test Manual

P. UL 181 - Factory-Made Air Ducts and Connectors.

Q. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

R. NFPA 70 - National Electrical Code

S. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

T. UL 33 - Heat Responsive Links for Fire-Protection Service.

U. UL 555 - Fire Dampers and Ceiling Dampers

1.3. 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.

1.4. REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA- 90A and NFPA-90B.

1.5. 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.

1.6. ALTERNATES

A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

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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, unistrut, kindorf or channel; strap hangers or the use of wire will not be permitted. All thread hangers shall not pass through or be inside duct. Hangers shall not penetrate the duct insulation vapor barrier. 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., Foster, Childers, or approved equal.

C. Flexible connections of neoprene, excelon, or other NFPA approved non-inflammable fabric shall be provided in the duct system at all fan inlet and outlet connections. Flexible duct connectors shall be Durodyne or approved equal.

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.

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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, exhaust, fresh air intake, relief, ventilation, outside air and combustion air ductwork shall be constructed for low pressure service (2 inch W.G.). All exposed round ductwork in finished areas shall be paintable grade, dual wall, constructed for medium pressure service (6 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.
17. All exterior ductwork shall be single wall type with exterior field applied jacketing

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insulation. Inner wall shall be galvanized steel metal; outer wall shall be aluminum exterior duct insulation system as specified in Division 23 Section, “HVAC Insulation”.

B. Round and/or Rectangular Ductwork (Stainless Steel Type 316):

1. Stainless steel ducts: ASTM A167, Type 316.
2. All stainless steel ducts shall be round longitudinal seam or rectangular stainless steel Type 316. Determine duct gauges suitable for duct diameter and welded joints.
3. All dishwash machine exhaust, exhaust ductwork/dampers shall be stainless steel.
4. All longitudinal seams shall be installed with seam up.
5. These exhaust systems are low pressure service.
6. All elbows are round. Ninety degree squared elbows are not permitted.
7. All joints are welded by gas fusion using rods of similar materials.
8. All dampers, manual and motorized, shall be stainless steel Type 304.
9. These exhaust systems shall be fabricated and installed in strict accordance with requirements of SMACNA and NFPA.
10. Provide stainless steel guy wires, stabilizers, tensioners and accessories at upblast fan discharge ducts.
11. All exterior exhaust ductwork shall be Type 316 stainless steel. Exterior rectangular exhaust ductwork shall be beveled and crossbroken for proper drainage.

C. Round Ductwork (Dual Wall - Medium Pressure)

1. Medium pressure flat oval and round ductwork shall be spiral lock-seam Type K-27 with Type P liner as manufactured by United Sheet Metal Company, Inc., Semco Manufacturing, Inc., Lindab, Ductmate, MKT Metal Manufacturing, or approved equal, Uniseal duct and Uniform fittings. Construct ductwork of galvanized sheet steel. Elbows 8 inches in diameter and smaller shall be smooth formed. Larger elbows shall be five section type. Tees and crosses and laterals shall be conical. Make joints with sleeve type couplings, short length sheet metal screws and duct sealant. Seal joints with Hardcast, Foster, Childers, or approved equal, as hereinbefore specified. Conform to duct manufacturer's recommendations for jointing and installation. Ductwork and fittings shall be manufactured by a company regularly engaged in the construction of spiral ductwork and fittings. Contractor-fabricated ductwork will not be acceptable for ductwork and fittings. Manufacturers substituted for the above specified manufacturers shall submit for approval independently published laboratory test data on all proposed ductwork and fittings showing materials of construction, air flow, pressure drop and acoustical performance characteristics.
2. Round dual wall ductwork shall be installed to the extent shown on the drawings. All duct lining shall be provided with a perforated galvanized liner on the surface exposed to the air stream. All exposed ductwork in finished areas and where indicated on contract drawings shall be painted in color as selected by Architect. All ductwork requiring paint shall be constructed of paint grade sheet steel with paintable finish.
3. Round dual wall ductwork shall contain a 2 inch thick fiberglass insulation sandwiched between inner and outer ducts.

D. Round/Flat Oval and/or Rectangular Ductwork (Single Wall Medium Pressure):

1. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized medium pressure sheet steel, lock forming quality, having G90 Zinc coating in conformance with ASTM A90.
2. Determine duct gauges based on duct diameter or duct size and pressures indicated.
3. Round and flat oval duct shall be spiral seam type.
4. All branch ducts shall connect to the main duct with a 45 degree conical lateral, or low loss fittings as shown on the drawings where possible. Where not possible, a 90 degree conical connection shall be used.

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5. All elbows shall be long radius.
6. All seams and joints of fittings shall be welded by gas fusion with rod material same as duct material.
7. Connections to equipment shall be flexible material, NEMA approved, having adequate reinforcing to be compatible with internal pressure of system.
8. Paint all cut ends and welded joints with aluminum paint.
9. Make allowance for internal duct lining where required. Sizes shown on the drawings are inside clear dimensions. Rectangular lined ductwork shall have perforated metal liner, similar to that hereinafter specified.
10. Determine duct gauges for the longest duct side and use for all four sides. Joints and reinforcing requirements apply to the longest duct side.
11. Reinforce all ducts to prevent buckling, vibration, or noise as recommended in the referenced construction standards and as required to suit the installed conditions.
12. Do not cross-break duct which will receive rigid insulation covering.
13. 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.
14. 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.
15. Turning vanes shall be the airfoil 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.
16. Bolt, screw, rivet, or spotweld reinforcing members securely to the duct on not less than 6-inch centers
17. Where ducts are open-ended without grilles, registers, or other means of stiffening, reinforce and stiffen, and open end with standing seams or an angle frame.
18. Remove all exposed traces of joint sealers, manufacturer's identification and other markings.

E. Duct Furnaces Flue and Combustion Air Vent Ductwork

1. Furnish and install flue exhaust pipes, combustion air inlet pipes as required by duct furnace manufacturer. Flue exhaust and combustion air pipes shall be of the sizes as required by the duct furnace manufacturer.
2. The duct furnace flue and combustion air vent ductwork shall be single wall, 20 gauge galvanized steel with die stamped or fabricated fittings. Ductwork shall be constructed for low pressure operation with longitudinal seam up.
3. Furnish and install ventilated thimble, flashing, flue pipe and combustion pipe. All joints shall be sealed with high temperature silicone rubber sealant.
4. Where the flue pipe or combustion pipe pass through walls or partitions, the space around the duct shall be sealed with non-combustible material. Maintain clearances to combustibles as required by N.F.P.A.-90A.

F. Gas Fired Radiant Heater Flue and Combustion Air Vent Ductwork

1. Furnish and install flue exhaust pipes, combustion air inlet pipes as required by gas fired radiant heater manufacturer. Flue exhaust and combustion air pipes shall be of the size as required by the gas fired radiant heater manufacturer.
2. The gas fired radiant heater flue ductwork shall be type B single wall, 18 gauge stainless steel with die stamped or fabricated fittings. Ductwork shall be constructed for low pressure operation with longitudinal seam up.
3. The gas fired radiant heater combustion air inlet pipe shall be Schedule 40 PVC with standard PVC piping fittings.
4. Furnish and install ventilated thimble, flashing, flue pipe, combustion pipe, rainhoods, and intake caps. All joints shall be sealed with high temperature silicone rubber sealant.

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5. Where the flue pipe or combustion pipe pass through wall or partitions, the space around the duct shall be sealed with non-combustible material. Maintain clearances to combustibles as required by N.F.P.A.-90A.

2.4. WASHROOM/DISHWASHER/SHOWER ROOM EXHAUST DUCTWORK

A. Aluminum Ducts: ASTM B209, aluminum sheet, alloy 3003-H14. Aluminum connectors and bar stock: Alloy 6061-T6, or of equivalent strength stainless steel ducts: ASTM A167, Type 316.

B. Ductwork shall be 20 gauge aluminum construction where concealed and 18 gauge Type 316 stainless steel where exposed.

C. Ducts shall be constructed for low pressure operation with all seams liquid tight.

D. Ductwork shall be pitched ¼ inch per foot back to hood or equipment for drainage.

E. Provide a cleanout door of the same material as the ductwork for inspection and cleaning of interior duct surface. Cleanout shall be located in the vertical riser. Label all duct cleanout doors.

2.5. WATER HEATER INTAKE AND WATER HEATER EXHAUST DUCTWORK (PIPING) MATERIAL

A. Water Heater Exhaust Piping CPVC Pressure Pipe: ASTM F 441/F441M, solid-wall pipe.

1. CPVC Socket Fittings: ASTM F 441/F441M pipe, socket type, and ASTM F438 socket type fitting.
2. Joints: Solvent weld with solvent cement.
3. Furnish and install roof curbs and roof terminations.
4. Use CPVC solvent cement that has a VOC content of 490 g/l or less when calculated to 40 CFR 59, subpart D (EPA method 24).
5. Use CPVC primer that has a VOC content of 550 g/l or less when calculated to 40 CFR 59, subpart D (EPA method 24).
6. Install lime chip neutralizer kit at all flue (exhaust) drain lines prior to discharge into floor drain. Condensate neutralizer shall be as manufactured by JJM Boiler Works or approved equal.

B. Water Heater Intake Piping – PVC Pressure Pipe: ASTM D2665, solid wall drain, waste and vent (schedule 40).

1. PVC Socket Fittings: Schedule 40 PVC, ASTM F89 socket fittings.
2. Joints: Solvent weld with solvent cement.
3. Use PVC solvent cement that has a VOC content of 510 g/L of less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Boiler and water heater intake ductwork shall be PVC.

2.6. AIR TRANSFER OPENINGS

A. Furnish and install metal sleeves or frames, of the same material as the duct or air terminals attached thereto, in all air transfer openings through walls, partitions, floors and other building construction, extending completely through the opening. Securely fasten the sleeves or frames in place and provide face flanges on both sides. Where grilles or registers are required, attach them to the sleeve or frame, or extend ductwork where shown on the drawings. If no grilles, registers or duct connections are required, furnish and install ½ inch x ½ inch removable galvanized wire

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mesh on one face.

2.7. AIR VOLUME CONTROLS

A. Furnish and install air volume control devices where indicated and where required to adjust and balance air flow in the systems, whether indicated or not. Volume dampers shall be provided in all branch ducts serving air outlets and inlets. For existing air devices install a new volume damper and where required for access, a new access door to allow access and adjustment.

B. Air extraction for air outlets and branch ducts shall be the gang-operated vane type, Tuttle & Bailey - Vectrol, Type VLC or VLK as appropriate, or approved equal, with suitable adjusting device and means of access.

C. Manual volume dampers in ductwork shall be factory-assembled units with rigid frame, opposed-blade action, and locking quadrant operator. Mark the extended damper shaft and align the operating handle to indicate the blade position. Dampers shall be as manufactured by Ruskin, American Warming and Ventilating, Inc., Arrow, Vent Products Company, or approved equal. Rectangular dampers shall be Type MD35, with steel channel frame, 16 gauge steel blades, 9 inch maximum blade spacing, low pressure, nylon bearings, galvanized finish with aluminum paint touch up. Round manual balancing dampers shall be Type MDRS25 manufactured by Ruskin, Arrow, American Warming and Ventilating, Inc., or as approved equal. When external insulation is to be applied, provide sheet metal standoffs on all manual volume dampers. Provide blade stops to minimize air gaps around damper blades when closed.

D. Motor-operated dampers shall be as hereinafter specified under Division 23 Section, “Instrumentation and Controls of HVAC & Plumbing System”.

E. Duct turning vanes shall be Tuttle & Bailey Ducturns, or approved equal.

F. Furnish and install duct collars and angle iron frames for the installation of ATC dampers.

G. Provide Type 316 stainless steel motor-operated dampers for installation in stainless steel ductwork.

H. Where volume dampers are installed in exposed finished spaces locate damper handle on top of duct.

I. Where volume dampers are installed above ceilings attach a colored piece of tape so that Test and Balance Engineer can easily locate for air flow adjustment.

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2.8. REMOTE MANUAL VOLUME DAMPER CABLE OPERATORS

A. Available manufacturers offering products that may be incorporated into the work include but are not limited to the following:

1. Young Regulator
2. Cesco Products
3. Pottorff
4. Ruskin

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass, Copper, or Aluminum.

D. Cable: Stainless Steel.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover-Plate Material: Steel.

G. Where volume dampers are located above hard ceilings, furnish and install remote manual volume damper cable operators.

2.9. INSTRUMENT TEST PORTS

A. Furnish and install instrument test ports in the ductwork to allow use of pitot tube length. Equip holes with Ventlok #699 instrument ports. Fittings shall extend beyond duct covering and insulation.

2.10. DUCT THERMOMETERS

A. Duct thermometers shall be Dresser Industries, Trerice, Weiss, Weksler, Miljoco, or approved equal direct-mounting filled system dial thermometers. Duct thermometers shall be vapor-actuated, universal-angle dial type, cast aluminum case with 4 ½ inch diameter, glass lens. Duct thermometers shall include adjustable joint with finish to match case, 180 degree adjustment in vertical plane, 360 degree adjustment in horizontal place, with locking device. Thermal bulbs shall be copper with phosphor-bronze bourden pressure tube. Movement shall be brass, precision geared. Duct thermometer scales shall be Progressive, satin-faced non-reflective aluminum with permanently etched markings. Each stem shall be copper-plated aluminum or brass for separable socket of length to suit installation.

B. Where ductwork is installed at a height that would require duct thermometers to be installed 10 feet above finished floor or greater then remote-ready filled - system dial thermometers shall be installed. Connecting tubing shall be bronze, double-braided, armor-over-copper capillary; of length to suite installation.

C. Duct thermometers shall be furnished and installed at energy recovery ventilators, and ERV modules, as follows:

LOCATION	RANGE
Outdoor Air Duct	-40 degrees Fahrenheit to 120 degrees Fahrenheit
Return Air Duct	40 degrees Fahrenheit to 180 degrees Fahrenheit
Mixed Air Plenum	30 degrees Fahrenheit to 180 degrees Fahrenheit
Supply Air Duct	30 degrees Fahrenheit to 180 degrees Fahrenheit
Exhaust Air Duct	30 degrees Fahrenheit to 180 degrees Fahrenheit

D. Description: Flanged fitting bracket for mounting in hole of duct, with threaded end for attaching thermometer.

1. Extension Neck Length: Nominal thickness of 2 inches, but not less than thickness of exterior insulation.
2. Insertion Neck Length: Nominal thickness of 2 inches, but not less than thickness of

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insulation lining.

2.11. FIRE DAMPERS

A. Furnish and install automatic fire dampers where indicated, in all 2-hour fire-rated partitions, shafts, slabs, etc., and where required by NFPA Standard No. 90A and by the Fire Marshal. Refer to the architectural drawings for location of all fire-rated walls, shafts and slabs. Fire Dampers shall also be provided at all transfer air devices installed in rated walls at all floor penetrations, and as shown on the contract drawings.

B. Construction of fire dampers shall conform to requirements of NFPA No. 90A, UL Standard 555 and shall bear UL label. Fire dampers shall be set in frames adequately secured to fire partitions, floors, etc., and installed in strict accordance with UL listing and manufacturer's instructions.

C. Fire damper shall be Dynamic Type for rectangular ductwork and round ductwork as manufactured by Ruskin, Air Balance, Inc., Arrow, Greenheck, Lloyd Industries, Nailor, Vent Products Company, or approved equal, multi-leaf accordion type, held open by adequate heavy gauge wires and suitably calibrated fusible links. Vertical dampers (horizontal air flow) shall close by gravity. Horizontal dampers (vertical air flow) shall be closed by suitable and positive spring closing devices.

D. Damper frames shall provide pocket which shall store the damper leaves in open position outside of the air stream and shall provide for 100 percent opening connecting to ductwork or grille face. Damper material shall match connecting ductwork.

E. Provide adequately sized hinged access doors with cam locks for access to all fusible links and for resetting fire dampers. Where applicable, access to fire dampers shall be through registers or grilles. Provide identification on access door indicating fire damper within. Letters shall be not less than ½-inch in height.

F. Submit complete information to the Engineer including installation details. Furnish and install sleeves, angles, break-away duct connections, per UL listing.

G. Furnish to the Owner in a suitable storage container not less than six (6) fusible links of each type, size, and rating used on the project. Where required, furnish Greenheck Type CR, CO, or Type C transition sleeves.

2.12. DUCT ACCESS DOORS

A. Furnish and install adequately sized duct access doors at fire dampers, smoke dampers, air measuring devices, motor-operated dampers, duct smoke detectors, 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. Where duct access doors are installed in medium pressure ductwork, they shall be as manufactured by Ruskin, Type ADHP-3, or approved equal, with six latches continuous gasket and insulated core.

C. For walk-in plenums, provide insulated walk-through access doors, Ruskin Type ADW2,

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American Air Balance Type WA-100, or as approved equal.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

2.13. SPIN-IN FITTINGS

A. Furnish and install spin-in fittings where indicated on the contract drawings, Model SM-20G, as manufactured by General Environment Corporation, or an approved equal.

2.14. DUCT LINING (LOW PRESSURE DUCTWORK)

A. All low pressure supply and return ductwork within 10 feet of air handling units, rooftop units, heating and ventilation units, kitchen make-up air units, energy recovery ventilation units, and as additionally shown on Contract Drawings, shall be lined on the interior for sound attenuation and thermal insulation.

B. All low pressure ductwork within 10 feet of return or exhaust air fans and as additionally shown on Contract Drawings shall be lined on the interior for sound attenuation and thermal insulation.

C. All internal duct lining for low pressure duct systems shall be provided with an interior galvanized perforated liner.

D. Provide additional exterior insulation where required and as indicated in Division 23 Section, “HVAC Insulation”.

E. The lining insulation shall be 1 inch thick, 3.0 pcf density, Aeroflex plus Duct Liner Type 300, Owens Corning Quiet R Rotary Duct Liner, Manville, Knauf, or approved equal. The material shall be specifically designed for this application, shall have a black, fire-resistant coating, shall meet NFPA Standards 90A and 90B and shall have a UL Fire Hazard Classification of Flame Spread 25 or less and smoke developed of 10 or less. The black-coated surface shall face the air stream.

F. All exposed edges and the leading edge of all cross joints of the liner shall be coated with the same adhesive used to secure the duct liner to metal surface. All air stream surfaces shall be treated with EPA registered fungicide Foster 40-20. Coating shall meet ASTM D 5590 with 0 growth rating.

G. The duct liner shall be adhered to the metal with 100 percent coverage of adhesive. Adhesive shall conform to Adhesive and Sealant Council Standards for adhesives for duct liner; ASTM C916, Type II (ASC-A-7001-A-1971). Adhesive shall be Foster 85-60, Childers CP-127 or approved equal.

H. The duct liner shall be additionally secured with mechanical fasteners, which shall compress the duct liner sufficiently to hold it firmly in place. Mechanical fasteners shall conform to Mechanical Fastener Standard MF-1-1971, available from Sheet Metal and Air Conditioning Contractors National Association.

I. All duct lining shall be installed in complete accordance with the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Duct Liner Application Standard, First Edition and Green Guard Indoor Air Quality certification program requirements.

J. Dimensions on drawings indicate inside clear opening of rectangular ductwork. Increase duct dimensions 2 inches each way for accommodating insulation on all shop or field-fabricated rectangular ductwork where lining is specified.

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2.15. DUCT LINING (MEDIUM PRESSURE DUCTWORK)

A. All medium pressure supply and return ductwork within 10 feet of air handling units, rooftop units, heating and ventilating units, kitchen make-up air units, energy recovery ventilators, ERV unit, exhaust ducts, and as additional shown on contract drawings shall be lined on the interior for sound attenuation and thermal insulation.

B. All medium pressure ductwork within 10 feet of return [exhaust] air fans and as shown on Contract Drawings shall be lined on the interior for sound attenuation and thermal insulation.

C. Provide additional exterior insulation where required and as indicated in Division 23 Section, “HVAC Insulation”.

D. All internal duct lining for medium pressure duct systems shall be provided with interior galvanized perforated liner.

E. The insulation shall be 1 inch thick, 3.0 pcf density, Aeroflex plus Duct Liner Type 300, Owens Corning Quiet R Rotary Duct Lines, Manville, Knauf, or approved equal. The material shall be specifically designed for this application, shall have a black, fire-resistant coating, shall meet NFPA Standards 90A and 90B and shall have a UL Fire Hazard Classification of Flame Spread 25 or less and smoke developed of 10 or less. The black-coated surface shall face the air stream.

F. All exposed edges and the leading edge of all cross joints of the liner shall be coated with the same adhesive used to secure the duct liner to metal surface. All air stream surfaces shall be treated with EPA registered fungicide Foster 40-20. Coating shall meet ASTM D5590 with 0 growth rating.

G. The duct liner shall be adhered to the metal with 100 percent coverage of adhesive. Adhesive shall conform to Adhesive and Sealant Council Standards for adhesives for duct liner; ASTM C 916 (ASC-A-7001-A-1971). Adhesive shall be Foster 85-60, Childers CP-127 or approved equal.

H. The duct liner shall be additionally secured with mechanical fasteners which shall compress the duct lines sufficiently to hold it firmly in place. Mechanical fasteners shall conform to Mechanical Fastener Standard MF-1-1971, available from Sheet Metal and Air Conditioning Contractors National Association.

I. All duct lining shall be installed in complete accordance with the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Duct Liner Application Standard, First Edition and Green Guard Indoor Air Quality certification program requirements.

J. Dimensions on drawings indicate inside clear opening of rectangular ductwork. Increase duct dimensions 2 inches each way for accommodating insulation on all shop or field-fabricated rectangular ductwork where lining is specified.

2.16. STACKS AND BREECHING (GAS FURNACES)

A. The factory-built modular connector, manifold and breeching system shall be laboratory-tested and listed by Underwriters Laboratories, for use with building heating equipment which produces exhausted flue gases at a temperature not exceeding 1000 degrees Fahrenheit (F) under continuous operating conditions and not exceeding 1400 degrees F under intermittent operating conditions (see UL 103 Sections 17 and 18 respectively) when burning gaseous, solid or liquid fuels as described in NFPA 211. The breeching system shall be designed and installed to be gas tight and thus prevent leakage of combustion products into a building. The system shall be designed to compensate for all flue gas induced thermal expansions.

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B. The double wall breeching shall have an inner gas carrying pipe of Type 304 stainless steel for natural gas. There shall be a nominal 1-inch fiber insulation between the walls. The outer jacket shall be aluminum-coated steel. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL listing. The aluminized steel surfaces exposed to the elements shall be protected by one base coat of primer and one finished coat of corrosion resistant paint suitable for outer jacket skim temperatures of the particular installation. Paint shall be 4100 or 9400 as manufactured by Rust-oleum or approved equal. Outer wall of type 304 stainless steel may be substituted for paint. Paint shall be field applied in color to match roof surface.

C. The stack system shall be installed according to the manufacturer's installation instructions and shall comply with the codes and standards of the State of Maryland, International Mechanical Code, and applicable N.F.P.A. pamphlets. Stack termination height shall be sufficient to prevent re-entrainment into other building openings. Stack termination shall be minimum of 15 feet away from all building openings, intakes. All breeching stack terminations with a 15 foot radius of any building opening intake, or louver shall be extended 3 feet above the opening, intake or louver.

D. Inner pipe joints shall be sealed by use of factory supplied V bands and sealant as specified in the manufacturer's installation instructions.

E. When installed according to the manufacturer's installation instructions, the piping and its supporting system shall resist side loads (whether system is horizontal or vertical) at least 1.5 times the weight per foot of the piping. Wall supports shall support 40 feet of pipe with a factor of safety of at least four (4). Plate supports shall support (as verified by manufacturer testing) 200 feet of pipe in 6-inch through 20-inch ID sizes and 100 feet of pipe in 24-inch ID and larger sizes with a factor of safety of at least four (4).

F. The entire breeching system from the equipment to termination, including all required accessories (ventilated roof thimbles, guy wires, storm collar, guy tensioners, expansion joints, discharge cone, supports, etc.), shall be from one manufacturer.

G. The breeching shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of ten years from date of installation. Drawings showing the actual layout and drawn to scale shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's 10-year warranty and in conjunction with sound engineering practice. The inner diameter for breeching and stacks shall be verified by the manufacturer's computations. The computations shall be technically sound, shall follow ASHRAE calculation methods, and incorporate the specific flow characteristics of the inner pipe. The Contractor shall furnish the exact equipment model and operating characteristics to the factory representative. Operating characteristics shall include flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout, and available external pressure at boiler or equipment outlet, etc., necessary to determine system operation at maximum and minimum levels of burner turndown range.

H. Equipment breeching, as hereinbefore specified, shall be provided for all new fuel-fired equipment, including but not limited to furnaces and similar equipment.

I. Appliance breeching shall be Type IPS as manufactured by Selkirk Metalbestos, Type DW Plus by Van Packer, Type P1 by Schebler, Type IPIC by Metal-FAB, or as approved equal.

2.17. GAS FIRED CLOTHES DRYER DUCTWORK

A. The factory-built modular connector, manifold and clothes dryer breeching system shall be laboratory-tested and listed by Underwriters Laboratories, for use with building heating equipment which produces exhausted flue gases at a temperature not exceeding 1000 degrees Fahrenheit (F)

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under continuous operating conditions and not exceeding 1400 degrees F under intermittent operating conditions (see UL 103 Sections 17 and 18 respectively) when burning gaseous, solid or liquid fuels as described in NFPA 211. The breeching system shall be designed and installed to be gas tight and thus prevent leakage of combustion products into a building. The system shall be designed to compensate for all flue gas induced thermal expansions.

B. The double wall breeching shall have an inner gas carrying pipe of Type 304 stainless steel for propane gas,. There shall be a nominal 1-inch fiber insulation between the walls. The outer jacket shall be aluminum-coated steel. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL listing. The aluminized steel surfaces exposed to the elements shall be protected by one base coat of primer and one finished coat of corrosion resistant paint suitable for outer jacket skim temperatures of the particular installation. Paint shall be 4100 or 9400 as manufactured by Rust-oleum or approved equal. Outer wall of type 304 stainless steel may be substituted for paint. Paint shall be field applied in color to match roof surface.

C. The stack system shall be installed according to the manufacturer's installation instructions and shall comply with the codes and standards of the State of Maryland, International Mechanical Code, and applicable N.F.P.A. pamphlets. Stack termination height shall be sufficient to prevent re-entrainment into other building openings. Stack termination shall be minimum of 15 feet away from all building openings, intakes. All breeching stack terminations with a 15 foot radius of any building opening intake, or louver shall be extended 3 feet above the opening, intake or louver.

D. Inner pipe joints shall be sealed by use of factory supplied V bands and sealant as specified in the manufacturer's installation instructions.

E. When installed according to the manufacturer's installation instructions, the piping and its supporting system shall resist side loads (whether system is horizontal or vertical) at least 1.5 times the weight per foot of the piping. Wall supports shall support 40 feet of pipe with a factor of safety of at least four (4). Plate supports shall support (as verified by manufacturer testing) 200 feet of pipe in 6-inch through 20-inch ID sizes and 100 feet of pipe in 24-inch ID and larger sizes with a factor of safety of at least four (4).

F. The entire breeching system from the equipment to termination, including all required accessories (ventilated roof thimbles, guy wires, storm collar, guy tensioners, expansion joints, discharge cone, supports, etc.), shall be from one manufacturer.

G. The breeching shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of ten years from date of installation. Drawings showing the actual layout and drawn to scale shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's 10-year warranty and in conjunction with sound engineering practice. The inner diameter for breeching and stacks shall be verified by the manufacturer's computations. The computations shall be technically sound, shall follow ASHRAE calculation methods, and incorporate the specific flow characteristics of the inner pipe. The Contractor shall furnish the exact clothes dryer model and operating characteristics to the factory representative. Operating characteristics shall include flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout, and available external pressure at clothes dryer or equipment outlet, etc., necessary to determine system operation at maximum and minimum levels of burner turndown range.

H. Equipment breeching, as hereinbefore specified, shall be provided for all new fuel-fired equipment, including but not limited to gas furnaces.

I. Equipment breeching and appliance breeching shall be Type IPS as manufactured by Selkirk Metalbestos, Type DW Plus by Van Packer, Type P1 by Schebler, Type IPIC by Metal-FAB, or as

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approved equal.

2.18. AIR DEVICE REQUIREMENTS

A. Furnish and install air supply, return, exhaust devices of sizes and capacities as scheduled on the drawings. Catalog numbers shown are Titus, Inc., products for equipment which have been found suitable for the application. Other manufacturers listed below or approved equal will be considered only if performance characteristics including throw, drop, pressure loss, sound pressure level, etc., are equal to or better than the performance characteristics of the specified products. All air devices shall be ADC certified. Ductwork behind registers, grilles, open ended ducts, and diffusers shall be given two coats of flat black paint. Perimeter of all ceiling diffusers shall be caulked to provide a neat, aesthetic appearance.

B. Where air terminal devices are installed in duct collars or branches, furnish and install air extractors. Furnish and install control grids, volume dampers, and/or other accessories necessary to ensure uniform air flow across the terminal devices. Accessories shall be of the same material as the terminal device. Install fixed blade terminals so that blades block the normal line of vision. Furnish three (3) of each type of removable key operators.

C. Contractor shall determine frame and mounting type as per type of ceiling as shown on Architectural drawings.

D. Air devices and accessories that are installed in a finished, non-white ceiling shall be of a color as selected by the Architect.

E. Noise Criteria: All air devices shall be sized and selected to limit maximum NC (Noise Criteria) levels to 30.

2.19. SUPPLY AIR DEVICES

A. LSD1 Diffuser, Linear Slot, Supply

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

a. Titus Model ML
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a.	Material:	Aluminum
b.	Finish:	Baked Enamel, White
c.	Face Style:	Linear Slots
d.	Mounting:	Surface
e.	Pattern:	Fully adjustable 180-degree pattern controllers
f.	Damper:	Integral, Opposed Blade type

3. Accessories:

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a. Plenum; Insulated

4. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

B. RD1 Diffuser, Round

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

a. Titus Model TMRA-AA
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: Baked Enamel, White
c. Face Style: Four Cone
d. Mounting: Duct Connection
e. Pattern: Fully Adjustable
f. Damper: Integral, Opposed Blade type

3. Accessories:

a. Equalizing grid
b. Safety Chain

4. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

C. SD1 Diffuser, Square/Rectangular

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

a. Titus Model TDCA-AA
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: Baked Enamel, White
c. Face Style: Louvered
d. Mounting: Lay-in or Gypboard
e. Pattern: Adjustable core style

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f. Damper: Integral, Opposed Blade type

3. Accessories:

a. Square to round neck adaptor
b. Adjustable pattern vanes

4. Provide auxiliary panel for lay-in tile installation.
5. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

D. SD2 Diffuser, Perforated

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

a. Titus Model PAR-AA
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: Baked Enamel, White
c. Face Style: Perforated
d. Mounting: Lay-in or Gypboard
e. Pattern: Straight Down
f. Damper: Opposed Blade type

3. Accessories:

a. Square to round neck adaptor

4. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

E. SG1 Grille, Square/Rectangular

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

a. Titus Model 300FS
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

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a. Material: Aluminum
b. Finish: Baked Enamel, White
c. Face Style: Grille
d. Mounting: Surface
e. Pattern: Double Deflection; spaced 3/4 inch apart.
f. Damper: Integral, Opposed Blade type

3. Accessories:

a. Drop control

4. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

F. SLB1 Diffuser, Linear Bar

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

a. Titus Model CT-PP
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: Baked Enamel, White
c. Face Style: Linear Bar
d. Mounting: Surface
e. Pattern: **[0°], [30°]** Deflection
f. Damper: Integral, Opposed Blade type

3. Accessories:

a. Pencil Proof

4. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2.20. RETURN/EXHAUST/TRANSFER GRILLES

A. LSD2 Diffuser, Linear Slot, Return

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

a. Titus Model MLR
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes

NOT FOR BIDDING

g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: Baked Enamel, White
c. Face Style: Linear Slots
d. Mounting: Surface
e. Pattern: Fully adjustable 180-degree pattern controllers
f. Damper: Integral, Opposed Blade type

3. Accessories:

a. Plenum; Insulated

4. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

B. RG1 Return/Exhaust/Transfer Grille, Square/Rectangular

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

a. Titus Model 350FS
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: White Baked Enamel
c. Ceiling Type: Lay-in, Gypboard, Sidewall
d. Blades: Fixed, 35° Angle, 3/4” Spacing

3. Accessories:

a. Face: Grille
b. Damper: Integral, Opposed Blade type

4. Provide auxiliary panel for lay-in tile installation.
5. The register shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

C. RG2 Return/Exhaust/Transfer Grille, Square/Rectangular with Filter, Aluminum

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

a. Titus Model 350FSF
b. Metal-Aire
c. Price

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d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: White Baked Enamel
c. Ceiling Type: Lay-in, Gypboard, Sidewall
d. Blades: Fixed, 35° Angle, 3/4” Spacing

3. Accessories:

a. Face: Grille
b. Damper: Integral, Opposed Blade type

4. Provide auxiliary panel for lay-in tile installation.
5. Provide return air filter racks and 1” thick filters.
6. The register shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.
7. Furnish spare filters with each air device.

D. RG3 Return/Exhaust/Transfer Grille, Square/Rectangular with Filter, Steel

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

a. Titus Model 350RSF
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Steel, 16 gauge
b. Finish: White Baked Enamel
c. Ceiling Type: Sidewall
d. Blades: Fixed, 35° Angle, 3/4” Spacing

3. Accessories:

a. Face: Grille
b. Damper: Integral, Opposed Blade type
c. Core: Hinged

4. Provide return air filter racks and 1” thick filters.
5. The register shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

E. Noise Criteria: All air devices shall be sized and selected to limit maximum NC (noise criteria) levels to 30.

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2.21. LOUVERS (FIXED BLADE)

A. Furnish and install wall louvers of the size and capacity shown on the contract drawings. Louvers shall be Greenheck Model EHV-901 (high velocity wind driven rain) heavy gauge extruded aluminum stationary type louvers, Vent Projects Company, or approved equal. Louvers shall be stationary, dual module type consisting of a "front" louver with J-style blades and a "rear" louver with vertical rain resistant style blades. Louver frame shall be a total depth of 9 inches.

B. Front louvers shall be drainable type fabricated from heavy gauge 6063-T5 aluminum extrusions of .081 inch nominal wall thickness. Blades shall be positioned at 37 degree and 45 degree angles, approximately 4.25 inches on centers. Rear louver shall b vertical rain resistant style, heavy gauge extruded 6063-T5 aluminum, 0.060 nominal thickness, positioned on approximately 1.5 inch blade spacing. Each louver shall be equipped with a frame and removable rear-mounted screen of flattened aluminum. Each factory assembled louver section shall be designed to withstand wind loadings of 25 psf. Louvers too large for complete factory assembly shall be built up by the installing contractor from factory assembled louver sections.

C. Louvers shall be tested in accordance with AMCA 550-L, AMCA-540, and AMCA 550 (Certified High Velocity, Rain Resistant, and Impact Resistant Louver).

D. Louvers shall be supplied with a factory Kynar finish applied after a thorough cleaning and preparation of the metal surface. A total dry film thickness of approximately 1.2 mils shall be provided. Custom color shall be as selected by Architect.

E. Louvers shall be provided with ¼ inch x ¼ inch aluminum bird screens, factory-furnished and installed. Louver performance data shall be A.M.C.A. certified. All louvers shall be caulked weathertight around entire perimeter.

2.22. LOUVER BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of insulating core surfaced on back and front with metal sheets and attached to back of louver

1. Thickness: 2 inches (50mm)
2. Metal Facing Sheets: Aluminum sheet, not less than .032 inch (.81mm) nominal thickness.
3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than .080 inch (2.03mm) nominal thickness with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same finish applied to louvers.
7. Attach blank-off panels with stainless steel sheet metal screws.
8. Cover all unused openings in louvers.

2.23. INTAKE/RELIEF HOODS

A. Furnish and install heavy gauge aluminum intake/relief hoods of size, capacity, and arrangement as shown on Contract Drawings. Intake/relief hoods shall be Greenheck Model FHI for intake or Model FHR for relief as manufactured by Greenheck, ACME Engineering, Cook, Twin City, Vent Products Company, or approved equal.

B. Gravity roof ventilators shall be constructed of heavy gauge aluminum or galvanized steel. Hoods shall be constructed of precision formed, arched panels with interlocking seams. Bases shall be

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constructed so that the curb cap is 8 inches larger than the throat size. Insulated roof curbs shall be furnished as specified and shall be of same manufacturer as roof hood.

C. Hood support members shall be constructed of galvanized steel and fastened so that the hood can be either removed completely from the base or hinged open. Birdscreens constructed of ½ inch galvanized steel mesh shall be mounted horizontally across the intake/discharge area of the hood. Intake units with throat widths through 42 inches shall ship assembled when throat lengths do not exceed 84 inches. Relief units with throat widths through 48 inches shall ship assembled when throat lengths do not exceed 96 inches.

D. Motor-operated dampers shall be provided by the ATC Subcontractor and installed by Mechanical Contractor.

E. Provide 12-inch high, fully insulated, aluminum hinged roof curbs with each hood. Furnish roof curbs with damper trays for field mounting of motor operated damper by the ATC subcontractor. Hood and roof curb shall be provided by the same manufacturer.

F. Motor operated dampers shall be provided by ATC subcontractor and installed by mechanical contractor. Coordinate damper tray with roof curbs per detail on the drawings.

2.24. 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 ½ inch x ½ 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 ¾ inch x 1/8 inch continuous galvanized perimeter frame. Install duct stiffeners greater than 16 inches in any direction at open-ended ducts.

D. Behind all open end ducts, paint ductwork and dampers with two (2) coats of flat black paint.

2.25. DRIP PANS

A. Furnish and install suitable watertight, aluminum drip pans where water or drain piping is routed over electrical switchgear, transformers, computers, 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”.

2.26. 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),

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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 or outdoors shall be sealed with Foster 32-19, Childers CP-146, United Duct Sealer WB, or equivalent, which is a water-based sealant formulated to withstand service temperatures from 20 degrees F to +200 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. Store and apply between 40°F (4°C) and 100°F (38°C); protect from freezing.
2. Assembly joints to be installed indoors shall be sealed with Foster 32-19, childers CP-146, UNI-GRIP™ duct sealer or equivalent, which is a water-based (vinyl-acrylic polymer) sealant formulated to withstand temperatures from –20 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.
3. 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.
4. 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.
5. 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.
6. Where insulation is to be secured to metal surfaces, the adhesive used shall be Foster 85-60, Childers CP-127, UNI-TACK™ duct liner adhesive or equivalent, which are water-based, vinyl-acrylic copolymer adhesives formulated to withstand temperatures from –20 degrees Fahrenheit to +200 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. Adhesive shall conform to ASTM C916, Type II.

B. Manufacturers: Duct Mate, United McGill, MKT Metal Manufacturers, Semco, Elgen, Childers, Foster, or as approved equal.

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2.27. AUXILIARY DRIP PANS

A. Furnish and install suitable watertight, aluminum drip pans for all suspended air handling units, heat pumps, ducted VRV units or air handling units installed on upper floor and/or attic. Each drip pan shall have a 1" copper type "M" drain piped to discharge where shown on drawings. Drain pan shall extend 3" beyond sides of air handling unit/heat pump. Sides shall be minimum 1.5" deep.

B. Drain pans shall be of 16 gauge welded construction. Provide drawings of typical drain pan construction for approval before construction. See Submittals, Division 23 Section, “Common Work Results for HVAC” and Division 01, Section, “General Requirements”.

C. Install U.L. 580 listed condensate float switch in auxiliary drain pan and wire to shut-down unit upon sensing water. All control and interlock wiring to be furnished and installed under Division 23 Section, “Instrumentation & Controls of HVAC & Plumbing Systems”

2.28. FILTER MEDIA DURING CONSTRUCTION

A. Filter media installed during construction: Minimum MERV 8.

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,

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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. Set plenum doors 6 to 12 inches (150 to 300 mm) above floor. Arrange door swings so that fan static pressure holds door in closed position.

P. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork systems. Also provide temporary closures of metal or taped polyethylene at all air handling equipment openings to prevent dust from entering equipment openings.

Q. Paint behind all air devices, louvers, and open end ducts with 2 coats of flat black paint.

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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. Also provide temporary closures of metal or taped polyethylene at all air handling equipment openings to prevent dust from entering equipment openings.

B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, duct detectors, air flow monitoring stations, duct-mounted equipment, duct coils and elsewhere as indicated. Provide minimum 10 x 10 inch size for hand access and 18 x 18 inch size for shoulder access. Review locations prior to fabrication.

C. Provide duct test holes where required for testing and balancing purposes. Review locations with Test and Balance Engineer prior to installation.

D. For all motor operated dampers, mark the shaft so operators know the position of the damper.

E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion-resistant springs, bearings, bushings and hinges.

F. Demonstrate re-setting of fire dampers to Owner's representative.

G. 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".

H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum duct widths from duct take-off.

I. Use splitter dampers only where indicated.

J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

K. Install diffusers, registers, and grilles to ductwork with airtight construction.

L. Check location of all air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangements.

M. Install duct thermometer support flanges in wall of duct. Attach to duct with screws. Locate duct mounted thermometers, minimum 10 feet downstream of mixing dampers, coils or other devices causing air turbulence.

N. Install remote - reading duct dial thermometers in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length. Mount control panel 60 inches above finished floor and label each dial thermometer.

O. Install duct accessories according to applicable details shown in SMACNA's HVAC Duct Construction Standards Metal and Flexible for metal ducts.

P. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

Q. Provide test holes at fan inlet and outlet and elsewhere as indicated.

R. Install fire, smoke, and combination fire and smoke dampers according to manufacturer's UL approved written instructions.

1. Install fusible links in fire dampers. Label access doors according to equipment served.

S. Adjust duct accessories for proper settings.

T. Adjust fire dampers for proper action.

3.3. DUCT LINING INSTALLATION REQUIREMENTS

A. All portions of duct designated to receive duct liner shall be completely covered with duct liner.

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Transverse joints shall be neatly butted and there shall be no interruptions or gaps. The black pigmented or mat faced surface of the duct liner shall face the airstream.

B. Duct liner shall be adhered to the sheet metal. with 90 percent coverage of adhesive complying with requirements of ASTM C916. All exposed leading edges and transverse joints shall be factory coated or coated with adhesive during fabrication. Install perforated galvanized inner liner where indicated

C. Duct liner shall be additionally secured with mechanical fasteners, either weld-secured or impact-driven, which shall compress the duct liner sufficiently to hold it firmly in place. Adhesive bonded pins are not permitted due to long term adhesive aging characteristics. Spacing of mechanical fasteners with respect to duct liner interior width shall be in accordance with SMACNA HVAC DGS. Maximum spacing for mechanical fasteners shall be as follows:

Velocity = 0 to 2,500 feet per minute (0 to 12.8m/s):	
From transverse end of liner	3: (75mm)
Across width of duct	12 inches (300 mm) O.C.
From corners of duct	4 inches (100mm)
Along length of duct	18 inches (450mm) O.C.

Velocity = 2,501 to 5,000 feet per minute (12.8 to 25.4 m/s):	
From transverse end of liner	3 inches (75m)
Across width of duct	6 inches (150mm) O.C.
From corners of duct	4 inches (100mm)
Along length of duct	16 inches (400mm) O.C.

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D. When air velocities exceed 4,000 fpm (20.3m/s), galvanized sheet metal nosing shall be applied to all leading edges of duct liner.

E. Acoustical Duct Liner shall be cut to assure overlapping and compressed longitudinal corner joints.

F. Upon completion of installation of duct liner and before operation is to commence, visually inspect the system and verify that the duct liner insulation has been correctly installed.

G. 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 of removal of such material.

H. Check the duct system to ensure that there are no air leaks through joints.

3.4. STACKS AND BREECHING INSTALLATION REQUIREMENTS

A. Install in accordance with manufacturer’s instructions.

B. Install in accordance with NFPA 54 (ANSI Z223.1) and NFPA 31.

C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Support breechings from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot (4 m) spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

E. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.

F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

G. Coordinate installation of dampers and induced draft fans.

H. For double wall gas vents, maintain UL listed minimum clearances from combustibles Assemble pipe and accessories as required for complete installation.

I. Install vent dampers, locating close to draft hood collar, and secure to breeching.

J. Assemble and install stack sections in accordance with NFPA 82, Industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement to ASTM C105. Connect base section to foundation using anchor lugs.

K. Level and plumb chimney and stacks

L. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

M. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.

N. Provide maximum 2 feet of breeching to connect appliance to chimney.

O. Do not install bull head tee at connections to equipment.

3.5. WATER HEATER INTAKE AND WATER HEATER EXHAUST DUCT INSTALLATION REQUIREMENTS

A. Install in accordance with manufacturer’s instructions.

B. Install in accordance with NFPA 54 (ANSI Z223.1).

C. Install flue pipes with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Support flue pipes from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support vertical flue pipes, and stacks at 6 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

E. Install concrete inserts for support of flue pipes and stacks in coordination with formwork.

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F. Pitch flue pipes with positive slope up from fuel-fired equipment to stack.

G. Install vent dampers, locating close to draft hood collar, and secure to flue pipes.

H. Assemble and install stack sections in accordance with NFPA 82, Industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement to ASTM C105. Connect base section to foundation using anchor lugs.

I. Level and plumb flue pipes and stacks

J. Clean flue pipes and stacks during installation, removing dust and debris.

K. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of flue pipes or stacks.

L. Do not install bull head tee at connections to equipment.

M. Provide and install condensate removal pipes and neutralizers per manufacturer's requirements.

3.6. 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. All medium pressure sheet metal ductwork shall undergo leakage tests at 5 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".

C. 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.

D. All duct accessories, including but not limited to volume dampers, ATC sensors, motor operated dampers, duct access doors, duct detectors, and duct coils shall be installed prior to duct leakage testing.

E. Submit a complete report of the ductwork leakage tests to the Architect and include final approved copies in test and balance reports.

3.7. 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

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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/fan identification and area served.

E. Length of fan color field for ductwork shall be 32 inches. Lettering shall be minimum 3-1/2 inches high.

3.8. CLOTHESDRYER DUCTWORK INSTALLATION REQUIREMENTS

A. Install in accordance with manufacturer's instructions.

B. Install clothes dryer ducts with minimum of joints. Align accurately at connections, with internal surfaces smooth.

C. Support clothes dryer ducts from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support vertical clothes dryer ducts, and stacks at 12 foot (4 m) spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

D. Level and plumb stacks.

E. Clean clothes dryer ductwork during installation, removing dust and debris.

F. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of clothes dryer ductwork, clothes dryer ductwork insulation, or stacks.

G. Do not install bull head tee at connections to equipment.

H. Install cleanouts at all changes in direction.

END OF SECTION

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SECTION 235523 GAS-FIRED RADIANT HEATERS

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 gas-fired, tubular infrared radiant heaters.

1.3. SUBMITTALS

A. Product Data: For each type of gas-fired radiant heater indicated. Include rated capacities, operating characteristics, and accessories.

B. Shop Drawings: For gas-fired radiant heaters. Include plans, elevations, sections, details, and attachments to other work.

1. Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of gas-fired radiant heaters, as well as procedures and diagrams.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which equipment will be attached.
2. Items penetrating roof and the following:

a. Vent combustion air, and gas piping rough-ins and connections.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For gas-fired radiant heaters to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.4. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

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1.5. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gas-fired radiant heater that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

1.6. EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Burner Igniters: One hot-surface burner igniter(s) for each style of gas-fired radiant heater furnished.

PART 2 PRODUCTS

2.1. TUBULAR INFRARED HEATERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

C. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:

1. Re-verber Ray
2. Combustion Research Corporation.
3. Gas-Fired Products Inc.; Space-Ray Div.
4. Reznor/Thomas & Betts Corporation.
5. Solaronics

D. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.20/CSA 2.34.

E. Fuel Type: Design burner for propane gas having characteristics same as those of gas available at Project site.

F. Combustion Tubing: 4-inch- (100-mm-) diameter stainless steel with high-emissivity, high-temperature, corrosion-resistant external finish.

G. Tubing Connections: Stainless-steel couplings or flared joints with stainless-steel draw bolts.

H. Reflector: Polished aluminum, 97 percent minimum reflectivity, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Provide for rotating reflector or heater around a horizontal axis for minimum 30-degree (0.52-radian) tilt from vertical.

1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 30 degrees (0.52 radians) from vertical.
2. Include hanger kit.

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I. Burner Safety Controls:

1. Gas Control Valve: Single-stage, regulated redundant 24-V ac gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
2. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.
3. Control Panel Interlock: Stops burner if panel is open.
4. Indicator Lights: Burner-on indicator light.

J. Burner and Emitter Type: Gravity-vented power burner, with the following features:

1. Emitter Tube: 4-inch- (100-mm-) diameter, aluminized-steel tubing with sight glass for burner and pilot flame observation.
2. Venting: Concentric vent for combustion air and flue gas with rain cap for both.

a. Vent Terminal: Vertical.

3. Burner/Ignition: Power gas burner with electronic spark and electronic flame safety.
4. Burner/Ignition: Stainless-steel burner cup and head with balanced-rotor draft fan and direct-sensing, hot-surface ignition
5. Combustion-Air Connection: Duct connection for combustion air to be drawn directly from outdoors by burner fan.

2.2. CONTROLS

A. Thermostat: 2-stage, wall-mounting type with 50 to 90 deg F (10 to 32 deg C) operating range and fan on switch.

1. Control Transformer: Integrally mounted.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install and connect gas-fired radiant heaters and associated fuel and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written installation instructions.

B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.

C. Maintain manufacturers' recommended clearances to combustibles.

3.2. CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to gas-fired radiant heaters to allow service and maintenance.

C. Gas Piping: Comply with Division 22 Section, Plumbing Piping, Valves and Fittings. Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.

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D. Vent Connections: Comply with Division 23 Section, HVAC Air Distribution.

E. Electrical Connections: Comply with applicable requirements in Division 26 Sections.

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

3.3. FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:

a. Test procedures used.
b. Test results that comply with requirements.
c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

3.4. ADJUSTING

A. Adjust initial temperature set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.5. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired radiant heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

NOT FOR BIDDING

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. ALTERNATES

A. Refer to Division 01 Section 012300, “Alternates”, for description of work under this Division affected by Alternates.

1.3. SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Foam duct sealant.
4. Grout.
5. Plywood backboards.
6. Protective wire guards.
7. Spare key cabinet(s).
8. 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.

E. 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.

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

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

H. 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.

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1.4. CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 26 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.
5. Copy of Master Electrician's License.

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.

D. Supervisory Qualifications: The electrical work on the project shall be under the direct supervision of a licensed Master Electrician.

E. Qualifications of Installers:

1. For the actual fabrication, installation, and testing of the work, shall use only thoroughly trained and experienced personnel who are completely familiar with the requirements of this work and with the installation recommendations of the manufacturers of the specified items.
2. Utilize a full-time project foreman in charge of all electrical work. This person shall be fully qualified and experience in such work and shall be available, on site, at all times during Construction. All problems, questions, coordination, etc. related to electrical work shall take place through this person to the Architect.

1.5. PERMITS, FEES, AND INSPECTIONS

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 and Engineer in advance of scheduled inspections.

E. An electrical foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections.

F. State Mandated Electrical Inspections: The Contractor shall obtain electrical installation inspection from a non-governmental electrical inspector approved by the State Fire Marshal. The Contractor shall coordinate inspections, coordinate inspection schedule with the Owner, and obtain the electrical inspection certificate within 15 days after completion of electrical installation. The Contractor shall obtain electrical inspections of portions of the Work as they are completed and as required by the electrical inspector, and sufficiently ahead of close-in work so that corrections and re-inspections may be made, and in all cases while the area is accessible and visible for inspection.

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1.6. UTILITY COMPANY COORDINATION

A. The Engineer has made the initial service application to Delaware Electric Cooperative (DEC) for the purposes of obtaining a new electric service. The utility company's contact person is Troy Dickerson, PE (email: tdickerson@delaware.coop, phone: (302) 349-3125). After award of the contract or notice to proceed whichever comes first, the Contractor is responsible for all communication, scheduling, site meetings, and follow-up with the utility company necessary for the installation of said utility in a timely manner, so service is active and available when needed for start-up, testing, and operation of all equipment and systems prior to substantial completion. Utility fees are to be paid directly by the Owner.

B. Contact and coordinate service entrance equipment and layout with local power company prior to ordering or installing any service entrance equipment. Contractor shall furnish and install all incoming raceway and service entrance cables. If the power company plans to install cable and/or conduit, Contractor is responsible for proper coordination of cable, conduit, lug sizes, etc., for proper interface between utility owned/installed equipment and Contractor-installed equipment.

C. The Owner shall make the application for electrical service and pay for all service charges, as coordinated with the Contractor.

1.7. 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.

1.8. 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 overhead ducts, piping, etc. Where any doubt exists, the exact location shall be determined by the Owner.

C. No electrical equipment, e.g. transformers, panelboards, disconnect switches, motor controllers, etc. shall be installed beneath ductwork, piping, etc.

D. All general trades and existing conditions shall be checked before installing any outlets, power wiring, etc.

E. 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.

F. 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

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Contract Price. The Engineer will decide on the item and manner in which the work shall be installed.

G. 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.

H. 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.

I. 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.

J. The complete set of Architectural, Civil, Structural, Food Service, Technology, Mechanical, and Electrical Drawings and Specifications apply to this work. The successful Bidder shall familiarize himself with all other related documents.

1.9. 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. Existing items of equipment are being reconnected under this Division of these Specifications. The Contractor shall be responsible for connecting all utilities as shown on the Drawings, to equipment identified as existing.

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.

1.10. ELECTRICAL WORK UNDER OTHER DIVISIONS

A. Architectural Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under Architectural divisions shall be supplied with control wiring, transformers, contacts, etc.
2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related

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thereto.

3. Architectural Equipment refers to, but is not limited to the following:

    a. Appliances
        i. Includes, but is not limited to refrigerators, microwaves, dishwashers, ranges, range hoods, clothes washers, clothes dryers, whirlpools, etc.
        ii. Verify equipment nameplates and connection requirements prior to rough-in.
        iii. Coordinate mounting heights and locations of outlet boxes serving appliances with approved appliance product data and approved casework shop drawings where applicable.
    b. Cabinets, Casework and Countertops
        i. Do not install outlets, switches, etc. behind casework, cabinets, etc.
        ii. Receptacle outlets and data/telephone outlets shall be mounted above the countertops unless otherwise indicated.
        iii. Where outlets are installed below countertops, provide grommets through countertops for cabling. Coordinate drilling of casework/countertops with casework installer.
        iv. Coordinate outlets above and below countertops and associated surface raceways (where applicable) with approved casework shop drawings to avoid conflicts with sinks and other appurtenances.
    c. Door Hardware
        i. Includes, but is not limited to electric strikes, magnetic hold-open devices, power-assist door operators, raise/lower switches, etc.
        ii. Verify voltages of door hardware with approved door hardware shop drawings.
        iii. Coordinate mounting height and location of power-assist door operator paddle stations with Architect to ensure ADA compliance.
        iv. Coordinate mounting height and location of raise/lower switches for overhead coiling doors/grilles with Architect.
    d. Glazing Systems
        i. Includes but is not limited to commercial storefront, curtain walls, skylights, windows, etc.
        ii. Do not install fire alarm initiation and notification appliances on glazing systems wherever possible. Where devices must be installed on glazing systems, indicate the same on fire alarm system shop drawings and obtain the permission of the Architect.
        iii. Coordinate installation of exit signs above doors that are integral to glazing systems. Conceal power wiring (MC cable) within glazing systems.
    e. Signage
        i. Includes but is not limited to building signage, monument signage, site signage, etc.

B. Civil Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under Civil divisions shall be supplied with control wiring, transformers, contacts, etc.
2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related thereto.
3. Civil Equipment refers to, but is not limited to the following:

    a. Irrigation System(s)
    b. Lift Stations
    c. Site Lighting

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d. Well Pumps

C. Food Service (Kitchen) Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under Food Service divisions shall be supplied with control wiring, transformers, contacts, etc.
2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related thereto.
3. Food Service Equipment refers to, but is not limited to the following:

    a. Commercial Kitchen Appliances
        i. Includes, but is not limited to refrigerators, freezers, warming cabinets, vending machines, cash registers, microwaves, dishwashers, garbage disposals, ranges, mixers, kettles, convection ovens, utility distribution systems, etc.
        ii. Verify equipment nameplates and connection requirements prior to rough-in.
        iii. Coordinate mounting heights and locations of outlet boxes serving appliances with approved appliance product data and approved casework shop drawings where applicable.

D. HVAC Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under HVAC divisions shall be supplied with control wiring, transformers, contacts, etc.
2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related thereto.
3. Certain mechanical units are furnished from the factory with motor starters, contactors, transformers, fuses, wiring, etc., required for fans, pumps, etc. When this equipment is supplied from the factory, Division 26 shall coordinate with Division 23 such that only one set of starters, fuses, switches, etc. is provided.
4. Some HVAC equipment must be protected by fuses, which shall be marked on the equipment nameplate. In these instances, if the equipment has an integral non-fused disconnecting means, the fusible safety switch indicated on the electrical drawings must remain per NEC Article 440.
5. In general, control and interlock equipment (including, but not limited to wiring, conduit, transformers, relays, contacts, etc.) for HVAC equipment and systems is furnished under Division 23. Division 26 shall install and connect all equipment as necessary.
6. HVAC equipment refers to, but is not limited to the following:

    a. Air Handling Units
    b. ATC Panels
    c. Condensing Units
    d. Ductless Split Systems
    e. Ductwork
        i. Do not install any electrical equipment, including but not limited to transformers, panelboards, safety switches, motor controllers, etc. beneath ductwork. Where this cannot be accomplished due to field conditions, notify the Architect/Engineer in writing.
    f. Electric Unit Heaters
    g. Energy Recovery Ventilators
    h. Exhaust Fans
    i. Fan Coil Units
    j. Heat Pumps

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k. Piping
   i. Do not install any electrical equipment, including but not limited to switchboards, transformers, panelboards, safety switches, motor controllers, etc. beneath piping. Where this cannot be accomplished due to field conditions, notify the Architect/Engineer in writing.
l. Radiant Heat Panels
m. Ventilation Fans

7. To ensure proper electrical coordination between the electrical components supplied under Division 26 and the equipment supplied under Division 23, a schedule shall be submitted, prior to start of work, for review by the Engineer with the following column headings:

   a. Equipment or Item
   b. HP or KVA
   c. Voltage and Phase
   d. Power Factor
   e. Capacitor
   f. Motor Starter
   g. Disconnect
   h. Controls
   i. Remarks

E. Owner Furnished Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished by the Owner shall be supplied with control wiring, transformers, contacts, etc.
2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related thereto.
3. Owner equipment refers to, but is not limited to the following:

   a. Existing Appliances and/or Equipment
   b. Electronic Appliances
      i. Includes, but is not limited to televisions, computers, copy/fax machines, printers, etc.
      ii. Verify equipment nameplates and connection requirements prior to rough-in.
      iii. Coordinate mounting heights and locations of outlet boxes serving appliances with approved appliance product data and approved casework shop drawings where applicable.
   c. Kitchen/Laundry Appliances
      i. Includes, but is not limited to refrigerators, microwaves, dishwashers, ranges, range hoods, clothes washers, clothes dryers, etc.
      ii. Verify equipment nameplates and connection requirements prior to rough-in.
      iii. Coordinate mounting heights and locations of outlet boxes serving appliances with approved appliance product data and approved casework shop drawings where applicable.

F. Plumbing Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under Plumbing divisions shall be supplied with control wiring, transformers, contacts, etc.
2. Division 26 shall provide power circuits to such equipment and a disconnecting means for each piece of equipment, as well as all electrical control equipment and wiring related

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thereto.

3. Certain plumbing units are furnished from the factory with motor starters, contactors, transformers, fuses, wiring, etc., required for pumps, etc. When this equipment is supplied from the factory, Division 26 shall coordinate with Division 22 such that only one set of starters, fuses, switches, etc. is provided.
4. In general, control and interlock equipment (including, but not limited to wiring, conduit, transformers, relays, contacts, etc.) for plumbing equipment and systems is furnished under Division 22. Division 26 shall install and connect all equipment as necessary.
5. Plumbing equipment refers to, but is not limited to the following:

    a. Electric Water Coolers
        i. Coordinate mounting height and location of receptacle outlets serving electric water coolers with approved shop drawings.
    b. Floor Drains
        i. Coordinate routing of conduits and raceways in floor slabs with floor drains.
    c. Condensate Pumps
        i. Coordinate connection type (i.e. switch or cord-and-plug) with approved shop drawings.
    d. Gas-Fired Water Heaters
        i. Coordinate connection type (i.e. switch or cord-and-plug) with approved shop drawings.
    e. Ice Makers
    f. Piping
        i. Do not install any electrical equipment, including but not limited to switchboards, transformers, panelboards, safety switches, motor controllers, etc. beneath piping. Where this cannot be accomplished due to field conditions, notify the Architect/Engineer in writing.
    g. Trap Priming Stations

1.11. 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.

1.12. 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.	DNREC	-	Delaware Department of Natural Resources and Environmental Control
6.	EPA	-	Environmental Protection Agency
7.	FM	-	Factory Mutual
8.	IBC	-	International Building Code
9.	IEEE	-	Institute of Electrical and Electronics Engineers
10.	NEC	-	National Electrical Code
11.	NECA	-	National Electrical Contractors Association
12.	NEMA	-	National Electrical Manufacturers Association
13.	NFPA	-	National Fire Protection Association

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14.	OSHA	-	Occupational Safety and Health Act
15.	UL	-	Underwriters' Laboratories

B. The application standards of the local electric utility company.

C. 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.

1.13. SUBMITTALS

A. Product Data: Include complete descriptive product data for items specified in Part 2 of this Section.

1.14. SUBMITTAL PROCEDURES

A. Refer to Division 01 Section, “Submittal Procedures”, for requirements in addition to those indicated herein.

B. 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, and/or Engineer, to be in the best interest of the Owner.

C. After acceptance of Material and Equipment List, submit six (6) copies, or more as required under the General Conditions, of complete descriptive data for all items as outlined below.

D. Electronic submittals shall be prepared as a Portable Document Format (PDF) file and shall include as page 1 the Contractor’s stamp, followed by the submittal contents. Submittal form shall identify the Project, Contractor, Subcontractor or Supplier, and pertinent Contract Document references.

E. Submittals shall consist of specifications, product data sheets, manufacturer’s catalog cuts, dimensional shop drawings, wiring diagrams, installation instructions, samples, and any other information necessary to indicate complete compliance with Contract Documents.

F. 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.

G. Identify submittals, indicating intended application, location and service of submitted items. Refer to Specification sections or paragraphs and Drawings where applicable.

H. Clearly indicate exact type, model number, style, size, operating characteristics, ratings, options and special features of proposed item specifically for application to this project. Submittals of a general nature will not be acceptable.

I. 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.

J. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior

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

K. 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.

L. 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.

M. 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.

N. Where proposals to use an item of equipment or application other than that specified or detailed on the Contract Drawings, which requires any redesign of the structure, partitions, foundation, HVAC, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign and all new drawings and detailing required thereafter shall be prepared by the Contractor at his own expense for review by the Owner's representative before any such work is implemented.

O. All Contractor-proposed changes and revisions shall be at the Contractor's risk and expense. The Contractor shall fully coordinate all revisions, substitutions and changes with other trades for a complete, code compliant, and fully functional installation.

P. 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.

Q. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct submittal. Identify all submittals by the name of the item/system and the applicable Specification Section and/or Drawing number. Grouping of items/systems that are not related shall be unacceptable.

R. Items and Systems

1. Access Doors
2. Arc Flash Hazard Labels
3. Circuit Breakers
4. Conductors and Cables - 600V or Less
5. Conduit and Raceway
6. Connectors and Splices
7. Electric Heating Cables and Controls
8. Electrical Connection Coordination Schedule
9. Emergency Off Push-Buttons
10. Enclosed Circuit Breakers
11. Enclosed Contactors
12. Enclosed Controllers
13. Enclosed Switches
14. Equipment Nameplates/Labels
15. Firestopping Materials
16. Foam Duct Sealant
17. Fuses, 600V or Less
18. Ground Busbars

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19. Ground Conductors
20. Ground Rods
21. Grout
22. Handholes
23. Hangers and Supports
24. Identification Products
25. Installation/Coordination Drawings
26. Installer Certificates
27. Junction and Pull Boxes
28. Lighting Control System
29. Lighting Fixtures, Exterior
30. Lighting Fixtures, Interior
31. Operation and Maintenance Manual
32. Outlet and Device Boxes
33. Panelboard Circuit Directories
34. Panelboards
35. Power System Studies
36. Qualification Data
37. Receptacles
38. Record Drawings
39. Retractable Cord Reels
40. Roof Penetration Boots /Curbs
41. Sleeves
42. Sleeve Seals
43. Surge Protective Devices
44. Testing Agency Qualifications
45. Test Reports
46. Toggle/Snap Switches
47. Transfer Switches
48. Transformers, 600V and Less
49. Underground Ductbank Products
50. Weatherproof Boxes and Covers
51. Wiring Diagrams

S. Submit for approval any other submittals 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.

T. 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 Engineer.

U. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.15. 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. Shop drawings shall include identification of products being installed, compliance with specified standards, notation of coordination requirements, notation of dimensions verified by field measurement, etc. Do not base shop drawings on reproductions of the Contract Documents or standard printed data.

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C. Submit shop drawings concurrent with product data. Shop drawings received without associated product data will be returned without review.

D. Submit for approval schematic diagrams of each electrical system installed in the building, including but not limited to Riser Diagrams and Schematic Wiring Diagrams for the following systems:

1. Emergency Power Supply System – Generator and Transfer Switch(es)
2. Lighting Control System

E. Shop Drawing diagrams shall indicate device location, service, type, make, model number and the identification number of each device in the particular system. Following approval by all authorities, the diagrams shall be inserted into the O&M Manual specified herein.

F. 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.

G. 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.

H. Refer to individual Specification Sections and Contract Drawings for additional shop drawing requirements.

I. For resubmissions, the Contractor must address in writing all of the Engineer’s comments on the original submission to verify compliance.

1.16. 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. Child Care Facility: A building or structure, or portion thereof for educational, supervisory, or personal services for more than four children seven years old or younger.

D. Concealed: Hidden from sight in chases, formed spaces, shafts, hung ceilings, or embedded in construction, or in crawl space.

E. Conduits: Include conduit, all fittings, identification, and other accessories relative to such conduit.

F. Contractor: The Electrical Contractor and any of his subcontractors, vendors, suppliers, or fabricators.

G. EPDM: Ethylene-propylene-diene terpolymer rubber

H. Exposed: Not installed underground or concealed as defined above.

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.

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J. Furnish and install or Provide: To supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

K. 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…

L. 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.

M. 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.

N. NBR: Acrylonitrile-butadiene rubber.

O. 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.

1.17. 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.

1.18. 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 (2) 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.

1.19. OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare six (6) hard copies and electronic copies of the Operation and

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Maintenance Manual and shall deliver these copies of the manual to the Owner. Provide one (1) electronic copy for each hard copy set of the O&M manual.

B. The manual shall be as specified herein. The manual must be approved and will not be accepted as final until so stamped.

C. Hard copies of the manual shall be bound in three-ring loose-leaf binders similar to National No. 3881 with the following title lettered on the front and spine of the binder: *Operation and Maintenance Manual – Sussex Technical School District – New Sussex Technical High School – Bid Pack C - Electrical*.

1. Provide divider tabs and table of contents for organizing and separating information. Tab titling shall be clearly printed under reinforced plastic tabs.
2. If more than one (1) binder is required, volume numbers shall be included on front and spine of each volume.
3. 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.

D. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of volume 1 (if applicable) of hard copies of the manual.

E. 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. Directory listing names, addresses, e-mail addresses, and telephone numbers for Architect, Engineer, Construction Manager, Contractor, Sub-contractor(s), equipment suppliers, sales and authorized service representatives.
3. Maintenance operation and lubrication instructions on each piece of equipment furnished.
4. Complete catalog data on each piece of electrical equipment furnished including approved Shop Drawing/Submittal with Engineer's Comments (if any).
5. Manufacturer's extended limited warranties on equipment.
6. Catalog data of all equipment, starters, etc. shall include wiring diagrams, parts list and assembly drawing(s).
7. Access panel charts with index illustrating the location and purpose of access panels.
8. Approved Electrical Certificates, including certificate of approval from electrical inspector.
9. List of extra materials turned over to Owner, with transmittal/receipt signed by Owner.
10. Sign-in sheets from demonstration and training sessions.
11. Start-up and test reports for equipment.

F. Additional items identified within other Sections of these Specifications.

G. Submit Operation and Maintenance Manual prior to the anticipated date of Substantial Completion for Engineer review and approval. Substantial Completion requires that Operation and Maintenance Manuals be reviewed and approved.

1.20. INSTRUCTION

A. Upon completion of all work, thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electrical equipment and systems.

B. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance.

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C. 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.

D. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one (1) 8-hour day.

E. Where specified in technical sections, provide longer periods required for specialized equipment.

F. The Operation and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

G. Deliver all instruction materials to the Owner prior to the formal instruction period.

H. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer.

I. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.21. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record demonstration and training video recordings. Record each training module separately.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Owner.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

1.22. INSTALLATION AND COORDINATION DRAWINGS

A. Prepare and submit scaled composite installation and coordination drawings indicating dimensions, clearances, and actual equipment dimensions to ensure proper coordination and installation of the work.

B. Indicate the proposed locations of power, lighting, and all special system equipment, raceways, and materials. Include the following at a minimum:

1. Mechanical Rooms indicating transformers, panelboards, enclosures, boxes, conduits, mechanical equipment, ductwork, and piping, etc.
2. Electrical Rooms indicating switchboards, panelboards, enclosures, boxes, transformers, conduits, wireways, etc.
3. Utility yards including transformers, generators, mechanical equipment, etc.
4. Working space and dedicated space clearances per the NEC.

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5. Clearances for equipment disassembly required for periodic maintenance.
6. Sizes and locations of required concrete bases.
7. Equipment support details.
8. Underground ducts and raceways.
9. Feeder conduits, junction/pull boxes, etc., including weight per linear foot for feeder conduits supported from structure.
10. Exterior wall and foundation penetrations.
11. Fire-rated wall and floor penetrations.
12. Roof penetrations.

C. Draw plans to a scale not less than ¼ inch equals one foot. Include plans, sections and elevations of the proposed work, showing all equipment (mechanical, plumbing and electrical), conduit and wiring in the areas involved. Fully dimension all work, horizontally and vertically. Show coordination with other work including piping, ductwork and other mechanical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

D. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

E. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction, including but not limited to:

1. Distribution Panelboards.
2. Transfer switches.
3. Transformers.

F. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work.

G. Identify all equipment and devices on wiring diagrams. Where field connections are shown to factory-wired terminals, furnish manufacturer's literature showing internal wiring of equipment.

H. The successful Bidder shall be responsible for indicating all raceways described in notes or indicated by home run symbols.

I. The complete set of Architectural, Civil, Structural, Technology, Mechanical, and Electrical Drawings and Specifications apply to this work. The successful bidder shall familiarize himself with all other related documents to avoid possible demolition and installation conflicts.

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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. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. 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, Non-Shrink Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, 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 ten sile 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).

2.4. BACKBOARDS

A. Backboards: Plywood, A/C grade, fire-retardant treated, ¾” x 48” x 96” (19 x 1220 x2440 mm) with no added urea formaldehyde.

B. Install each fire-retardant-treated plywood backboard six inches off the floor to bottom. Secure backboards with a minimum of eight (8) screws. Plywood backboards shall have one side with exterior glue and one finished smooth side. Mark all backboards and cabinets with appropriate legends (e.g., "COMM").

C. Verify with local codes or AHJ prior to painting fire-retardant-treated plywood backboard with stamped fire rating labels. If allowed by code, paint fire-retardant-treated plywood backboard with coats of durable white enamel (or other finish color as selected by the Architect).

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2.5. PROTECTIVE WIRE GUARDS/SHIELDS

A. Provide protective guards over devices subject to physical damage. All devices installed in mechanical and electrical rooms shall be provided with protective guards. Protective guards shall be manufacturer's recommended product for the device being protected or a suitable guard as manufactured by American Time & Signal Company (800-328-8996), Safety Technology International (STI) (800-888-4784), or Institutional Systems Services Corporation (800-524-0537).

B. Devices to be provided with protective guards include, but are not limited to, the following:

1. Lighting Fixtures
2. Fire Alarm Pull Stations
3. Thermostats
4. Smoke/Heat Detectors
5. Speakers
6. Fire Alarm Audio/Visual Devices (Horns, Strobes, etc…)
7. Exit Signs
8. Emergency Lighting Units
9. Security Devices/Motion Detectors
10. Wiring Devices
11. Emergency Shut-Off Stations
12. Other Devices as required by Owner

C. Wireguards shall be fabricated from ¼-inch (9-gauge) cold-rolled steel rods, welded together with mounting tabs. Wireguards shall be finished with a powder-based epoxy to protect against corrosion. Finish color shall match the finishes for the area being installed, except guards for fire alarm devices shall be red finish color.

D. Indoor Protective Shield: Factory-fabricated, clear thermoplastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

E. Protective guards/shields shall be considered incidental to the product installed in an area subject to damage as indicated on the drawings and shall be provided at no additional cost to the Owner.

2.6. SPARE KEY CABINET

A. Description: Wall-mounted, locking utility cabinet(s) with key hooks for spare keys provided with electrical equipment.

B. Construction: 16 or 14 gauge steel, ANSI 61 gray polyester powder paint finish inside and out.

C. Features:

1. Four mounting keyholes in back of enclosure
2. Removable door with reversible hinge; door can hinge from either left or right side and can be changed without tools
3. Door has quarter-turn key lock; two keys included
4. Retractable spring hinge
5. Integral key hooks in door and back of enclosure

D. Dimensions: Cabinet(s) shall be of proper size for orderly storage of spare keys stored in the same, plus space for 15 percent spare capacity. Cabinet(s) shall be no smaller than 12”H x 12”W x 2”D.

E. Identification: Provide engraved nameplate to read “SPARE KEYS” in 1/2" high lettering on front

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door of cabinet(s). Refer to Division 26 Section, “Electrical Identification” for nameplate requirements.

F. Installation: Provide one (1) locking key cabinet in the main electrical room. Cabinet(s) shall be mounted 5’-6” to top unless otherwise noted on the Contract Drawings.

G. Basis of Design: Provide key hook style locking utility cabinet as manufactured by Hoffman/Pentair, or approved equal.

PART 3 EXECUTION

3.1. 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. Where any abandoned conduits in existing floors, walls, [pipe tunnels,] ceilings, etc., conflict with new work, remove abandoned conduits as necessary to accommodate new work.

E. 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.

F. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the Authority(ies) Having Jurisdiction (AHJ).

G. Make provisions and include in bid all costs associated with confined entry/space requirements in all applicable OSHA regulations.

H. Where required to maintain the existing systems in operation, temporarily back-feed existing systems from new equipment. Contractor shall temporarily extend existing conduit systems to new conduit systems.

I. At completion of project all temporary conduit, wires, etc., shall be removed in their entirety.

J. Existing conduit, equipment, wiring, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

K. 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.

L. 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.

M. 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

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existing construction.

N. Where required, provide and coordinate removal and re-installation of existing equipment. Take care to protect materials and equipment indicated for reuse. Contractor shall repair or replace items which are damaged. Contractor shall have Owner's representative present to confirm condition of equipment prior to demolition.

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 conduit 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.

3.2. 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 Structural Engineer.

3.3. TEMPORARY FACILITIES

A. General: Refer to the Division 01 Sections for general requirements of temporary facilities.

B. Description: Furnish and install the necessary metering and distribution equipment for an adequate, 3-phase, 4-wire temporary electrical service and all temporary wiring, including step-down or step-up dry-type transformers as required. Exact requirements for temporary service shall be determined by the construction manager and successful bidder.

C. Attention is directed to the Occupational Safety and Health Act (OSHA), Americans with Disabilities Act (ADA) and National Electrical Code (NEC) requirements for electrical work on construction sites.

D. Materials:

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1. Lights at each floor in each stair. At least one light outlet per 900square feet on each floor exclusive of stairs.
2. One 20-ampere circuit with ground fault protection for each 7500 square feet of gross floor area per floor to which various trades may attach their cords.
3. One temporary power line in each corridor including connections to saws, if required, with ground fault protection.
4. Power for testing and operating of elevators.
5. Power for crane operation if required.

E. Installation: Temporary lighting shall provide minimum foot candle levels for construction as follows:

AREA	FOOT CANDLE LEVEL
General construction area lighting, corridors, hallways and exit ways.	5
Electrical equipment rooms, active storerooms, shops, locker and dressing areas	10

F. The Owner shall pay for all energy charges for temporary service.

G. Obtain and pay for temporary electrical service for construction power.

H. Provide all underground and/or overhead equipment, transformers, overcurrent devices, wires, connections, etc., for obtaining power from utility company lines.

I. Remove all temporary power installations and connections after permanent power is established and/or prior to completion of the project.

3.4. OUTAGES

A. 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.

B. Provide a minimum of seven (7) 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.

C. Submit Outage Request Form, attached at the end of this Section, to Owner for approval.

3.5. PHASING

A. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities Having Jurisdiction (AHJ).

B. Provide dust barriers/partitions, penetration closures, etc. to ensure safety of building occupants and protection of existing surroundings.

C. The building shall remain watertight at all times.

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3.6. 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-mounted 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 NEC Article 110.

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 requirements for each piece of equipment receiving one or more electrical connections, including but not limited to voltage, phase, and maximum fuse/overcurrent protection device rating. Provide electrical circuit of proper characteristics to serve provided equipment.

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. Make all connections to equipment in accordance with manufacturer's instructions.

J. Right of Way: Give to piping systems installed at a required slope.

K. Coordinate electrical work under other Divisions in accordance with Part 1 of this Section, Article "Electrical Work Under Other Divisions".

3.7. 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 NEC Article 110.26.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in this Section.

D. Coordinate sleeve selection and application with selection and application of firestopping specified

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in Division 26 Section 260528, "Firestopping for Electrical Systems".

3.8. EXCAVATION AND BACKFILLING

A. General:

1. Perform all necessary excavation, or installation of work under Division 26, in whatever materials or conditions encountered, using suitable methods and equipment.
2. Accurately establish required lines and grades and properly locate the work.
3. Determine the locations of all existing utilities before commencing the work.

B. Excavation:

1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, OSHA, and other applicable Guidelines.
3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling:

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

3.9. WALL AND FLOOR PENETRATIONS

A. All penetrations of partitions, ceilings, roofs and floors under Division 26 shall be sleeved, sealed, and caulked as specified herein.

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 260528, “Firestopping for Electrical Systems”.

C. Where penetrating through exterior walls below grade, provide waterproof sleeve seals, as specified in Part 2 of this Section.

D. Provide conduit escutcheons for all exposed conduit penetrations in finished interior spaces and all exposed exterior penetrations.

E. Conduit 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.

3.10. PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior

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walls, and interior waterproof construction. Where such penetrations are necessary, furnish and install all necessary curbs, flashings, fittings, sleeves, and caulking to make penetrations absolutely watertight.

B. Where conduits 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 curbs and 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.

3.11. 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. Sleeves installed in floors shall extend 2 inches (50 mm) above finished floor level unless otherwise indicated on the Contract Drawings.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

I. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements of Division 07 Section, "Joint Sealants".

K. 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 260258, “Firestopping for Electrical Systems”.

L. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and joint sealant/grout.

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N. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals. Seal interior of each raceway with Foam Duct Sealant as specified herein.

3.12. 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 260528, "Firestopping for Electrical Systems".

3.13. HANGERS AND SUPPORTS

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.

C. Refer to Division 26 Section 260529, “Hangers and Supports for Electrical Systems”, for additional requirements.

3.14. CONCRETE AND MASONRY WORK

A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 26.

B. Perform work in accordance with requirements of Division 03 and other applicable Divisions of these Specifications.

C. Concrete shall achieve compressive strength not less than 3,000 psi after 28 days unless otherwise indicated on the Contract Drawings or manufacturer’s shop drawings.

D. Grout shall be non-shrink, high strength mortar, free of iron of 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.

E. Installing Equipment Foundations (Housekeeping Pads):

1. Provide four (4) inch high concrete foundations (housekeeping pads) for all interior pad-mounted equipment, extending a minimum of 6 inches beyond equipment bases, unless otherwise noted.
2. Provide six (6) inch high concrete foundations (housekeeping pads) for all exterior pad-mounted equipment, extending a minimum of 12 inches beyond equipment bases, unless otherwise noted.
3. Furnish foundations, bolts, sleeves, and appurtenances and set under the section furnishing the equipment. Anchor the concrete foundations by dowels inserted into the floor slab. Provide welded wire fabric reinforcement, chamfer exposed edges and corners, and finish exposed surfaces smooth.
4. Unless otherwise specified, provide all concrete work required in accordance with the requirements of Division 03.
5. Equipment shall be properly aligned. Level and grout equipment where necessary.

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Support conduit independently of equipment and so as not to cause a strain or thrust.

6. Determine exact location of all equipment, foundations, and supports after Shop Drawings of equipment have been approved.

F. Where new concrete housekeeping pads are placed on existing concrete, saw cut the existing concrete to the perimeter dimension of the new pad to a depth of ½ inch. Break out the top ½ inch area of the existing concrete. Add stubs of #4 rebar angled into the existing concrete at a depth of approximately 50 percent of the existing slab thickness. The top portion of the rebar stub shall extend into the new pad by approximately 50 percent of its thickness. Furnish one rebar stub per every two square feet of new pad. Chemically bond the new concrete to the existing concrete.

G. Place reinforcement accurately in position shown, securely fasten and support to prevent displacement before or during pouring. Clean, bend, place, and splice reinforcement in accordance with approved shop drawings. Lap ends and sides of mesh reinforcement in slabs not less than one inch. Coverage of main reinforcing shall be as follows:

1. Slabs - 3/4 inch
2. Concrete poured against earth - 3 inches
3. Other locations - 2 inches

H. Properly align, level, and grout all equipment where necessary.

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. 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.

3.17. PROVISIONS FOR ACCESS

A. The Contractor shall provide access panels and doors for all concealed equipment, and other devices

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requiring maintenance, service, adjustment 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. 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 lift-out 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. 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.

F. Provide sufficient access and working space for repair and maintenance about all lighting and electrical equipment to permit ready and safe operation and maintenance of such equipment in accordance with OSHA 29 CFR 1910 Subpart D and 1910.303(g).

3.18. 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, conduit, boxes, 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 Architect, unless otherwise indicated by the Owner.

H. All exposed conduit, boxes, equipment, etc. shall be painted. Colors shall be as selected by the

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Architect and conform to ANSI Standards.

I. Do not paint panelboard fronts, switchboards, transformers, motor controllers, safety switches, grounding busbars, equipment nameplates, warning labels, etc.

3.19. COLOR SELECTION

A. Color of finishes shall be as selected by the Architect.

3.20. 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.

3.21. 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. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items.

3.22. 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.

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E. Submit all test results to the Architect for approval.

END OF SECTION

NOT FOR BIDDING

OUTAGE REQUEST FORM

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)

PART 1 (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:** _____

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER 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. Product Data: Provide for each cable assembly type, wire, cables, conductors, and connectors.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Indicate procedures and values obtained.

C. Project Record Documents: Record actual locations of components and circuits.

1.4. QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to requirements specified in Division 01 Section, "Quality Control", an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full member company of the International Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on site testing specified in Part 3 of this Section.

B. 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.

C. Comply with NEMA/Insulated Cable Engineers Association (ICEA) Standards.

D. Comply with NECA Standard of Installation.

E. Comply with NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. 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

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3. D753: Standard Specification for General Purpose Polychloroprene Jacket for Wire and Cable

G. Electrical Testing Laboratories (ETL): Provide wiring, cabling and connector products which are ETL listed and labeled.

H. 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

I. NFPA: Comply with NFPA 70 requirements for construction, installation and color coding of electrical wire, cable and connections.

J. National Electrical Manufacturer's Association (NEMA): Comply with requirements of the following:

1. WC70: Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

K. 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

L. 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, Binational Wire and Cable Packaging Standard.

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 Engineer and 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. Feeder conductor sizes are based on copper as indicated on the "Feeder Schedule" on the Contract Drawings.

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C. Branch circuit conductor sizes are based on copper.

D. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

E. 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.
b. BICC Brand Rex Company.
c. CME Wire and Cable.
d. Colonial Wire Company.
e. Encore Wire Corporation.
f. General Cable.
g. Senator Wire & Cable Company.
h. Southwire Company.

2. Connectors and Accessories for Wires and Cables:

a. 3M Company; Electrical Products Division.
b. AMP Incorporated.
c. Buchanan.
d. General Signal; O Z/Gedney Unit.
e. Greaves Corporation.
f. Ideal Industries.
g. Monogram Company; AFC.
h. NSI Industries, Inc.
i. Square D Company; Anderson.

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.

4. Metal Clad (MC) Connectors

a. Arlington Industries, Inc.

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b. Bridgeport.
c. Crouse-Hinds.
d. Thomas & Betts.

2.2. GENERAL CONDUCTOR REQUIREMENTS

A. UL-listed building wires and cables with conductor material, insulation type, cable construction and rating as specified herein.

B. 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.

C. Conductor Insulation:

1. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.

D. Conductors shall be minimum of 12 AWG, unless otherwise required by equipment manufacturer.

E. Conductors shall be solid for 10 AWG and smaller, and stranded for 8 AWG and larger, unless otherwise indicated herein or on the Contract Drawings.

F. Conductors shall be stranded for connections to the following equipment:

1. Motors (including fans, pumps, etc.)
2. Site lighting fixtures (pole-mounted)
3. Surge protective devices
4. Transformers
5. Variable frequency controllers

G. 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:

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

3. 120/240-Volt, 1-Phase, 3-Wire System:

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a. Phase A: Black
b. Phase B: Red
c. Neutral: White
d. Ground: Green

2.3. COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors. 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.

2.4. ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

2.5. 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: Not acceptable.

E. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic high conductivity

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copper tubing, internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

G. 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.

H. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer's tolerances.

I. Wire Nut Connectors:

1. Description: Twist-on wire connectors for branch circuit conductors 10 AWG and smaller with a color-coded housing.
2. Construction: Flame-retardant polypropylene housing, rated for 105 degrees Celsius. Zinc-plated steel insert. Square-wire spring to maintain secure positive grip that will not relax over time, no pre-twisting required.
3. Dimensions: Connectors shall be appropriately sized according to manufacturer’s recommendation for the suitable wire sizes and voltage rating (600 volts minimum).
4. Quality Assurance:
   a. UL Listed to 486C and 94V-2 Flame Rating.
   b. CSA Certified to C22.2 No. 188
   c. RoHS Compliant
5. Special Features:
   a. Wire connectors for making grounding connections shall have green-colored housing and shall have opening at end of connector for grounding conductor to pass through for connection to metallic outlet boxes.
   b. Wire connectors for all exterior and underground work and work in damp/wet interior locations shall be pre-filled with silicone-based sealant to protect against moisture and corrosion, and shall be UL Listed to 486D for use in damp/wet locations, including direct burial applications.
   c. Wire connectors for high temperature applications, e.g. high-wattage lighting fixtures and signs, shall be UL listed to 150 degrees Celsius, and shall have a black fire-retardant plastic shell design to withstand heat build-up.
6. Basis of Design: Provide products by Ideal Industries, Inc. or approved equal.

J. Gel Tap Splices (for Conductors 10 AWG and Smaller in Damp/Wet Locations)

1. Description: Gel sealant filled splice for buried, underground, and overhead applications for low voltage (1000V or less) circuits. Protects connections from moisture ingress, corrosion, and pollution.
2. Construction: Range-taking mechanical connector made of aluminum accepts both aluminum and copper conductors. Molded cover of UV stable, impact resistant polypropylene provides rugged protection. Silicone gel is hydrophobic dielectric insulation and provides constant pressure on cable and connector to provide water seal. Seal is specially formulated for high temperature environments.
3. Dimensions: Splices and connectors shall be appropriately sized according to manufacturer’s recommendation for the suitable wire sizes and voltage rating.
4. Quality Assurance: UL listed.
5. Special Features: Silicone gel shall easily peel away from connector, leaving a clean

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connection. Splices shall be rated for temperatures from -40 degrees Celsius to 90 degrees Celsius.

6. Basis of Design: GTAP Series as manufactured by Raychem/Tyco, or approved equal.

K. Insulated Connectors (for Conductors 8 AWG and Larger in Dry Locations)

1. Description: Multi-conductor connectors for low voltage (600V or less) circuits, insulated with high-dielectric strength plastisol, molded for precise fit and supplied with removable access plugs over the hex screws.
2. Construction: Range-taking mechanical connector made of aluminum accepts both aluminum and copper conductors. Molded cover of UV stable, impact resistant polypropylene provides rugged protection. Mounting holes at each end of the connector for direct isolated mounting to wiring trough, panelboard, or wireway.
3. Dimensions: Splices and connectors shall be appropriately sized according to manufacturer's recommendation for the suitable wire sizes, quantities, and voltage rating.
4. Quality Assurance: UL listed. UV resistant.
5. Special Features: Connectors shall be rated for temperatures from -45 degrees Celsius to 90 degrees Celsius.
6. Basis of Design: IPLM/IPLMD Series as manufactured by Polaris, or approved equal.

L. Gel Filled Insulated Connectors (for Conductors 8 AWG and Larger in Damp/Wet Locations)

1. Description: Multi-conductor connectors for low voltage (1,000V or less) circuits, insulated with high-dielectric strength plastisol, molded for precise fit and supplied with removable access plugs over the hex screws. Gel-filled for damp/wet or submersed locations to protect connections from moisture ingress and corrosion.
2. Construction: Range-taking mechanical connector made of tin-plated aluminum accepts both aluminum and copper conductors. Molded cover of UV stable, impact resistant polypropylene provides rugged protection. Cable entry ports and hinged screw port caps shall be sealed with hydrophobic dielectric gel insulation.
3. Dimensions: Splices and connectors shall be appropriately sized according to manufacturer's recommendation for the suitable wire sizes, quantities, and voltage rating.
4. Quality Assurance: ANSI C119.1 for complete unit, ANSI C119.4 for connector, ASTM D543 for chemical resistance, ASTM G-53-95 and ASTM D-638-95 for UV resistance.
5. Special Features: Silicone gel shall be easily removed from conductor for re-entry. Connectors shall be rated for temperatures from -40 degrees Celsius to 95 degrees Celsius.
6. Basis of Design: GPRT Series as manufactured by Raychem/Tyco, or approved equal.

2.6. METAL CLAD (MC) CABLE

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 copper grounding conductor. Conductors shall be cabled together with a binder tape bearing a print legend that is wrapped around the assembly. An interlocked armor shall be applied over the assembly. Conductors shall be protected by an anti-short bushing at each termination.

C. Cable serving lighting fixtures and/or lighting control devices with 0-10V dimming controls shall have 16 AWG copper TFN insulated single conductors within interlocked armor. Control conductors shall have purple and pink insulation/jacketing.

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D. Only cables with conductor sizes 12 AWG and 10 AWG shall be permitted.

E. Multi-circuit MC cable is not permitted.

2.7. METAL CLAD (MC) CABLE CONNECTORS

A. Snap-In Connectors

1. Snap-in connectors for metal clad cable shall be constructed of die-cast zinc, shall be compatible with steel and aluminum cables, and shall have the following features:

a. Insulated throat
b. Removable ring to secure connector to box
c. Angled, two-prong clip to secure cable
d. Removable screw to secure cable clip

2. Snap-in connectors shall be available in a variety of sizes and configurations to accommodate different cable sizes/diameters, wire counts, cable counts, etc.
3. Single connectors shall be compatible with 1/2-inch knockouts. Duplex connectors shall be compatible with 3/4-inch knockouts.
4. Provide SNAP^{2}IT connectors as manufactured by Arlington Industries, Inc., or approved equal by listed manufacturer.

B. Lock-Nut Connectors

1. Straight connectors shall be one-piece spring-steel, set screw design with nylon insulator and locknut. Provide ACB series, as manufactured by Crouse-Hinds, or approved equal.
2. 45 and 90 degree connectors shall be die cast zinc, clamp type with insulated throat and locknut. Provide ACBXX45 or ACBXX90 series as manufactured by Crouse-Hinds, or approved equal.

2.8. 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.

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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 or required by the equipment manufacturer.

B. Conductors 8 AWG and larger shall be stranded. Conductors 10 AWG and smaller shall be solid except as indicated in Part 2 of this Section.

C. All conductors shall be of the size indicated unless otherwise required by the National Electrical Code and/or the equipment manufacturer. Any discrepancies shall be brought to the attention of the Architect/Engineer.

D. Control wiring shall not be less than 14 AWG and shall be color coded using colors impregnated into the insulation. All control wiring shall be color coded with wires of colors different from those used to designate phase wires.

E. 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.

F. All circuits for underground exterior electric work shall be 10 AWG (minimum) and contain a 10 AWG (minimum) copper grounding conductor. All exterior wiring shall be installed in conduit as specified above, unless otherwise noted on the Drawings.

G. 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.

H. Wiring shall be tagged at terminations, in pull boxes, junction boxes, outlet boxes, panelboards, etc.

I. All emergency wiring shall have the same color coding but shall clearly be identified as emergency in all outlets, fixtures, etc.

J. Switch leg wire shall be labeled with “S” tag.

K. Wiring for general 15 and 20 amp branch circuit work shall be as follows unless otherwise indicated:

HOME RUN LENGTH AND WIRE SIZE				CIRCUIT LENGTH AND WIRE SIZE			
120 Volt		277 Volt		120 Volt		277 Volt	
0 – 60 '	12AWG	0 – 175 '	12AWG	0-100 '	12AWG	0 – 200 '	12AWG
60 – 100 '	10AWG	175 - 350'	10AWG	100’ & Up	10AWG	200 ' & Up	10AWG
100' & Up	8AWG	350> & Up	8AWG				

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L. Circuit length as given above shall be the wire length between the first and last outlet on the circuit. Home run length as given above shall be the wire length between the first outlet and the panelboard. In accordance with the above, where the size of branch circuit conductors is increased by the minimum required by the NEC for the branch circuit rating, ensure that the termination provisions of all equipment connected to such circuits are listed as suitable for the conductor sizes involved.

M. 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.

N. Joints of 8 AWG and larger 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.

3.4. MC CABLE APPLICATIONS

A. MC cable shall be permitted only where concealed above accessible ceilings and/or within drywall partitions and in accordance with the requirements of Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”.

B. MC Cable shall be allowed for connections within a room from a junction box to lighting fixtures.

C. Conduit home runs shall be in electrical metallic tubing (EMT).

D. MC cable shall be allowed from a junction box within a room to receptacles in the same room.

E. MC cable shall not be allowed to cross one room to another room whether the wall between two rooms goes up to slab or not. If the rooms are identified as two separate rooms, MC cable shall not be used between the two rooms.

F. MC cable shall not be used between two receptacles when they are in two separate rooms, on the same wall.

G. Provide anti-short bushings for all MC cable terminations.

H. Cables shall be supported with appropriate hangers; tie wire is not acceptable.

I. MC cable shall not be used to support other cables/wires.

3.5. 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

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follow surface contours where possible.

F. Support cables according to Division 26 Section 260500, “Common Work Results for Electrical” and Division 26 Section 265029, “Hangers and Supports for Electrical Systems”.

G. Seal around cables penetrating fire rated elements according to Division 26 Section 260528, “Firestopping for Electrical Systems”.

H. Identify wires and cables according to Division 26 Section 260553, “Identification for Electrical Systems”.

I. Conductors installed in parallel shall be of equal lengths.

J. Wiring at Outlets: Install with at least 6 inches (150 mm) of slack conductor at each outlet in accordance with Article 300.14 of the National Electrical Code.

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 wire shall be labeled at both ends. Labels shall be self-sticking wire markers.

N. For rubber and plastic-covered wire and cable, pulling compound Ideal Yellow 77 may be used.

O. 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 wires 4/0 AWG and smaller. Two-hole lugs for all wires 250 kcmil AWG and larger.

P. Install wires and cables using braided rope larger than the cable being pulled to keep twists to a minimum.

Q. Provide an insulated green equipment grounding conductor (EGC), sized per NEC, for all feeder and branch circuits, shown or not shown.

R. Multi-wire branch circuits shall not be permitted. Provide a separate insulated neutral (grounded) conductor for all feeder and branch circuits requiring a neutral connection.

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.

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U. Conductors installed in runs within 6 inches of heating pipes or equipment shall be of types required by the NEC and shall be listed for the application.

V. No conductors shall be drawn into conduit until all work, which may cause cable damage, is completed.

W. All wiring in lighting fixture channels, over boilers, in Kitchen hoods, and in other high ambient temperature areas, shall be of types required by NEC and shall be listed for the application.

X. 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.

Y. All cable runs shall contain S loops or other means to accommodate expansion or contraction as required.

Z. Cable bends will have a radius not less than the value recommended by the cable manufacturer.

AA. All labels shall be of durable material and securely fastened to the cable.

BB. Wiring of different system voltages shall not be mixed at pull boxes enclosures, surface metal raceway, wire troughs, etc., unless a barrier (separator) is provided between the differing systems.

3.6. 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. 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.

H. 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.

I. For splices in branch circuits and feeders, provide connectors as follows:

1. Wire Sizes 10 AWG and smaller: Provide wire nut connectors as specified in Part 2 of this Section.
2. Wire Sizes 8 AWG and Larger: Provide insulated connectors as specified in Part 2 of this Section.

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J. Thoroughly clean wiring prior to installing lugs or connectors.

3.7. IDENTIFICATION

A. All building wire and cable shall be color-coded to identify the electrical system(s) as specified. Where color-coding is field-applied, the same shall be accomplished with colored electrical tape wrapped concentrically around each conductor in half-lapped turns, for at least the last six (6) inches of the conductor. One turn around the conductor is not acceptable.

B. Identify wire and cable using Thomas and Betts Type WM vinyl markers.

C. 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.

D. Provide identification tags on each conductor entering each panelboard, switch, junction box, and pull box to identify conductor.

E. Comply with the requirements of Division 26 Section 260553, "Identification for Electrical Systems".

F. 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.

3.8. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect for defects and physical damage, labeling, and compliance with requirements of drawings and schedules.
2. Clean conductors using Manufacturer's approved methods and materials.
3. Verify that conductors are correct size and are terminated with appropriately sized lugs.
4. Verify that conductors are correct color for phase identification.
5. Verify that conductors are labeled to identify circuit designation.
6. Verify that neutral conductors are only terminated at neutral lugs/bus, and that grounding conductors are only terminated at grounding lugs/bus.

B. Electrical Tests: Upon installation of conductors and before electrical circuitry has been energized, provide the following minimum inspections and tests according to manufacturer's written instructions to ensure conductors are operational within industry and manufacturer's tolerances, are installed according to the Contract Documents, and are suitable for energizing.

1. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in the original Contract Documents.
2. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration.
3. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
4. Verify continuity of each conductor.
5. Insulation Resistance Testing: Perform megohm meter tests of all service and feeder

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circuits, including each phase, neutral, and grounding conductor, as follows:

a. Minimum Test Voltage: 1000 Vdc.
b. Minimum Insulation Resistance: 1 megohms.
c. Duration of Each Test: 1 minute.
d. Temperature Correction: Correct results for test temperature deviation from 20 degrees C standard.
e. Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.
f. Prepare reports certified by testing agency identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

6. Infrared Scanning: Perform an infrared scan of each splice and termination in conductors 3 AWG and larger, as follows:

a. Remove equipment covers so terminations are accessible to scanner.
b. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.
c. Provide calibration record for device.
d. Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.
e. Prepare reports [certified by testing agency] identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

7. Test Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

END OF SECTION

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SECTION 260520 - ELECTRIC HEATING 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 heating cables for the following applications:

1. Heat tracing for freeze protection.

1.3. DEFINITIONS

A. AWG: American Wire Gauge.

B. C: Celsius.

C. F: Fahrenheit.

1.4. SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer installed and field installed wiring.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Maintenance Data: For electric heating cables to include in maintenance manuals specified in Division 01.

E. Warranties: Special warranties specified in this Section.

1.5. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6. COORDINATION

A. Coordinate layout and installation of electric heating cables and system components with other construction.

1. Coordinate with Food Service Equipment installer for piping installed under Division 11.
2. Coordinate with piping installer, for condensate piping provided under Division 23.

1.7. WARRANTY

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A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of electric heating cables that fail in materials or workmanship within specified warranty period.

C. Warranty Period: Two years from date of Substantial Completion.

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. Accutron Heat Tracing Systems.
2. Ari Industries.
3. BICC Pyrotenax USA Inc.
4. Caloric, Inc.
5. Chromalox; Wiegard Industrial Division; Emerson Electric Company.
6. Copperheat Inc.
7. Delta Therm Corp.
8. Easy Heat, Inc.
9. INDEECO.
10. Maxxon Corp.; Infloor Heating Systems Div.
11. Nelson Heat Tracing Systems.
12. Omega Engineering Inc.
13. Raychem Corporation.
14. Thermon Manufacturing Co.

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2.2. HEATING CABLES

A. The self-regulating heater shall consist of two (2) 16 AWG nickel coated-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heater to be crossed over itself without overheating, to be used directly on plastic pipe, and to be cut to length in the field. The heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket.

B. In order to provide energy conservation and to prevent overheating, the heater shall have a self-regulating factor of at least 90 percent. The self-regulation factor is defined as the percentage reduction, without thermostatic control, of the heater output going from 40 degrees F pipe temperature operation to 150 degrees F pipe temperature operation.

C. The heater shall operate on line voltages of 120 volts without the use of transformers.

D. The heater shall be sized according to this table. The required heater output rating is in watts per foot at 50 degrees F.

Pipe Size	**Watts per foot**
3 inch or less	5 watt

4 inch	5 watt
6 inch	8 watt
8 inch to 10 inch	2 strips - 5 watt
12 inch to 14 inch	2 strips - 8 watt

E. Power connection, end seal, splice and tee kit components shall be applied in the field.

F. The system shall be controlled by a thermostat set at 40 degrees F either directly or through an appropriate contactor.

2.3. HEATING CABLE CONROLLER - ELECTRONIC

A. Heat trace cables providing freeze protection for water piping shall be controlled by an electronic outdoor thermostat.

B. Outdoor thermostat shall utilize stainless steel sensor with 25 foot lead to sense pipe temperature, and shall have adjustable temperature range from 30 to 110 degrees Fahrenheit (-1 to 43 degrees Celsius).

C. Thermostat switch shall be rated at 120VAC, 30 amperes.

D. Thermostat shall have LED indicators for alarm, power, and heating cable status.

E. Provide Raychem Digitrace EC-TS electronic thermostat, or approved equal by listed manufacturer.

2.4. HEATING CABLE CONTROLLER – ELECTRONIC WITH GROUND FAULT PROTECTION AND BMS GATEWAY

A. Description: Heat trace cables providing freeze protection for water piping shall be controlled by an electronic outdoor controller with integrated 30-mA ground fault protection and a multi-protocol gateway for communication with Modbus and/or BACnet building management systems to allow the building management system to remotely configure, control, and monitor the heating cable circuit(s).

B. Electronic heat trace controllers shall have the following features:

1. Modbus RTU/RS-485 communication module.
2. BACnet MSTP multi-protocol gateway.
3. Six character alphanumeric display.
4. -40 degrees Fahrenheit to 140 degrees Fahrenheit (-40 degrees Celsius to 60 degrees Celsius) operation.
5. Single or dual temperature sensor inputs to allow selection of one or eight control modes and programming of all temperature parameters.
6. High and low temperature alarms.
7. High temperature cut-out.
8. Low current alarms.
9. 30A rated electromechanical relay (EMR) output switch with device failure alarm.
10. Ground fault alarm and trip.
11. Proportional ambient sensing control to maximize energy efficiency.
12. Minimum/Maximum temperature tracking

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13. Auto-cycling to momentarily energize the circuit during periods of non-use to detect issues with the heat tracing circuit.

C. Provide Raychem Digitrace C910-485 heat trace controller with Raychem ProtoNode Gateway, or approved equal by listed manufacturer.

2.5. ACCESSORIES

A. Cable Installation Accessories: Tapes, cable ties, warning labels, end seals and splices, and installation clips.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine surfaces and substrates to receive heating cables for compliance with requirements for installation, tolerances, and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
2. Ensure pipe testing is complete.
3. Ensure surfaces and substrates are level and plumb.

B. Test cables for electrical continuity before installing.

C. Test cables for insulation resistance before installing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION

A. Cut cable(s) to lengths required.

B. Install heater to cold lead connections in accessible locations. Do not embed in concrete or plaster.

C. Avoid crossing expansion, construction, or control joints with heating cables. Provide sufficient slack conductor in expansion loop.

D. Provide labels for piping insulation/jacketing to identify the same as “electrically heat-traced”.

3.3. CONNECTIONS

A. Electrical installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of wiring, conduit, and specialties.

B. Connect heating cables and other components to wiring systems.

C. 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.

D. Connect heating cable controller(s) for domestic water freeze protection to building management

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system via Modbus or BACnet gateway to remotely configure, control, and monitor the heating cable circuit(s), including transmitting alarm conditions (e.g. temperature sensor failure, high or low temperature, and ground-fault) if detected. Coordinate work with Division 23 Contractor.

3.4. FIELD QUALITY CONTROL

A. Testing: Perform tests after installation but before application of coverings, such as insulation, plaster, or concrete.

1. Test cables for electrical continuity before energizing.
2. Test cables for insulation resistance before energizing. Remove cables if measured resistance is less than 10 megohms to ground.
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation.

C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.5. ADJUSTING

A. Set field adjustable thermostat ranges as indicated.

3.6. PROTECTION

A. Protect installed heating cables, including leads, from damage prior to Substantial Completion.

END OF SECTION

NOT FOR BIDDING

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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. Related Sections include the following:

1. Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables”, for conductor and cable requirements.

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 the electrical service system neutral at service entrance equipment to grounding electrodes and metallic water service as supplementary.

C. Bond each separately-derived system neutral to nearest grounding system.

D. 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.

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1.3. DEFINITIONS

A. EGB: Electrical grounding busbar.

B. EGC: Equipment grounding conductor.

C. GEC: Grounding electrode conductor.

D. SSBJ: Supply-side bonding jumper.

E. PBB: Telecommunications primary bonding.

F. SBB: Telecommunications secondary bonding.

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 grounding rods, conductors, connectors and connection materials, and grounding fittings. Submit ground system manufacturer's recommended installation procedure for review.

C. Field tests and observation reports indicating and interpreting the test reports for compliance with

performance requirements, certified by Testing Agency.

1.5. QUALITY ASSURANCE

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7, or a full member company of the International Electrical Testing Association (NETA).

1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3 of this Section.

B. Comply with NFPA 70 - National Electrical Code.

C. Comply with UL 467 - UL Standard for Safety Grounding and Bonding Equipment.

D. Comply with ANSI/IEEE C2 - National Electrical Safety Code.

E. Comply with ANSI/IEEE 32 - Requirements, terms and test procedures for neutral grounding devices.

F. Comply with IEEE Standard 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

G. Comply with ANSI C33.8.

H. 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.

1.6. PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of grounding electrodes and all primary grounding locations (i.e., grounding busbar location(s), water service connection(s), gas service connection, building steel, test wells, 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. Erico Inc.; Electrical Products Group.
2. Harger Lightning and Grounding; Harger, Inc.
3. Heary Brothers Lightning Protection Co.
4. Ideal Industries, Inc.
5. ILSCO.
6. O-Z/Gedney Co.
7. Raco, Inc.
8. Thomas & Betts, Electrical.

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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 260519, "Low-Voltage Electrical Power 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 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 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. Underground Conductors: Bare, tinned, stranded, 4/0 AWG size minimum, except as otherwise indicated.

E. 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. MISCELLANEOUS CONDUCTORS

A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section, minimum size ¼-inch thick x 4-inches, length as required.

B. Braided Bonding Jumpers: Copper tape, braided bare copper wire, terminated with copper ferrules.

C. Bonding Straps: Soft copper, 0.05 inch (1 mm) thick and 2 inches (50 mm) wide, unless otherwise indicated.

2.5. CONNECTOR PRODUCTS

A. Mechanical Connectors

1. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock-washers 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 unless indicated on the Drawings.
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

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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.

C. Exothermic Connections: Provide exothermic-weld kit selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

2.6. GROUNDING ELECTRODES AND TEST WELLS

A. Grounding Rods: Copper-clad rod with rigid steel core.

1. Size: 3/4 inch by 120 inches (19 by 3000 mm). Provide the number of rods required to obtain proper ground resistance.
2. Rods shall have a minimum of ten (10) mils of copper.
3. Ground rods shall be UL listed #467.

B. Plate Electrodes: Copper, square or rectangular shape. Minimum 0.10 inch (3 mm) thick, size as indicated.

C. Test Wells: provide 12” x 12” handhole marked “Ground” as detailed on the Contract Drawings.

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. Lighting branch circuits.
c. Receptacle branch circuits.
d. Single-phase motor or appliance branch circuits.
e. Three-phase motor or appliance branch circuits.
f. Flexible raceway runs.
g. Metal-clad (MC) cable 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.
4. Water Heater, and Heat-Tracing Circuits: Install a separate equipment grounding conductor to each water heater and heat-tracing assembly. Bond conductor to heater units, piping, connected equipment, and components.

B. Telecommunications System Grounding:

1. Provide one (1) telecommunications primary bonding bus bar (PBB) in the electrical room

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in each building (i.e., greenhouse and west pavilion). The PBB shall be bonded to the electrical ground bus bar (EGB) in the main electrical room with one (1) 4/0 AWG copper grounding conductor.

2. Provide ancillary bonding connections from each PBB to telecommunications equipment as detailed on the Technology Contract Documents.

C. Mechanical System Grounding:

1. The incoming domestic and fire protection water services shall be bonded to the electrical grounding system; provide equipment grounding conductor (EGC) sized per the National Electrical Code.
2. The incoming natural gas service shall be bonded to the electrical grounding system; provide equipment grounding conductor (EGC) sized per the National Electrical Code.
3. All mechanical equipment, including but not limited to pumps, motors, packaged equipment, fans, heaters, etc. and their enclosures shall be properly grounded in accordance with Article 250 of the National Electrical Code.
4. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

D. Separately Derived Systems: Ground and bond all separately derived systems in accordance with Article 250.30 of the National Electrical Code, and as follows:

1. Transformers:

a. Provide a grounding electrode conductor from the transformer to the nearest grounding electrode, e.g. building steel. Where the grounding electrode conductor is installed within metallic raceway, both ends of the raceway shall be also be bonded.
b. Provide a system bonding jumper from the transformer neutral point to the transformer enclosure. The system bonding jumper must remain within the enclosure where it originates.
c. Provide a supply-side bonding jumper from the transformer neutral point to the ground bus bar in the first disconnecting means or overcurrent device, e.g. panelboard.

2. Metal Water Pipe:

a. All metal water piping in the area served by the separately derived system shall be bonded to the neutral point of the separately derived system with a bonding jumper in accordance with Article 250.104 of the National Electrical Code.
b. Metal water piping is permitted to be bonded to the structural metal building frame in lieu of the neutral point of the separately derived system, if the structural metal serves as the grounding electrode for the separately derived system.

3. Structural Metal:

a. Exposed structural metal in the area served by the separately derived system shall be bonded to the neutral point of the separately derived system with a bonding jumper in accordance with Article 250.104 of the National Electrical Code.
b. A separate bonding jumper to structural metal is not required where the structural metal serves as the grounding electrode for the separately derived system.

4. Grounding and bonding conductors and jumpers shall be sized in accordance with Table 250.66, Table 250.122 and Article 250.102 of the National Electrical Code.

E. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to a grounding electrode in

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addition to separate equipment grounding conductor run with supply branch circuit.

3.2. INSTALLATION

A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

B. Grounding Bus Bars: Space 1 inch (25 mm) from wall and support from wall 6 inches (150 mm) above finished floor, except as otherwise indicated.

C. Grounding Electrodes: Provide a minimum of three (3) grounding electrodes, unless otherwise indicated on the Drawings, in accordance with the following:

1. Locate a minimum of twenty-feet from each other and at least the same distance from any other grounding electrode, unless otherwise indicated on the Drawings.
2. Drive until tops are 24 inches below finished floor or final grade, except as otherwise indicated.
3. Interconnect with grounding-electrode conductors using exothermic welds, except at test wells, unless otherwise indicated. Make these connections without damaging copper coating or exposing steel.

D. 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.

E. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 inches (600 mm) below grade.

F. Metal Water Service Pipe: Provide insulated copper grounding conductors, sized as indicated, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding-clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Do not install a grounding jumper across dielectric fittings. Bond grounding-conductor conduit to conductor at each end.

G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding-clamp connectors.

H. Test Wells: One for each driven grounding electrode, except as otherwise indicated. Set top of well flush with finished grade or floor. Fill with 1-inch- (25-mm-) maximum-size crushed stone or gravel.

I. 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.

J. The grounded conductor (neutral) of the wiring system shall be connected to the system grounding conductor at a single place in the system by removable bonding jumpers, sized according to the applicable provisions of the National Electrical Code. The grounded conductor (neutral) connection to the grounding conductor (ground) shall be located in the enclosure for the system's overcurrent protection or where otherwise indicated on the Drawings or Specifications.

K. Ground buses and neutral buses in all switchboards, distribution panelboards, branch panelboards, and those provided in any equipment shall be isolated except where required to be connected as specified above for the service entrance and in transformer terminal compartments.

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L. 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 busing, shall not affect the system ground.

M. Ground bus shall be provided as indicated on the Drawings or as necessary to provide termination for equipment grounding conductor. Non-current carrying metal parts of electric equipment shall be effectively grounded by bonding to the bus. The ground bus shall be bonded to both the system neutral and the service ground at the service entrance only.

N. 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.

O. Grounding of exterior fence shall include ¾-inch x 8'-0-inch ground rods, ground clamps, flexible braided straps and other accessories as required for a complete ground system for fencing. Total resistance to ground shall not exceed 10 ohms.

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. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor (EGC) Terminations: For 8 AWG and larger, use compression-type grounding lugs. 10 AWG and smaller grounding conductors may be terminated with wire nut connectors as specified in Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables”.

D. 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.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and grounding rods.

F. 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

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those specified in UL 486A and UL 486B.

G. 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.

H. 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.

3.4. UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Grounding System: Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes.

3.5. FIELD QUALITY CONTROL

A. Independent Testing Agency: Engage an independent electrical testing organization to perform tests described below.

B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method according to IEEE 81.

C. Maximum grounding to resistance values are as follows:

1. Equipment Rated 500 kVA and Less: 10 ohms.
2. Equipment Rated 500 to 1000 kVA: 5 ohms.
3. Equipment Rated More than 1000 kVA: 3 ohms.
4. Manhole Grounds: 5 ohms.

D. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance and to accomplish recommended work.

E. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results. Submit all tests to the Architect/Engineer for approval.

3.6. ADJUSTING AND CLEANING

A. Restore surface features, including vegetation, at areas disturbed by work of this Section. Reestablish original grades, except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include top soiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

NOT FOR BIDDING

SECTION 260528 - FIRESTOPPING FOR ELECTRICAL SYSTEMS

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. Related Sections include the following:

1. Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”, for raceway seals and manufactured electrical devices.

1.2. SUMMARY

A. Section includes:

1. Through-penetration firestopping in fire rated construction.
2. Through-penetration smoke-stopping in smoke partitions.

1.3. REFERENCES

A. American Society for Testing and Materials Standards: ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

B. 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)

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.

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F. Sleeve: Metal fabrication or pipe section extended through thickness of barrier and used to permanently guard penetration. Refer to Division 26 Section 260500, “Common Work Results for Electrical”, for sleeve requirements.

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.

C. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable UL system number, or UL classified devices.
2. Manufacturer or manufacturer's representative shall provide qualified engineering judgment and drawings relating to non-standard applications as needed.

1.7. QUALITY ASSURANCE

A. Installer's qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, State or local authority where applicable.
2. At least 2 years’ experience with systems.
3. Successfully completed at least 5 comparable scale projects using this system.

B. Local and State regulatory requirements: Submit forms or acceptance for proposed assemblies not conforming to specific UL Firestop System numbers, or UL classified devices.

C. Materials shall have been tested to provide fire rating at least equal to that of the construction.

D. 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.

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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.

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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. SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified in "The Systems and Applications Schedule" in Part 3 of this Section, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.4. 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.

D. Box Inserts: Intumescent inserts designed for installation inside of outlet and switch boxes to help protect fire-rated assemblies.

E. Putty Pads: Moldable firestop putty designed for installation on outside of outlet and switch boxes.

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 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.

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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 overall thickness of the penetration, or as recommended by the firestop manufacturer.

G. Provide firestop box inserts and/or putty pads for outlet boxes in fire-rated partitions.

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.

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*

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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+	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+

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
	CBJ1021 CS-195+, MPS-2+ CBJ1031 2001 CBJ1032 2001 FA1002 CP 25WB+ WJ1010 CP 25WB+ WJ1023 2001		
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 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	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+, 20003 FC3007 CP 25WB+, MPS-2+ FC3008 FS-195+
Mixed Penetrating Items	CAJ8001 CS-195+ FS-195+ CAJ8003 2000, 2000+, 20003 CAJ8004 2000, 2000+, 20003	WL8002 CS-195+, FS-195+	

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PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
Combos	CAJ8006 2001 CAJ8013 FS-195+, CP 25 CBJ8004 CS-195, FS-195+ CBJ8005 CS-195+, MPS-2+ CBJ8008 2001 FA8001 FS-195+, CP 25WB+		

*Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF SECTION

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for general installation requirements.

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 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.

C. Supporting devices and fastening methods shall be subject to the review and approval of the Structural Engineer.

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.

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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. Installer's Qualifications:

1. Installer must be a factory-trained manufacturer's authorized representative/installer with not less than five years experience in the installation of Strut Support Systems of this size and conformation.

F. All Strut Support System components must be supplied by a single manufacturer.

G. 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.
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.

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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. Dry, Interior Locations: 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 installed in dry interior locations shall be hot-dip galvanized, unless otherwise noted.

B. Damp or Wet Locations: Supports, support hardware, and fasteners installed in damp or wet locations, including exterior locations, shall be Type 316 stainless steel.

C. Laundry and Concessions Areas: Supports, support hardware, and fasteners installed in kitchens and other foodservice areas shall be 316 stainless steel.

D. Corrosive Locations: Supports, support hardware, and associated fasteners installed in corrosive locations, including but not limited to chemical storage rooms, greenhouses, etc. shall be type 316 stainless steel, or fiberglass (polyester, PVC, vinyl ester).

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.

C. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

D. U-Channel Systems:

1. Sixteen-gauge channels with 9/16-inch-diameter slotted holes at a minimum of two inches on center in top surface.
2. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.
3. Provide plastic end caps for ends of u-channel at free-standing equipment supports and exterior locations.

E. Concrete Equipment Pads:

1. Refer to Division 26 Section 260500, “Common Work Results for Electrical”, for installation requirements.

F. Floor-Mounted Stands: Construct with structural steel members or steel pipe and fasten with flanges bolted to the floor.

G. Ceiling Suspended Platforms: Construct with steel hangers. Brace and fasten to building structure.

H. Wall-Mounted Platforms: Construct with steel brackets.

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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: Self-drilling anchors or power-driven studs.

2.5. VIBRATION ISOLATION MOUNT TYPES

A. Type DNP (Double Neoprene Pad)

1. Neoprene pad isolators shall be formed by two layers of ¼-inch to 1/16-inch thick ribbed or waffled neoprene, separated by a stainless steel or aluminum plate. Layers shall be permanently adhered together. Pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type DNP isolators shall be formed from one of the following products or approved equal:

a. Type NR: Amber/Booth.
b. Type Korpad: Korfund Dynamics.
c. Type WSW: Mason Industries.
d. Type NPS: Peabody Noise Control.
e. Series Shear Flex: Vibration Mountings and Control.

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 U-channel 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.

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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 (New): Iron or steel inserts. Expander type anchors, specified for existing may be used provided concrete is clear of conduit for drilled depth.
5. Concrete (Existing): Double-plated expander type anchors. Phillips, Hilti, or approved equivalent. Loads shall not exceed 1/4 of tested pullout (or shear) strength.
6. Precast Concrete Plank: Drill hole through plank; bolt hanger rod to 4” x 4” x 1/8” steel plate on top of plank.

I. Tests: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

1. Expansion anchors.
2. Toggle bolts.
3. Power-driven threaded studs.

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J. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

K. 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 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

L. Provide additional hangers or steel members to distribute the load among two or more structural members when required or directed.

M. Drilling of new concrete slabs will not be permitted. Anchors and inserts shall be cast in the concrete slabs.

N. 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 ensure 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 ensure proper position and correct any deviation.

O. 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,

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lath, plaster, splines, etc.).

5. In spaces with suspended ceilings, support conduits directly from structural slabs, decks (or framing members). Do not support conduits on ceiling suspension members.
6. Support surface or pendant lighting fixtures:

    a. From an outlet box by means of an interposed metal strap, where weight is less than 5 lbs.
    b. From an outlet box by means of a hickey or other direct threaded connection, where weight is from 5 to 50 lbs.
    c. Directly from structural slab, deck or framing member, where weight exceeds 50 lbs.

7. In addition to the above, provide cushioned, swivel type hangers with appropriate outlet boxes for pendant fixtures in mechanical areas. Such hangers shall have a support rating at least twice that of the load supported.
8. Support recessed lighting fixtures directly from structural slab, deck, or framing members. Refer to Division 26 Section 265100, "Interior Lighting", for additional installation requirements.
9. 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.
10. For point-of-attachment weight of 100 lbs. or less, fasten items as follows:

    a. On wood, use wood screws.
    b. On concrete and solid masonry that is already in place, use self-drilling concrete anchors or expansion bolt and couplings.
    c. On hollow construction, use toggle bolts.
    d. On structural steel, use beam clamps.

11. For point-of-attachment weights from 100 lbs. to 300 lbs., provide supports as follows:

    a. At cast-in-place concrete slabs, use concrete inserts in bottom of slab, with 8" slip-through steel rods set transverse to the reinforcing steel.
    b. At concrete slab already in place, uses 16-inches x 8-inches x ½-inch steel plates at the top of the slab, with through-bolts welded in place. The plates shall be chased in and grouted flush, where no fill is to be applied.

12. For point-of-attachment weights over 300 lbs., provide supports as follows: At cast-in-place concrete slabs, uses 16-inch x 8-inch x ½-inch steel plate, with through bolts welded in place. Top of the plate shall be 1-1/2-inches below the top of the slab or on top of the slab where a fill slab is to be installed.
13. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.
14. 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.
15. Vertical conduits shall be supported by heavy wrought iron clamps or collars anchored to construction at each floor.

P. Inserts:

1. Inserts for suspended items in poured concrete construction shall be malleable-iron concrete inserts, adjustable type with insert nut. Items manufactured by Barrett, Crawford, Elcen, or Grinnell shall be used where applicable.
2. Inserts for surface-mounted items shall be suitable for the composition of the slab, wall, or structure on which installation is to be made.

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Q. TABLE I: SPACING FOR RACEWAY SUPPORTS

TABLE I: SPACING FOR RACEWAY SUPPORTS				
Raceway Size (Inches)	No. of Conductors in Run	Location	PVC & RMC (Ft.)	EMT (Ft.)
		HORIZONTAL RUNS		
3/4	1 or 2	Flat ceiling or wall.	5	5
3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7
3/4	3 or more	Any location.	7	7
3/4 - 1	3 or more	Any location.		
1 & larger	1 or 2	Flat ceiling or wall.	6	6
1 & larger	1 or more	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10
1 & larger	3 or more	Any location.	10	10
Any	---	Concealed.	10	10
		VERTICAL RUNS		
1/2, 3/4	---	Exposed.	7	7
1, 1-1/4	---	Exposed.	8	8
1-1/2 & larger	---	Exposed.	10	10
Any	---	Concealed.	10	10
Abbreviations:	EMT	Electrical Metallic Tubing		
	PVC	Rigid Polyvinyl Chloride Conduit		
	RMC	Rigid Metal Conduit		

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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

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Related Sections include the following:

1. Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables”, for conductors installed in raceways and boxes and conductor terminations.
2. Division 26 Section 260528, “Firestopping for Electrical Systems”, for requirements for firestopping at penetrations through walls and floors that are fire barriers.
3. Division 26 Section 260529, “Hangers and Supports for Electrical Systems”, for raceways and box supports.
4. Division 26 Section 260535, “Raceways and Boxes for Low-Voltage Systems” for raceways and box requirements for communications cabling.
5. Division 26 Section 260543, “Underground Ducts and Raceways for Electrical Systems” for raceways installed in ductbanks and for ductbank accessories.
6. Division 26 Section 262726, “Wiring Devices”, for devices installed in boxes.

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. PVC externally coated, RMC
g. RMC
h. RNC
i. 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

1.3. DEFINITIONS

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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. RMC: Rigid Metal Conduit.

G. RNC: Rigid Nonmetallic Conduit.

1.4. SUBMITTALS

A. Product Data: For raceways, wireways and fittings, hinged cover enclosures, and cabinets.

B. Shop Drawings: Include layout drawings showing components and wiring for nonstandard boxes, 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 final locations, mounting heights, and orientation of all outlet, junction, and pull boxes.

E. Coordinate mounting heights and locations of outlet boxes thoroughly with approved Furniture plans.

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.

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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:

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 Corporation

2. Nonmetallic Conduit and Tubing:

a. Anamet, Inc.; Anaconda Metal Hose.
b. Arnco 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 Corporation

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. 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.

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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. 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. EMT and Fittings: Hot galvanized steel O.D. with an organic corrosion-resistant I.D. coating. Listed to UL Safety Standard 797 and manufactured in accordance with ANSI C80.3.

1. Fittings: Compression type, NEMA FB1.

B. FMC: Zinc coated steel.

C. LFMC: Flexible steel conduit with PVC jacket.

D. RMC: ANSI C80.1 and UL 6.

E. Plastic Coated Steel Conduit and Fittings: NEMA RN 1.

F. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3. COLORED METAL CONDUIT AND TUBING

A. EMT: Hot galvanized steel O.D. with vibrant color top coat and an organic corrosion-resistant I.D. coating. Listed to UL Safety Standard 797 and manufactured in accordance with ANSI C80.3.

B. Provide True Color® EMT as manufactured by Allied Tube and Conduit, or approved equal by listed manufacturer.

2.4. NONMETALLIC CONDUIT AND TUBING

A. PVC: NEMA TC 2, UL 651, Schedule 40 or 80.

B. PVC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

C. LFNC: UL 1660.

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2.5. 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:

1. Dry Interior Locations: Manufacturer's standard enamel or galvanized finish, NEMA 1.
2. Damp/Wet Locations: ANSI 49 gray polyester over phosphatized steel, NEMA 3R.

2.6. 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.

2.7. PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1, galvanized flat-rolled sheet steel.

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.

D. Boxes for Buried Flush Grade Locations: Refer to Division 26 Section 260545, “Utility Holes”, for product requirements.

2.8. 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.

2.9. BUSHINGS

A. Bushings shall be self-extinguishing thermoplastic type with 105 degrees C (minimum) temperature rating.

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B. Bushings with grounding lugs shall be malleable iron body with 105 degrees C (minimum) insulating ring. Insulating material shall be locked in place and non-removable.

2.10. 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).

2.11. 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.

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 AND BOX REQUIREMENTS

A. Conduit Application Schedule:

APPLICATION	CONDUIT TYPE	REMARKS
In or under concrete slab	RNC (Schedule 40 PVC)	Use RMC elbows to stub up through slab, unless otherwise noted on the drawings. Coat RMC with two heavy coats of asphaltum, or provide PVC-coated RMC. Elbows for grounding electrode conductors shall be RNC.
Exposed exterior locations.	RMC	Use threaded or rain-tight fittings and stainless steel hardware.

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APPLICATION	CONDUIT TYPE	REMARKS
Damp/Wet interior locations.	RMC	Use threaded or rain-tight fittings and stainless steel hardware.
Exposed dry interior locations	EMT, RMC	Schedule 40 PVC is acceptable for concealing grounding electrode conductors, except for plenum spaces. Provide RMC where subject to physical damage.
Exterior underground.	RNC (Sched. 40 PVC)	RMC Elbows/Sweeps unless otherwise noted on the Drawings. Coat RMC with two heavy coats of asphaltum, or provide PVC-coated RMC. Elbows for grounding electrode conductors shall be RNC.
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 and stainless steel hardware.
Equipment connections in exterior locations.	LFMC (e.g Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings and stainless steel hardware.
Concealed in dry wall construction.	EMT, MC Cabling	Refer to Division 26 Section 260519, "Conductors and Cables", for MC Cable Requirements.
Concealed above suspended ceilings.	EMT, MC Cabling	Refer to Division 26 Section 260519, "Conductors and Cables", for MC Cable Requirements.
Concealed in masonry walls.	EMT	
Corrosive locations (e.g. greenhouses, etc.) where NOT subject to damage.	EMT Coated with Epoxy Paint Schedule 40 PVC	Provide Type 316 stainless steel hardware. Provide PVC straps no more than 36" on center.
Corrosive locations (e.g. greenhouses, etc.) where subject to damage.	RMC Coated with Epoxy Paint Schedule 80 PVC	Provide Type 316 stainless steel hardware. Provide PVC straps no more than 36" on center and stainless steel hardware.
Equipment connections in corrosive locations (e.g. greenhouses, etc.)	LFNC	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings and Type 316 stainless steel hardware.

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B. General Requirements

1. Provide hot-dip Rigid Metal Conduit (RMC) for exposed work in locations subject to physical damage, for work in damp/wet locations, and for interior conduit stubs through slab.
2. Where rigid non-metallic conduit is exposed, it shall be Schedule 80 PVC, with all provisions for thermal expansion/contraction as recommended by the Manufacturer.
3. Conduits for exterior underground electric work shall be rigid steel, galvanized and sherardized, leaving the building and to points 5 feet beyond footings. Beyond 5 feet of building, underground conduits shall be non-metallic Schedule 40 PVC, Type II.
4. Elbows for conduits turning up through slabs and/or equipment pads shall be rigid metal conduit (RMC) unless otherwise noted on the Drawings or required by the electric utility.
5. All steel conduits below grade or in contact with earth shall be PVC-coated or be painted with two heavy coats of asphaltum.
6. Conduits shall slope from entrance equipment toward outside of building.
7. Provide hot-dip Rigid Metal Conduit (RMC) with bonded PVC jacket (Plastic-Bond or Kor-Kap) for work not completely encased in concrete but laid directly in or in contact with ground or on a vapor barrier and additionally, as directed.
8. Provide hot-dip Rigid Metal Conduit (RMC) with bonded PVC jacket (Plastic-Bond or

Kor-Kap) for work in kitchen coolers and freezers.

9. All emergency and standby system wiring shall be installed in a dedicated conduit system clearly identified as “Emergency” or “Standby”.
10. MC cable shall be permitted for emergency and standby system wiring where concealed above accessible ceilings and/or within drywall partitions in accordance with the requirements of this Section”.
11. Provide non-metallic (PVC) conduit and fittings with stainless steel hardware in all corrosive environments, including but not limited to greenhouses, chemical storage rooms, etc. unless otherwise indicated.
12. Aluminum conduit is prohibited.

C. 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 concrete-tight or rain-tight compression fittings made from zinc-plated steel. 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 for conduits in damp or wet locations, underground locations, and in floor slabs.

D. 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.

E. Outlet Boxes:

1. Outlet boxes for dry interior locations and for concealed work shall be zinc-coated or cadmium-plated sheet steel boxes suitable for the service and type outlet.
2. Boxes and conduit fittings for damp or wet locations and exposed locations subject to damage shall be NEMA 4 cast-aluminum, cast steel or cast-iron type with gasketed cover

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plates and threaded hubs for conduit entrance.

3. Extra-large boxes shall be provided in accordance with the National Electrical Code where necessary to prevent crowding of wire in the box.
4. Plastic boxes and cast "white metal" boxes classified as NEMA 4 will not be acceptable.
5. Outlet boxes in un-plastered 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.
6. All outlet boxes used for supporting fixtures shall be furnished with malleable iron fixture studs of "no-bolt" type secured by locknut.
7. 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.
8. All boxes, whether outlet, junction, pull, or equipment, shall be furnished with appropriate covers.
9. No sectionalized boxes shall be used.
10. 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.
11. Outlet boxes in fire-rated partitions shall have firestop box inserts and/or firestopping putty pads. Refer to Division 26 Section 260528, “Firestopping for Electrical Systems”, for additional information.
12. Provide factory-made knockout closures for unused openings in outlet boxes.
13. Provide blank coverplates for all unused boxes.
14. For multiple device installations, provide multi-gang boxes. Sectional boxes are not permitted. Provide barrier separation of different voltage conductors in the same box.
15. Thoroughly coordinate mounting heights of boxes with casework and backsplash heights.
16. 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.
17. Provide back supports for boxes in metal stud walls.

F. 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 conductors with different system voltages 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 OF RACEWAYS

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

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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:

1. Communications System
2. Control Wiring
3. Emergency Lighting
4. Emergency Power
5. Fire Alarm System
6. Incoming Telephone Service
7. Incoming Electric Service
8. Lighting
9. Power 120/208 volt
10. Power 120/240 volt
11. Power 277/480 volt
12. Security System
13. Standby Lighting
14. Standby Power

C. All raceway systems shall be completely wired as specified herein, shown on drawings and/or required for satisfactory operation of the various systems.

D. 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.

E. Underground conduits for services outside of building and entrance into building shall be as specified herein.

F. Raceways or conduits entering buildings or structures from outside shall be sealed, including spare or unused raceways. Sealants shall be identified for use with the cable/conductor insulation.

G. Conduits or raceways installed underground shall be sealed or plugged at both ends, including spare or unused raceways. Sealants shall be identified for use with the cable/conductor insulation.

H. 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.

I. Minimum Raceway Size:

1. 3/4-inch trade size for interior work
2. 1-inch trade size for exterior underground work.

J. Conceal raceways within finished walls, ceilings, and floors wherever possible, unless otherwise indicated.

K. Electrical Metallic Tubing (EMT) shall be used for the following unless otherwise indicated:

1. Branch circuits and feeders for lighting, receptacles, and power concealed in:

a. Dry wall construction.

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b. Hard ceilings, e.g. gypsum, wood, etc.
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. Hard ceilings, e.g. gypsum, wood, etc…

L. Rigid Metal Conduit (RMC) 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.

M. Communications, Control, Automatic Temperature Control (ATC), Fire Alarm, and Security system wiring shall be installed in raceways within partitions, terminated 8" above accessible ceiling with 90 degree bend with insulating bushing on the end. Free-run cabling above accessible ceilings shall be supported by J-hooks and/or bridle rings at required spacing intervals. Cabling above inaccessible ceilings and in exposed locations shall be installed completely in raceway.

N. Wiring above ceiling shall be plenum rated cable, where required by Code.

O. Wiring installed concealed above hard ceilings and exposed in areas with no ceilings shall be installed in conduit.

P. 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.

Q. 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.

R. 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.

S. Install raceways level and square and at proper elevations. Provide adequate headroom.

T. Complete raceway installation before starting conductor installation.

U. Support raceways as specified in Division 26 Section 260529, "Hangers and Supports for Electrical Systems". Arrange supports to prevent misalignment during wiring installation.

V. 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.

W. 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.

X. 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.

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Y. 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.

Z. Conduits may be installed in grade level concrete floor slabs with the following limitations:

1. Maximum size – 2”.
2. Minimum concrete cover – 1", above and below.
3. Minimum spacing between conduits - 6" on center.
4. Conduit outside diameter - 1/3 of slab thickness, maximum.
5. Installed between bottom and top reinforcing, and centerline of conduit at the mid-depth of the slab.
6. Secured to prevent possible change in position, sagging, or shifting as concrete is poured.
7. Water or damp-proofing integrity of slab is not disturbed.
8. Conduits larger than 1-1/4" may be installed in [grade level] concrete floor slabs only with the specific permission of the Engineer, or as specifically indicated on the drawings, all in accordance with the above limitation.
9. Conduits in close proximity to each other at panelboards, etc., shall be located and wrapped with wire mesh to prevent cracking of slab.
10. Transition non-metallic tubing to rigid steel conduit before rising above the floor.
11. Space raceways laterally to prevent voids in the concrete.
12. Run conduit parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.

AA. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

BB. Run parallel or banked raceways together, on common supports where practical.

CC. 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.

DD. 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.

EE. Tighten set screws of threadless fittings with suitable tools.

FF. Install pull wires in empty raceways. Use 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.

GG. 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.

HH. Lubricants for pulling wires shall be approved for use with the types of wire and conduit installed.

II. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material.

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Patch all nicks and scrapes in PVC coating after installing conduits.

JJ. Use conduit hubs to fasten conduit to boxes in damp and wet locations.

KK. All metal raceways for circuits over 250-volts to ground shall be bonded per NEC Article 250.97.

LL. 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.

MM. Avoid moisture traps; provide junction box with drain fittings at low points in conduit system.

NN. Die-cast fittings of pot metal will not be accepted.

OO. Conduits shall be free of any burrs, foreign objects, and water prior to conduit installation.

PP. 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 3/4" conduit.

QQ. Where conduits turn up out of concrete slabs and are not concealed by wall construction, bends shall be carefully made so that no portion of the radius is above the floor.

RR. Rigid conduit or Electrical Metallic Tubing (EMT) shall not be strapped or fastened to equipment subject to vibration or mounted on shock-absorbing bases.

SS. Conduit shall be installed in such manner as to ensure against the collection of trapped condensation, and runs of conduit shall be without traps wherever possible. Drill 1/8" diameter weep holes where necessary.

TT. 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.

UU. Provide wall flanges and gasketing on conduits entering fan housings to minimize air leakage at points of penetration of housing.

VV. Conduit risers shall be rigidly supported on the building structure, using appropriate supports only.

WW. 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.

XX. 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.

YY. 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.

ZZ. Screws and other hardware for all work in damp/wet locations shall be stainless steel, unless

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otherwise noted.

AAA. Zinc coated galvanized steel screws may be used for interior dry locations only.

BBB. No running threads shall be cut or used.

CCC. Conduits which are installed at this time and left empty for future use and which are five feet or more in length, including all communication conduits shall have a non-ferrous, 600 lb. tensile strength drag line left in place for future use. All empty conduits including conduit stubs shall be tagged at all exposed ends with tags identifying the location of the end of the conduit.

3.4 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 facilitate pulling of wires and 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 of proper Code size for the number of wires and/or conduits passing through or terminating therein, as well as the quantity, type, and dimensions of wiring device(s) installed therein. In no case shall any box be less than 4" square. Special attention shall be paid to boxes with deep wiring devices, E.G., GFCI receptacles, USB charger receptacles, and network lighting switches, etc.

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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 approved factory-made knock-out seals.

R. Outlet boxes installed in plenum ceilings shall be in accordance with applicable codes.

S. 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.

T. Outlet boxes for toggle switches at doorways shall be located at the strike side of the door as finally hung.

U. 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.

V. Install junction and pull boxes to be accessible.

W. Locations of junction and pull boxes requiring access panels shall be reviewed by the Owner's Representative.

X. Install hinged-cover enclosures and cabinets plumb. Support at each corner at minimum.

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 enter a raceway, cabinet, pull box, and junction box, the conductors shall be protected by an insulated bushing providing a smoothly rounded surface.

E. Water tight hubs 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.

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3.6 FLEXIBLE CONNECTIONS

A. Provide Flexible Metal Conduit (FMC), e.g. Greenfield, in short lengths (maximum 6 feet) for the final connection of dry type transformers and vibrating equipment in dry interior locations. The flexible connections to equipment shall be sufficient slack to permit removal of the same.

B. Provide Liquidtight Flexible Metal Conduit (LFMC), e.g. Sealtite, in short lengths (maximum 6 feet) for the final connection of exterior equipment, motors and equipment in damp or wet locations as defined in Division 26 Section “Common Work Results for Electrical”.

C. Provide Liquidtight Flexible Nonmetallic Conduit (LFNC) in short lengths (maximum 6 feet) for the final connection of equipment in corrosive locations (e.g. chemical storage rooms, greenhouses, etc.).

D. 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.

E. Flexible connections shall be sized per the Contract Drawings, or as required in accordance with Code; the more stringent requirement shall apply.

3.7 PAINTING AND FINISHES

A. All exterior equipment and conduits shall be painted to match adjacent surface in color as selected by Architect, unless otherwise indicated by the Owner.

B. All exposed conduit, boxes, equipment, etc. shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

C. Conduit and boxes for fire alarm cabling and devices shall be red, except for finished locations, where they shall be painted to match adjacent surfaces.

D. Paint all steel conduits in contact with earth with two coats of asphaltum for corrosion protection.

3.8 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.

3.9 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.

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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 existing conduits or new conduits installed by others, the entire run to the nearest box or other termination point shall be cleaned.

END OF SECTION

NOT FOR BIDDING

SECTION 260535 - RACEWAYS AND BOXES FOR LOW-VOLTAGE SYSTEMS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including general and Supplementary Conditions and Division 01 Specifications apply to this Section.

1.2. SUMMARY

A. This section includes requirements for miscellaneous raceway systems for the following:

1. Communications (data/voice) systems.
2. Audio/Video systems.
3. Security system.
4. Access Control System.
5. Video Surveillance System.

1.3. SCOPE OF WORK

A. Provide conduit, boxes, cable trays, and surface raceways to form empty raceway systems.

B. Equipment and wiring will be installed under Division 27 and Division 28 unless otherwise indicated on the Contract Drawings or in another Section of these Specifications.

PART 2 PRODUCTS

2.1. CONDUIT

A. Minimum size 1" unless noted otherwise. Refer to Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”, for product requirements.

2.2. OUTLET BOXES

A. General Requirements

1. Provide single or multiple gang boxes as shown on the Contract Drawings.
2. Outlet boxes shall be listed to UL Standard 514A, Metallic Outlet Boxes.
3. Refer to Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”, for general product requirements.

B. Two-Gang Outlet Boxes for Masonry Walls

1. Description: Large capacity, two-gang, 4” deep outlet boxes with plaster/tile rings as required to suit device quantities and types. Boxes shall have welded corners and device ears inside the box to prevent mortar from getting in the device holes. Boxes shall accept standard device and flat covers. Boxes shall have a ground screw in each gang. Provide supports to secure outlet boxes to concrete block to prevent movement during construction.
2. Dimensions: 4-1/4”H x 4”W x 4”D.
3. Capacity: 54 cubic inches.

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4. Knockouts:

   a. Top: (2) 1/2", (2) 1/2"-3/4" tangential knockouts
   b. Bottom: (1) 1" - 1-1/4" - 1-1/2" - 2" concentric knockouts
   c. Back: (2) 1/2"-3/4" tangential knockouts

5. Provide Hubbell Catalog No. HBL985, or approved equal by listed manufacturer.

C. Three-Gang Outlet Boxes for Masonry Walls

1. Description: Large capacity, three-gang, 4" deep outlet boxes with plaster/tile rings as required to suit device quantities and types. Boxes shall have welded corners and device ears inside the box to prevent mortar from getting in the device holes. Boxes shall accept standard device and flat covers. Boxes shall have a ground screw in each gang. Provide supports to secure outlet boxes to concrete block to prevent movement during construction.
2. Dimensions: 4-1/4"H x 5-7/8"W x 4"D.
3. Capacity: 79 cubic inches.
4. Knockouts:

   a. Top: (3) 1/2", (3) 1/2"-3/4" tangential knockouts
   b. Bottom: (1) 1/2", (1) 1/2"-3/4" tangential knockouts, (1) 1" - 1-1/4" - 1-1/2" - 2" concentric knockouts
   c. Back: (3) 1/2"-3/4" tangential knockouts

5. Provide Hubbell Catalog No. HBL986, or approved equal by listed manufacturer.

D. Two-Gang Outlet Boxes for Metal Stud and GWB Walls

1. Description: Large capacity, two-gang outlet boxes with plaster/tile rings as required to suit device quantities and types. Boxes shall provide ample space for Category 6/6A and optical fiber cable bends. Boxes shall accept standard 4-11/16" mud rings.
2. Dimensions: 4-11/16"H x 4-11/16"W x 3-1/4"D
3. Capacity: 66.7 cubic inches.
4. Knockouts

   a. Sides: (2) 3/4"-1" tangential knockouts, (2) 1"-1-1/4" tangential knockouts, plus (2) 1"-2" concentric knockouts.
   b. Back: (2) 3/4"-1" tangential knockouts, (2) 1/2" knockouts

5. Provide Hubbell Catalog No. HBL260, or approved equal by listed manufacturer.

E. Three-Gang Outlet Boxes for Metal Stud and GWB Walls

1. Description: Large capacity, three-gang outlet boxes with plaster/tile rings as required to suit device quantities and types. Boxes shall provide ample space for Category 6/6A and optical fiber cable bends. Boxes shall accept standard 4-11/16" mud rings.
2. Dimensions: 4-11/16"H x 7-3/4"W x 3-1/4"D
3. Capacity: 113.3 cubic inches.
4. Knockouts:

   a. Sides: (4) 1/2"-3/4" tangential knockouts, (4) 3/4"-1" tangential knockouts, (2) 1"-1-1/4" tangential knockouts, plus (2) 1"-2" concentric knockouts.
   b. Back: (2) 1/2"-3/4" tangential knockouts, (2) 3/4"-1" tangential knockouts, (2) 1"-1-1/4" tangential knockouts

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5. Provide Hubbell Catalog No. HBL263, or approved equal by listed manufacturer.

2.3. PULL AND JUNCTION BOXES

A. Refer to Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”.

2.4. FLOOR BOXES

A. Refer to Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”.

2.5. COVER PLATES

A. Device plates will be provided under Division 27 and Division 28.

2.6. SURFACE RACEWAYS

A. Refer to Division 26 Section 260533.23, “Surface Raceways for Electrical Systems”.

2.7. CABLE TRAYS

A. Refer to Division 27.

PART 3 EXECUTION

3.1. INSTALLATION

A. Provide all raceway components, as required, for complete system. Extend conduits and/or surface raceways to nearest accessible ceiling space for devices with connections within the space, and to the nearest accessible corridor ceiling space for connections/cabling back to the MDF or IDF room, unless otherwise noted on the drawings.

B. Each run of conduit shall contain not more than two 90 degree bends and no run shall exceed 100 ft. in length. Minimum radii for bends: 10 1/2" for 1" conduit, and a minimum of ten times the trade size diameter bends for larger sizes. Do NOT use conduit fittings in lieu of bends.

C. Provide insulating bushings on all conduit terminations.

D. Provide pullboxes in conduit runs exceeding 100 feet (30 m) in length, and in runs with more than two right angle bends. Do NOT use conduit fittings in lieu of bends.

E. Identify all cabinets, and pull and junction boxes as to system usage.

F. Provide nylon pull cord in each conduit run.

G. Provide identification tags on all conduit runs.

H. Provide cover plates on all outlet boxes.

I. Provide plywood backboards and duplex receptacles in equipment room(s). Confirm location on job site prior to installation. Paint all backboards with prime coat of fire resistant paint and finish coat of enamel in color to match wall. In unfinished rooms, provide gray finish coat.

J. Coordinate all work with Owner and Division 27 and Division 28 Contractors.

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K. Provide underground conduit to property line for utility service entrance. Verify exact location with serving utility. Refer to Technology Contract Drawings and Division 26 Section 261120, “Utility Incoming Service Provisions” for additional information.

END OF SECTION

NOT FOR BIDDING

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

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

B. Sections of other Divisions in this Specification which relate to excavation and concrete construction.

C. Related Sections include the following:

1. Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables”, for conductors installed in underground ducts and raceways.
2. Division 26 Section 260528, “Firestopping for Electrical Systems”, for requirements for firestopping at penetrations through walls and floors that are fire barriers.
3. Division 26 Section 260533, “Raceways and Boxes Electrical Systems”, for raceway requirements.
4. Division 26 Section 260535, “Raceways and Boxes for Low-Voltage Systems” for raceway requirements for communications cabling.
5. Division 26 Section 260545, “Utility Holes”, for utility holes where underground ducts and raceways may terminate.

1.2. SUMMARY

A. This Section includes complete concrete ductbank construction and direct burial materials and methods for outside power and communications systems transmission and distribution.

B. This Section specifies underground duct placement, materials, and installation procedures.

1.3. CONTRACTOR RESPONSIBILITIES

A. All work described in this Section shall be performed and paid for under Division 26.

B. Existing Subsurface Utilities: Existing subsurface facilities are shown on the plans to help the Contractor avoid damage to essential utilities which must remain in service. Take reasonable steps to ascertain the exact location of all underground facilities prior to doing work that may damage such facilities. If the discovery of underground facilities not indicated on the plans or in a location different from what is indicated on the plans, protect such facilities, notify the Owner's representative immediately, and record actual conditions found onto the record drawings.

C. Construction Staking:

1. Provide the stakes and reference marks necessary for the construction of the improvements covered by this Contract.
2. Control stakes which constitute reference points for all Construction work shall be conspicuously marked with red flagging tape. Provide responsibility to inform employees and Subcontractors of the stakes' importance, and the necessity for their preservation. The cost of replacing such controls, should it become necessary for any reason whatsoever, shall be furnished at no additional cost to the Owner.

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1.4. QUALITY ASSURANCE

A. Installer: Company specializing in cast-in-place concrete structures with a minimum of three years documented experience.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1, or an equivalent Certification program.

B. Materials: All materials shall be new and the best of their respective kinds, free from all defects and as specified on the plans and the specifications or as accepted by the Project Engineer. Furnish materials or manufactured articles of the best grade in quality and workmanship obtainable on the market from firms of established good reputation, or if not ordinarily carried in stock, shall conform to the usual standards of first-class materials or articles of the kind required, with due consideration of the use to which they are to be put. In general, the work performed shall be in conformity and harmony with the intent to secure the best standard of Construction and equipment of the work as a whole or in part.

C. Manufacturer's Recommendations: Whether specifically mentioned or not in these Specifications, all materials, equipment, devices, etc., shall be installed in a manner meeting the approval of the manufacturer of the particular item.

D. Codes and Standards: Provide underground ductbanks conforming to the following:

1. National Electrical Manufacturers Association (NEMA) - Conform to the manufacturing standards of the following:

a. RNI: PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
b. TC 2: Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
c. TC 3: PVC Fittings for Use with Rigid PVC Conduit and Tubing.
d. TC 6: PVC and BAS Plastic Utilities Duct for Underground Installation.
e. TC 7: Smooth-Wall Coilable Polyethylene Electrical Plastic Duct.
f. TC 8: Extra-Strength PVC Plastic Utilities duct for Underground Installation.
g. TC 9: Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

2. Underwriters Laboratories, Inc. (UL): Conform to the following:

a. 6: Rigid Metal Conduit.
b. 651: Schedule 40 and 80 Rigid PVC Conduit.
c. 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit.

3. American Concrete Institute (ACI):

a. 318: Building Code Requirements for Reinforced Concrete.

4. American Society for Testing & Materials (ASTM)

a. F512: Smooth-Wall PVC Conduit & Fittings for Underground Installation.

E. Certification: Manufacturer shall be a company specializing in ductbank structures with a minimum five years documented experience.

1.5. SUBMITTALS

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A. Submit shop drawings and product data for all conduit, duct, ductbank materials, accessories, and miscellaneous components. Submit product data for each type of manufactured material and product indicated.

B. Indicate material specifications, dimensions, capacities, and reinforcing details. Submit concrete product data, concrete mix design, and certified mill test reports for steel bars.

C. Submit coordination shop drawings of ductbank and underground cable installations including profiles and elevations of all utility crossings. Proposed deviations from details on the Drawings shall be clearly marked on all Submittals.

D. Record Documents: Show dimensional locations of underground ducts, handholes, and manholes.

1.6. SITE CONDITIONS

A. General: Clearing work shall not begin until temporary fences, barricades, warning signs and other pedestrian control devices are installed.

B. Traffic Access:

1. Conduct operations and schedule cleanup in a manner which causes the least possible obstruction and inconvenience to adjacent property owners, pedestrians and vehicular traffic. Furnish, erect, construct and maintain such temporary fences, barriers, lights, reflectors, cones, signs, ramps, etc., that may be necessary to adequately provide separation and warn the public of work in progress and of any existing dangerous conditions. This requirement shall apply continuously and shall not be limited to normal working hours.
2. Provide responsibility for coordinating and obtaining approvals of the location for temporary barricades and/or detours of traffic from the Police and Fire Departments.
3. If peripheral fencing is used, it shall be provided with reflectors, flashers, signs, dangles, or barricades as the fence is being built.
4. Maintain continued access to parking areas, roads, abutting properties, and other facilities which the construction will cross.
5. If traffic is reduced to one way, provide a flag person. A minimum of one lane shall be maintained open to traffic at all times.
6. When entering or leaving road ways carrying public traffic, the equipment whether empty or loaded, shall in all cases yield to public traffic.
7. Supply and maintain cone placements at his sole additional expense.
8. All traffic signs which fall within the line of Construction or are obstructed by the equipment or operations shall be temporarily relocated to an unobstructed area. Temporarily relocated traffic signs shall be returned to their original location at the end of construction.

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PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering the specified products that may be incorporated in the work, include, but are not limited to, the following:

1. Conduit and Fittings:

a. Carlon Electrical Products.
b. George-Ingraham Corporation.
c. Condux International.

2. Ductbank Accessories:

a. Carlon.
b. Osburn Associates.
c. Underground Devices, Inc.
d. OZ/Gedney

2.2. UNDERGROUND DUCTBANKS

A. General: Underground ductbanks to be arrangements of single bore, PVC plastic conduits concrete encased. The number and size of conduits to be as indicated. Turn up connections through slabs or floors shall be rigid metal.

B. Material:

1. Conduit and Fittings:

a. Type II, heavy wall Schedule 40 PVC plastic, sunlight UV-resistant, in accordance with the requirements of NEMA publications TC-2 and TC-3 (fittings).
b. Rigid galvanized heavy wall steel conduit (UL 6) with threaded couplings.
c. Rigid Metal Conduit, PVC Coated, UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40.
d. Conduit and fittings shall have a temperature rating at least equal to the operating temperature of the cable which it contains, minimum 90 degrees C. Conduit and fittings shall be free from all substances that injuriously affect any wire or cable insulation.
e. The Manufacturer shall certify that the plastic is 100 percent virgin material and the finished product meets the specifications. All PVC conduit and fittings shall have solvent-weld connections and shall provide a water-tight joint.

2. Concrete: Comply with ACI 318 -- 3,000 PSI strength in 28 days.

a. Cement: Portland Blast-Furnace Slag Cement, Type IS or equal meeting ASTM C593M Specifications and the requirements of ACI 318 and 301.
b. Fine Aggregate: Concrete sand meeting requirements of ASTM C33.
c. Course Aggregate: ASTM #57 crushed limestone, meeting requirements of ASTM C33.
d. Air Entraining Admix: Complies with ASTM C260 Standard Specifications for Air Entraining Admixtures for Concrete.
e. Water: Complies with ASTM C94 Standard Specifications for Ready-mixed Concrete.

3. Use pea gravel aggregate for void-free duct penetration.
4. Reinforcing: Deformed conforming to ASTM A615 - Grade 40, minimum 3/4". Provide coated rebar where exposed to earth, such as on ductbank stubouts. Bars shall be free of loose scale, rust, or other coatings that will reduce bond.
5. Spacers: Manufactured precast plastic assembly, base spacer, top spacers and intermediate spacers, to maintain 4-inches between conduits and completely enclosed and locked conduit assembly. Set on masonry leveling blocks.
6. Joint Sealant: Watertight as recommended by conduit manufacturer.
7. Cable Sealing Bushings: OZ type CSB, with PVC coated discs, or equal.
8. Thruwall and Floor Seals: OZ type FSK or WSK, or equal.
9. Expansion Joints: Expansion joints shall be Dylite, as manufactured by Copper,

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Scorogord, or Dow Chemical and shall conform to ASTM D-1752, Type II.

10. Construction Joints: Construction joints shall be formed using Jahn Screed Joint materials as manufactured by Superior Concrete Accessories, Inc.

C. Conduit

1. Size as indicated on the Drawings. If conduit sizes are not indicated on the Drawings, then the conduits shall be sized as follows:

   a. Four inches nominal for 600 volts or lower and for Communication
   b. Five inches nominal for voltages above 600 volts.

D. Elbows: rigid heavy wall galvanized steel with a minimum bend radius of 36 inches (915 mm).

E. Conduit Termination in Utility Holes and Buildings

1. End Bells: Manufactured end bells of appropriate sizes at each end of conduit. When entering a new building or a new manhole, the end bells for PVC shall be a pre-manufactured system (as manufactured by Formex, or equal) with conduit seals, provision for roughing into the concrete, and water stops.
2. Bushings: Pre-manufactured groundable steel bushings of appropriate sizes where bell ends are not used. Steel bushings shall be used on all metal conduit. When entering a new building, or a new manhole, the bell ends for PVC shall be a pre-manufactured system (System as manufactured by Formex or equal) with conduit seals, provisions for roughing into the concrete pour and water stops.
3. Seals: When entering, below grade, an existing building or manhole, the concrete shall be core-drilled for the appropriate size conduit and seal. The seal shall be a mechanical interlocking assembly seal of modular synthetic rubber links properly sized to fit the pipe and tightened in place, in accordance with the manufacturer's instruction.
4. Fire Stopping/Sealant: All cable filled conduits shall be sealed with 3M Fire Barrier 2001 Silicone RTV Foam Conduit Sealant manufactured by 3M Fire Protection Products, or approved equal.

F. Plugs: Closure plugs or caps of the same material as the conduit at the ends of the unused sections at manholes, and at building entrance openings.

G. Pull wire: Provide a polypropylene, twisted yellow, rot and mildew-resistant 3/8" minimum pull rope (2400 lbs. tensile strength) in each empty duct.

H. Grounding: Rigid steel conduit with end bells shall be provided with an Appleton Catalog No. XJB Series or equal ground bushing with bonding strap. Connect bonding strap to ground wire in manhole(s) and electrical distribution equipment, e.g. transformer(s).

I. Drainage Assembly: All ducts shall drain to an open end away from the building or electrical equipment. Ducts shall drain towards manhole(s) and handholes wherever possible.

2.3. ACCESSORIES

A. Duct Supports: Rigid PVC spacers selected to provide minimum duct spacings and concrete cover depths indicated, while supporting ducts during concreting. Spacers shall be interlocked horizontally only. Provide nylon tie-downs to hold ducts to spacers. Concrete blocks are prohibited for duct spacers.

B. End Bells: Flared, smooth-surfaced fittings of same material as conduit; if of different material, including adapter for connection to conduit.

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C. Underground Line Warning Tapes:

1. Refer to Division 26 Section 260553, “Identification fore Electrical Systems”, for product requirements.
2. Bury underground line warning tape 12-inches below grade above every ductbank and buried conduit.

2.4. UNDERGROUND LINE WARNING TAPE

A. Non-biodegradable, polyethylene tape, 5 mil minimum thickness and a minimum of 6 inches wide with detectable metallic foil. Provide warning labels on 3 foot centers, colored as follows:

1. Electrical ducts, piping or cable (600V and below) – Red tape with black printed labeling: CAUTION-BURIED ELECTRIC LINE BELOW.
2. Electrical ducts, piping or cable (above 600V) - Red tape with black printed labeling: CAUTION –BURIED HIGH VOLTAGE CABLE BELOW.
3. Telephone conduits or cable - Orange tape with black printed labeling: CAUTION - BURIED TELEPHONE LINE BELOW.
4. Communications Conduits or Cable – Orange tape with black printed labeling: CAUTION – BURIED COMMUNICATIONS LINE BELOW.
5. Fiber Optic conduits or cable - Orange tape with black printed labeling: CAUTION - BURIED FIBER OPTIC LINE BELOW.

2.5. TEST PITS

A. Provide test pits to locate all utilities and structures. Provide test pits as necessary to determine actual locations and profiles of obstructions to proposed new work.

B. Verify existing utilities, locations, and inverts and points of connection.

PART 3 EXECUTION

3.1. LOCATION AND LAYOUT

A. Indicated plans and profiles: Approximate, based on field information and available as-built plans.

B. Actual locations and profiles: Based on test pits to locate all shown utilities and structures. Test pits at beginning, center, end, and at all ductbank bends and utility crossings.

C. Plan and profile adjustments: All provided at no additional cost to Owner, subject to approval.

D. Examine site to receive underground ductbanks for compliance with installation tolerances and other conditions affecting performance of the underground ductbanks. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2. INSTALLATION

A. In accordance with NEMA publication TC-2 and manufacturer's recommendations.

B. Top of envelope below grade: Minimum as indicated on the Drawings.

C. Concrete envelope: 3 inches minimum beyond surface of any conduit, minimum 2 inches between conduits. Top of ductbank shall be crowned to prevent puddling of water.

D. Seal and Thru Wall Fittings: At entrances to buildings for watertight construction.

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E. Sweeps and bends: Minimum 25 foot radius (except at conduit risers) unless otherwise approved to accomplish changes in direction of runs either horizontally or vertically. Double offsets: Minimum 100 foot radius. Sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 36 inches.

F. Mandrel conduits: Mandrel 12 inch long, 1/4 inch less than conduit I.D. Draw a testing mandrel through each duct.

G. Clean conduits: After mandrel, with stiff brush, leave no particles or debris. Immediately install end plugs after cleaning.

H. Pull Line: Provide 100-pound-tested nylon pull line in all conduits, including spares. Provide 3 feet of slack at each end of conduit and tag.

I. Stagger vertical conduit joints: Minimum 6 inches. All joints shall have couplings installed.

J. Reinforcing steel: Provide reinforcing steel the entire length of the duct system. Provide four #4 bars, one in each corner minimum, overlap the joints 12-inches, and tie them into the respective utility, vaults, and buildings, etc. Rebar shall not be installed less than 2-inches from sides of any duct.

3.3. EXCAVATION, BACKFILLING, COMPACTING AND SITE PREPARATION

A. Provide all excavating and backfilling and site preparation necessary to install underground ductbanks, cables, etc., included in this section of the work. Excavation and backfill shall be performed in accordance with the requirements of Division 26 Section 260500, “Common Work Results for Electrical”.

B. Install forms on sides of the ductbank if the trench is not of the proper firmness to prevent cave-in. Provide all required excavating, shoring, sheeting, bracing, and backfilling.

C. The bottom of the trench shall be undisturbed earth. If the trench bottom is too low for proper grade, fill to the proper level with sand and mechanically compact it. Cut trenches neatly and uniformly.

D. Each excavated section between utility holes and from utility holes to the building shall be completely excavated and graded before any duct is laid in that section.

E. Provide underground line warning tape 12-inches below finished grade over all ductbanks. Refer to Division 26 Section 260553, “Identification for Electrical Systems”, for product requirements.

F. Excavation and Backfill: Refer to Division 26 Section 260500, “Common Work Results for Electrical”.

G. After excavation of the trench, stakes shall be driven in the bottom of the trench at four-foot intervals to establish the grade and route of the duct bank.

H. Pitch the trenches uniformly towards utility holes or both ways from high points between utility holes for the required duct line drainage. Avoid pitching ducts towards buildings wherever possible.

I. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that concrete envelope can be poured without soil inclusions. Forms are required where the soil is not self-supporting.

J. After the concrete-encased duct has sufficiently cured, the trench shall be backfilled to grade with earth.

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K. Restore surface features at areas disturbed by excavation, and reestablish original grades except as otherwise indicated. Replace removed sod as soon as possible after backfilling is completed. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching..

L. Restore disturbed paving.

M. Remove pavements, sidewalks, curbs, and gutters where necessitated by construction of ducts.

N. On completion of underground duct construction, replace pavements, sidewalks, curbs and gutters.

O. Surplus earth from the trenches, after compacting, shall be removed and disposed of.

3.4. CUTTING AND PATCHING

A. Provide all cutting and patching necessary for the installation of the electrical work. Any damage done to the work already in place by reason of this work shall be repaired expense by a qualified mechanic experienced in such work. Patching shall be uniform in appearance and shall match with the surrounding surface.

B. Existing Obstructions: Where drawings indicate that underground conduits are to cross under existing roadways, walks or other similar paved areas, steel conduits shall be driven under such areas in lieu of installing the conduits in trenches as specified above. After installation of conduit by either method, all existing paved or grass areas which have been disturbed in any way shall be restored to their original conditions.

C. Patching shall be done in accordance with the requirements of Division 02 for the appropriate disturbed surface materials.

D. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.

3.5. PLACEMENT OF CONDUIT

A. Within five (5) feet of each building wall or utility hole penetration, install heavy wall galvanized steel conduit within the concrete envelope to provide protection against vertical shearing.

B. Install spacers as recommended by the conduit manufacturer and requirements stated above, but not to exceed a maximum of four feet on center for PVC conduit and eight feet on center for steel conduit. Bottom spacers shall rest on 8-inch x 16-inch x 2-inch minimum concrete pads to prevent them from sinking into the ground and reducing the bottom concrete cover. Stagger conduit joints in concrete encasement 6 inches minimum horizontally.

1. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked conduit assembly.
2. Before placing concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete placement. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.
3. Set on masonry leveling blocks prior to pour.

C. Pitch conduit properly for drainage to manholes and handholes and to prevent low pockets or irregular dips between conduit ends. Minimum pitch to be 4 inches per 100 feet.

D. Provide accurate locations of conduit in utility hole.

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E. Depending on encasement necessary for duct formation, place conduits on spacers. The minimum encasement thickness 1-1/2-inches on all sides.

F. Lay conduits using spacers to provide tier spacing.

G. Make tight conduit joints by complying with recommendations of conduit manufacturer, using coupling jointing compound or PVC primer and solvent cement. All joints in conduits and fittings shall be made up tight and shall be watertight. All threaded portions of steel conduits that are not to be encased in concrete and adjoining ends of conduits, couplings and fittings, shall be heavily coated with asphaltum after installation. All connections between conduits of different types shall be made in an approved manner, using adapters of other materials and methods recommended for the purpose by the conduit manufacturers.

H. Provide not more than one 90-degree bend or equivalent between pull points for primary conduit and two 90-degree bends or equivalent for signal conduit.

I. In ductbanks with both primary and signal conduit, primary conduit shall be straight and the signal conduit shall contain bends as necessary to accommodate the primary duct. Any offsets or bends shall be made in steel conduit. PVC conduit may only be used in straight lengths.

J. Provide end bells on ducts at utility holes. When entering a manhole, end bells shall be a pre-manufactured system (system as manufactured by Formex or equal) with conduit seals and provisions for roughing into the concrete.

K. Provide insulated, grounding bushings on duct ends in equipment enclosure.

L. Plug or cap empty conduits. Provide standard manufactured plugs.

M. Seal all ducts and conduits, at both ends with foam duct sealant to prevent the entrance of moisture and gases. Refer to Division 26 Section 260500, “Common Work Results for Electrical” for product requirements.

N. After ducts are in place and before the concrete is poured, the installation shall be inspected by the Engineer. Notify the Engineer at least two days before the time of inspection.

O. Clear conduit by rod and pull an approved test mandrel from structure to structure or from structure to the conduit termination.

P. Leave nylon or polyester pull line in each conduit, tagged to identify the conduit's point of origin, contents and final destination.

Q. Conduit Couplings: Conduit couplings shall be staggered so that couplings on adjacent conduits will not lie in the same transverse plane. End bells shall be spaced approximately 9 inches center to center at face of manhole wall for 4-inch conduits and proportionately spaced for other sizes. The change from regular conduit spacing to end bell spacing shall start 10 feet from the face of the manhole wall and shall be made in such a way that the slope of any conduit will not be less than that of the main bank and no trap will be formed. New conduit entrances into existing manholes and building walls shall enter at the most desirable locations consistent with grading requirements and existing entrance and shall be waterproofed in a satisfactory manner.

R. Bends: Conduit generally shall be straight between manholes or upturned elbows. Where bends are unavoidable in non-metallic conduits, they may be made by assembling couplings at a slight angle, provided the watertight seals are not broken and the resulting radius is not less than 100 feet. For radii less than 100 feet, 5-degree angle couplings or 5-degree factory-made bend sections shall be used.

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S. Install top of duct bank minimum 30 inches below finished grade.

T. Multiple conduit: Install multiple conduit as follows:

1. Multiple conduit runs, direct burial or in duct bank, shall be supported on preformed, non-metallic separators. Spacing between exterior surfaces of conduits generally shall be not less than the following:

a. Two (2) inches between conduits containing cables operating at not over 600 volts.
b. Two (2) inches between conduits containing cables operating at over 600 volts.
c. Two (2) inches between telecommunications conduits.
d. Six (6) inches between a telecommunications conduit and any power conduit in the same envelope.
e. Spacing between separators shall be close enough to prevent sagging of conduits and breaking of couplings and watertight seals. Separators shall also be spaced to keep deformation of conduit at the separators to 0.10 inch or less. Separators shall be secured with cords where necessary and no tie wires, reinforcing rods or other metallic materials shall be placed around the conduits, either individually or in groups, in such a manner as to form a magnetic loop.

2. Multiple conduit runs shall be arranged substantially as shown on the drawings, but minor changes in location or cross sectional arrangement shall be made as necessary to avoid obstructions. Where conduit runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, the condition shall be referred for instructions before further work is done. All underground conduit work shall be coordinated with other outside service work. Existing outside services shall be maintained in operation unless directed otherwise.

3.6. CONCRETE WORK

A. Unless otherwise indicated, all concrete work for electrical ductbanks, etc., shall be provided under this section of the work. [All concrete work shall conform to the requirements as hereinbefore specified in Division 03 entitled Concrete.] All concrete shall be minimum 3,000 psi compressive strength at 28 days. Concrete for ductbanks shall be Class B, 470 lb. of Portland cement per cubic yard.

B. Supervise the placement of concrete in the ductbank.

C. Complete entire section of conduit from utility hole to manhole or from manhole to building before encasement by concrete. The entire conduit system shall be tied together with wire and anchored to the bottom of the trench to prevent any movement or floating while pouring concrete.

D. Place concrete as specified in Section. Top of concrete envelopes shall be not less than 24 inches below grade.

E. Provide minimum of 3-inches (76mm) of concrete cover over conduit at the top, bottom, and sides of the duct bank. Provide crowned top on the concrete to prevent water accumulation. At poured manholes, tie duct and manhole reinforcing steel together to provide a permanent connection.

F. Place concrete continuously from [manhole to manhole] [utility pole] to building without interruption.

G. Extend concrete envelope to finish floor grade or interior wall surface in buildings at finish pad grade at equipment. Maintain moisture seal.

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H. Conduits in completed ductbanks shall be straight to within 1/4 inch per 100 feet in both vertical and horizontal directions.

I. Pull solid mandrels and swabs (diameter 1/4 inch smaller than conduit) through each conduit in completed ductbank before installing cables.

J. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install according to the following:

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, and secure separators to the earth and to ducts to prevent floating during concreting.

    a. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups. Provide nonferrous tie wires to prevent displacement of the ducts during pouring of concrete.
    b. Provide spacers staggered at least 6 inches vertically along the length of the duct run to eliminate the potential for a weak vertical shear plane in concrete encasements.
    c. Provide a minimum of four spacers per 20-foot interval (5 feet maximum) along the length of the duct run.

2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each run of envelope between manholes or other terminations in one continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (18mm) reinforcing rod dowels extending 18 inches (450 mm) into the concrete on both sides of joint near the corners of the envelope.
3. Reinforcing: Provide reinforcing steel bars at the top and bottom of each concrete envelope as shown on Drawings and at the present and indicated future locations, including but not limited to the following:

    a. Crossing fill or loose soil (4 feet beyond the exterior limits on each side).
    b. Crossing other utilities (8 feet beyond the exterior limits on each side).
    c. Entering buildings, manholes, vaults, etc. (20 feet beyond).
    d. Crossing vehicle roadways and parking areas (underneath and 20 feet beyond the exterior limits on each side).
    e. Rebar shall not be installed less than 2-inches from the sides of any duct.
    f. Under all pavement (6 feet beyond edge of pavement).
    g. Crossing soils and rock where the bottom of the trench is not undisturbed soil or the bearing is less than 3,000 psf, then the entire distance such conditions exist, plus 10 feet either side of these conditions.

4. Forms: Use the walls of the trench to form the side walls of the duct bank where the soil is self-supporting and concrete envelope can be poured without soil inclusions. Otherwise, use forms.
5. Minimum Clearances Between Ducts: Three inches (75 mm) between ducts and exterior envelope wall, 3 inches (75 mm) between ducts for like services, and 6 inches (150 mm) between power and signal ducts. Provide plastic spacers to maintain clearances.
6. Depth: Except as otherwise indicated, install top of duct banks at least 36 inches (900 mm) below finished grade in nontraffic areas for 600 volts and below. Install at least 36 inches (900 mm) below finished grade in vehicular traffic areas for 600 volts and above.

K. Partial Pouring: Each run of envelope between utility holes shall be poured in one continuous operation. Where more than one pour is necessary, each pour shall terminate in a vertical plane,

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and 3/4-inch reinforcing rod dowel extending 18 inches into the concrete on each side of the joint shall be provided. The number and locations of dowels shall be as approved. Partial pours shall not terminate in horizontal or angular planes.

L. Extensive Disturbed Earth: Where an envelope is installed over an extensive area of disturbed earth, such as that within the periphery of the building, a separate 3,000 psi concrete base, satisfactory, shall be provided to ensure stability of the conduits during installation. The base shall be allowed to set before the conduit bank is installed.

M. Obstructions Below Grade: Where an envelope is installed over disturbed earth, across other conduits or pipe lines or under roads or driveways, it shall be reinforced. Reinforcement shall also be provided where envelopes connect to manhole and building walls, to prevent shearing of the joints. Where envelopes are terminated for future extension, dowels shall be provided as specified above for joints between pours. Reinforcement, generally, shall consist of 3/4-inch rods located in a single layer 1-1/2 inches above the bottom of the envelope. Outside rods shall be located 1-1/2 inches in from the outside edges of the envelopes and an intermediate rod shall be placed in the center of each space between conduits in the lowest row. Provide No. 4 steel reinforcing bars in top of envelope under paved areas. Additional reinforcement shall be furnished as directed following an inspection of the trench.

N. Stub-Ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete pads, extend steel conduit a minimum of 5 feet (1.5m) from the edge of the pad and 5 feet outside of the building foundation. Install insulated grounding bushings on the terminations. Couple steel conduits to the ducts with adapters designed for the purpose and then encase coupling with 3 inches (75 mm) of concrete. Provide insulated grounding bushings on the terminations.

O. Above-Grade Conduit

1. All exposed conduit rising more than one foot (1') above the adjacent grade shall be rigid steel conduit, full weight, pipe size, finished inside and outside by a hot-dipped galvanized method. Conduit shall have threaded-type couplings and fittings with insulated end bushing. Rigid steel conduit shall extend a minimum of eighteen inches (18-inches) below grade before transition to PVC conduit.
2. Provide galvanized or cadmium-plated nails, screws, clips, or other means of securely anchoring conduit to buildings or other structures as required for a complete installation. Adequate provisions shall be taken to prevent dielectric action between dissimilar metals.

P. Sealing: Provide temporary closure at terminations of ducts that are wired under this project. Seal spare ducts at terminations. Use foam duct sealant as specified in Division 26 Section, “Common Work Results for Electrical”.

Q. Duct Entrances to Manholes: Space end bells approximately 10 inches (250 mm) on center for 5-inch (125 mm) ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet (3m) from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Provide expansion joint material between duct and handhole.

1. Duct bank envelopes connecting to underground structures shall be flared to have an enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the cut bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is placed to assure a seal between the envelope and the wall of the structure.

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R. Building Entrances: Transition from underground duct to conduit 10 feet (3m) minimum outside the building wall. Use fittings manufactured for the purpose. Follow appropriate installation instructions below.

1. Concrete-Encased Ducts: Install reinforcing in ductbanks passing through disturbed earth near buildings and other excavations. Coordinate ductbank with structural design to support ductbank at wall without reducing structural or watertight integrity of building wall.
2. Waterproofed Wall and Floor Entrances: Install a watertight entrance-sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with 1 or more integral flanges. Secure membrane waterproofing of the device to make permanently watertight.

S. Mandrelling: After concrete envelopes have set, all conduits shall be mandrelled to ensure smooth interior surfaces free from burrs or obstructions that might damage the conductor Insulation or sheaths.

3.7. CONDUIT AND DUCT INSTALLATION

A. Install nonmetallic conduit and duct as indicated according to Manufacturer's written instructions.

B. Slope: Pitch ducts a minimum of 4 inches per 100 feet (1:300) to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two (2) manholes to drain in both directions. Trenches shall be evenly graded so that conduits will have a uniform rate of fall of not less than 3 inches per 100 feet and will be free from either horizontal or vertical waves. Unless otherwise specified, each conduit shall slope uniformly from one manhole to the next or from a high point between manholes. Low points between manholes or between upturned elbows, shall be avoided wherever possible. Where it is not possible to avoid a trap or low point in a conduit which has no concrete envelope, provide a 1/2-inch hole drilled in the bottom of the conduit at the low point and a crushed stone sump of suitable volume below the conduit. If possible, install the sump above the high water table elevation for the particular location. Otherwise, provide special means to prevent the accumulation of water within the conduit.

C. Curves and Bends: Use manufactured elbows with a minimum radius of 36 inches for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet both horizontally and vertically at other locations.

D. Make joints in ducts and fittings watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

E. Installation of warning tapes: After placing a minimum of 12 –inches or a maximum of 18 inches of backfill over the ducts, place the appropriate warning tapes above and parallel to the centerline of the duct for the entire length of the duct trench.

F. Provide pull rope and measuring tape at the time a mandrel is pulled through each conduit. Record the wall-to-wall measurements and the size of mandrel used at this time. Provide this documentation to the Project Engineer on the following working day. After acceptance of these documents, the Contractor shall remove the measuring tape, leaving only the pull rope in the conduits.

G. All work and materials covered by these Specifications shall be subject to inspection at times by the Owner's designated representative. Any work concealed before it has been inspected by the Owner's designated representative shall be re-opened or uncovered and any required modification made to that portion of the work. All trenches shall be opened from manhole to manhole or manhole to building prior to laying conduit in that trench. Exceptions (such as street crossings) will be approved prior to excavation on a case-by-case basis by the Owner at a regular project meeting. These sites

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shall be inspected by the Owner's representative during excavation, installation, backfill, restoration, and cleanup.

H. Separation distance from other buried utilities as follows:

1. All others: 18-inches.

I. Cap ends of spare/empty ducts and raceways with manufactured end caps.

J. Raceways or conduits entering buildings or structures from outside shall be sealed, including spare or unused raceways. Sealants shall be identified for use with the cable/conductor insulation.

K. Raceways or conduits installed underground shall be sealed or plugged at both ends, including spare or unused raceways. Sealants shall be identified for use with the cable/conductor insulation.

3.8. DIRECT BURIED CONDUIT

A. Provide where indicated direct-buried electrical circuits utilizing Schedule 40 PVC or PVC-coated rigid galvanized steel conduit, as indicated. Conduit shall be as specified in Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”. Burial depth shall be as follows:

1. Below paved roads: 36-inches below bottom of paving.
2. Under non-vehicle concrete: 36-inches below bottom of paving.
3. Other areas: 30-inches.

B. Minimum separation from other utilities shall be the same as for ductbanks, specified previously in this Section.

C. Where feasible, and where indicated, install direct-buried lines parallel, but separated from other utility lines. Group several direct-buried conduits in a common trench where running in the same direction, or to/from the same source. All direct-buried conduits shall have yellow plastic warning tape buried midway between the conduit and finished grade. Tape shall be the same as used for ductbanks.

D. Where direct-buried conduits penetrate walls or floor slabs, seal all spaces around conduit and fittings. Provide through-wall fittings on all wall penetrations.

E. Where an underground conduit, without a concrete envelope, enters the building through a non-waterproofed wall or floor, provide a sleeve made of Schedule 40 galvanized pipe. The space between the conduit and the sleeve shall be filled with a suitable plastic expansible compound or an oakum and lead joint on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device hereinbefore specified will be acceptable in lieu of the sleeve.

3.9. IDENTIFICATION

A. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground line warning tape located directly above line at 12 inches (150 to 200 mm) below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches (400 mm) overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

B. Where two (2) or more services share a common ductbank, i.e. telephone and fiber optic, warning tape for each service shall be installed above each service’s respective conduit(s).

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3.10. RECORD DOCUMENTS

A. Provide record set data of the actual elevation of the top of each end of each raceway or ductbank at the midpoint, at no more than 100 foot intervals, where changes in elevation are less than 2 feet between data points, or 10 foot intervals when the elevation between intervals is different by 2 feet or more between data points.

B. Provide record drawings indicating actual locations of all installed ductbanks, handholes and manholes including elevations. The record drawing shall indicate location, elevation, and type of service for all utilities crossed by new ductbank.

C. Cable Records: The Contractor shall provide a complete listing of all cables installed in each conduit and ductbank, along with all cable splice locations.

3.11. FIELD QUALITY CONTROL

A. Field inspection and testing shall be performed under provisions of Division 26 Section 260500, “Common Work Results for Electrical”, in the presence of the Engineer.

B. Backfilling shall not be done until the concrete has cured for at least three calendar days.

C. Exposed surfaces of concrete shall be kept wet (damp) throughout the curing period.

D. Upon completion of the duct bank installation, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall be not less than 12 inches long, and shall have a diameter 1/4-inch less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than, the diameter of the duct.

E. Seal the ducts and conduits at building entrances, and at outdoor terminations for equipment, with a suitable non-hardening compound to prevent the entrance of moisture and gases.

END OF SECTION

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SECTION 260545 - UTILITY HOLES

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. SCOPE

A. Prefabricated and cast-in-place utility holes, utility hole accessories, and pre-cast polymer handholes.

B. Complete construction and outfitting of all new utility holes, handholes, and in-ground junction boxes.

C. Provide all labor, materials, equipment, and services necessary to provide utility holes and handholes as indicated on the Contract Drawings and as specified herein.

D. Each utility hole shall include at least the following: cast iron cover and rim, masonry collar between the cast iron cover rim and the utility hole, drain field opening, drain field, grounding rod, support members for wire or cable, and ladder.

E. The Contractor shall be responsible for the structural integrity of each utility hole as installed including its associated components such as: bearing capacity of the coil or fill supporting it, cast iron cover and rim, masonry collar, utility hole and openings through utility hole surfaces.

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1.3. RELATED WORK

A. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for excavation and backfill requirements.
2. Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables”, for conductors installed in raceways and boxes and conductor terminations.
3. Division 26 Section 260543, “Underground Ducts and Raceways for Electrical Systems” for direct-buried conduits and underground ductbanks terminating at utility holes.

1.4. QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm experienced in manufacturing underground precast concrete or cast-in-place utility structures of types and sizes required and similar to those indicated for this Project. Firm must have a minimum of a 3-year record of successful in-service performance.

B. Comply with NFPA 70: National Electrical Code and ANSI C2 National Electrical Safety Code for components and installation.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms Listed and Labeled: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications; A Nationally Recognized Testing Laboratory

(NRTL) as defined in OSHA Regulation 1910.7.

D. Coordinate layout and installation of conduits, utility holes, and handholes with final arrangement of other utilities as determined in the field.

E. Coordinate elevations of conduit and ductbank entrances into utility holes and handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and ensure duct runs drain to utility holes and handholes, and as approved by the Engineer.

F. The following Codes, Regulations, Reference Standards and Specifications apply to work included in this Section:

1. Codes and regulations of the jurisdictional authorities.
2. Codes and Standards, Section 01060:

a. AASHTO Standards: M199 - Precast Reinforced Concrete Utility Hole.
b. ANSI: C80.1.
c. ASTM: A36, A48, A153, A386, A615, C33, F512.
d. Federal Specifications:
i. TT-P-0035.
ii. RR-F-621E Frames, Covers, Gratings, Steps, Sumps, and Catch Basin Utility Hole.
iii. SS-S-210A, Sealing Compound, Pre-formed Plastic for Expansion Joints and Pipe Joints.
e. National Electrical Code, NFPA 70.
f. American Concrete Institute (ACI):
i. 318 - Building Code Requirements for Reinforced Concrete.

1.5. SUBMITTALS

A. Submit shop drawings and product data under provisions of General Conditions of the Contract and Division 26.

B. Indicate material specifications, dimensions, capacities, size and location of openings, reinforcing details, and accessory locations.

C. Submit product data for handholes.

D. Shop drawings showing details and design calculations for precast utility holes and handholes, including reinforcing steel and required load-bearing capacity. Stamp drawings with seal of a Delaware registered professional structural engineer.

1. Drawings for each size and configuration of precast utility hole and handhole with details of accessories and joints.
2. Drawings depicting size, shape, configuration and identification of all cover plates and their legends.

E. Submit site shop drawings indicating the proposed locations of all utility holes and handholes. Proposed deviations from the Contract Drawings shall be clearly marked on the Submittals. Shop drawings shall indicate duct profiles and coordination with other utilities and underground structures. Include plans and sections drawn to accurate scale.

F. Submit manufacturer's installation instructions under provisions of General Conditions of the Contract.

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G. Inspection report for factory inspections, according to ASTM C 1037.

H. Field test reports indicating and interpreting test results relative to compliance with performance requirements of Field Quality Control Article in Part 3 of this Section.

1.6. PROJECT RECORD DOCUMENTS

A. Submit under provisions Division 26 Section 260500, “Common Work Results for Electrical”.

B. Accurately record actual locations and depths of each utility hole and handhole. Indicate location, elevations, type of service, quantity and depth of all ductbank connections.

1.7. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Division 26 Section 260500, “Common Work Results for Electrical”.

B. Accept products on site. Inspect for damage.

C. Deliver ducts to site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

D. Store precast concrete units at site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

E. Lift and support precast concrete units only at designated lifting or supporting points.

1.8. COORDINATION

A. Obtain all available information on underground utilities before starting excavation. If underground utilities interfere with shown location of handholes, bring this to the attention of the Engineer as soon as possible. Handhole locations shall be revised or relocated only with the approval of the Engineer.

B. Coordinate exact location of each handhole centerline based on local grade, new and existing utilities, and other items which may affect placement.

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PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering the specified products that may be incorporated in the work include, but are not limited to, the following:

1. Precast Polymer Handholes and Pullboxes:

a. APC Underground
b. Hubbell Quazite (Basis of Design)
c. Jensen Precast
d. Oldcastle

2.2. PRECAST POLYMER HANDHOLES AND PULL BOXES

A. Description: Precast polymer concrete enclosures for use as hand holes, pull boxes, splice boxes or

equipment enclosures for underground utility services.

B. Construction:

1. Polymer concrete shall be made from selectively-graded aggregates in combination with a polymer resin, and shall be reinforced with fiberglass for exceptional strength and rigidity.
2. Covers shall be heavy-duty type with gasket to reduce incoming fluids into the enclosure. Covers shall be secured to enclosures with stainless steel bolts.

C. Dimensions:

1. Enclosures shall be sized as indicated on the Contract Drawings, unless otherwise noted or required by the National Electrical Code based on size and layout of conduits terminated at the same.
2. Provide enclosures where required for long underground conduit runs, in addition to enclosures indicated on the Contract Drawings.
3. Enclosures shall be no less than 11-inches x 18-inches x 18-inches deep.

D. Covers:

1. Heavy-duty type with non-skid surface, same design load (Tier level) rating as respective enclosures.
2. Tier level ratings shall be embossed on the surface of all covers.
3. Gasket to reduce incoming fluids into the enclosure, secured to enclosures with stainless steel bolts.
4. Factory embossed with lettering (minimum 1/2" high text) to identify system served by enclosure, as follows:

a.	Power, 600V or Less:	Electric
b.	Lighting:	Lighting
c.	Grounding Electrode:	Ground
d.	Telecommunications:	Communications
e.	Telephone:	Telephone
f.	Cable Television:	C.A.T.V.
g.	Optical Fiber:	Fiber Optics

E. Installation: Enclosures shall sit flush with finished grade elevation. Provide a minimum of 6-inch layer of compacted gravel for drainage, with filter cloth between handhole and gravel layer.

F. Quality Assurance:

1. Enclosures and covers shall conform to all test provisions of the most current ANSI/SCTE 77 “Specification for Underground Enclosure Integrity” for Tier 15 (minimum) applications and shall be UL listed. Refer to Contract Drawings for Tier Ratings of individual handholes.
2. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met shall be included with product submittal.

G. Basis of Design: Quazite PG style enclosures, as manufactured by Hubbell.

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PART 3 EXECUTION

3.1. EXCAVATION

A. Provide responsibility for all demolition, excavation and backfilling required to install handholes.

B. After completion of utility hole installation, return all ground and pavement surfaces to original condition or to condition as indicated on the drawings. This includes all sidewalks, curbs, streets, parking areas, lawns, shrubs, etc.

3.2. INSTALLATION

A. Install precast handholes and pullboxes in accordance with manufacturer's instructions.

B. Use gasketed precast neck and shaft sections to bring utility hole entrance to proper elevation.

C. Install utility holes plumb.

D. Set the top of each handhole to finished grade elevation.

E. Provide where indicated and where required for long underground wire runs. Larger dimensions may be required per NEC for cables involved.

F. Handholes shall be set level and adjusted for the final grade. Conduit penetrations shall be sealed with grout or waterproof sealant. All conduit ends shall have nylon or plastic bushings to prevent damage to insulation when pulling.

G. All wiring within handholes, whether spliced or not, shall be identified with permanently indented or engraved tags as to circuit origination, circuit #, and load served.

H. Cap ends of spare/empty conduits stubbed up in handholes with manufactured end caps.

I. Seal ends of conduits with conductors in handholes with foam duct sealant as specified under Division 26 Section 260500, “Common Work Results for Electrical”.

3.3. FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements upon completion of installation of underground duct and utility structures.

1. Grounding: Test utility holes grounding to ensure electrical continuity of bonding and rounding connections. Measure ground resistance at each ground rod and report results. Use an instrument specifically designed for ground-resistance measurements.
2. Duct Integrity: Rod ducts with a mandrel 1/4-inch (6 mm) smaller in diameter than internal diameter of ducts. Where rodding indicates obstructions in ducts, remove the obstructions and retest.
3. Water Tightness: Make internal inspection of utility holes and handholes three (3) months after completion of construction for indications of water ingress. Where leakage is noted, remove water and seal leak sources. Reinspect after two (2) months and reseal remaining leak sources. Repeat process at two (2) month intervals until leaks are corrected.

B. Correct installations where possible, and retest to demonstrate compliance. Otherwise, remove and replace defective products and retest.

3.4. CLEANING

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A. Pull brush through full length of ducts. Use round bristle brush with a diameter 1/2 inch (12 mm) greater than internal diameter of duct.

B. Clean internal surfaces of utility holes and handholes. Remove foreign material.

C. All necessary precautions to avoid the flooding of utility holes and conduits. If the utility holes or conduits should become flooded or littered with debris any time prior to final acceptance, pump dry and clean utility holes and ducts to the satisfaction of the Engineer.

D. Clean-Up: Remove debris from handholes and ensure complete installation is left in neat and finished condition.

END OF SECTION

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Related Sections include the following:

1. Division 26 Section 260543, “Underground Ducts and Raceways for Electrical Systems” for underground line warning tape to be installed above underground ducts and raceways.
2. Division 26 Section 260573, “Power System Studies”, for arc-flash hazard labels for electrical equipment.
3. Division 26 Section 262416, “Panelboards”, for circuit directories to be installed in panelboards.
4. Division 26 Section 262726, “Wiring Devices”, for factory-engraved device plates.

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, 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.

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.

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PART 2 PRODUCTS

2.1. RACEWAY AND CABLE LABELS

A. Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

1. Color: Black letters on orange field.
2. Legend: Indicates voltage and service as well as circuit designation for all feeders.
3. Emergency circuits shall also have legend to read “EMERGENCY”.

B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend, overlaminated with a clear, weather- and chemical-resistant coating.

C. Pretensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the line it identifies and arranged to stay in place by pretensioned gripping action when placed in position.

D. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 3/4 inch wide, in appropriate colors for system voltage and phase.

E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.2. WIRING DEVICE FACEPLATE LABELS

A. Adhesive Labels:

1. Thermal transfer printable, clear polyester material with glossy finish, 1/2" high, width as required. Printed lettering shall be 1/4" high black text.
2. Labels shall be backed with permanent acrylic adhesive and shall exhibit good adhesion to many metal and other types of surfaces, including textured surfaces and low surface energy plastics.
3. Labels shall be resistant to humidity, temperature and UV light.
4. Labels shall meet requirements of UL 969 Labeling and Marking Standard and shall be RoHS compliant.
5. Provide Brady B-432 Series, or approved equal by acceptable manufacturer.

B. Factory Labeled Faceplates:

1. Faceplates for devices on emergency and standby circuits shall be factory-engraved to read “EMERGENCY”. Refer to Division 26 Section 262726, “Wiring Devices”, for additional information.
2. Faceplates for devices on GFCI-protected circuits shall be factory engraved to read “GFCI”. Refer to Division 26 Section 262726, “Wiring Devices”, for additional information.

2.3. EQUIPMENT NAMEPLATES

A. General Nameplate Requirements:

1. Use colors prescribed by ANSI A13.1, NFPA 70 and as follows:

a. Normal Power System: White lettering on black background.
b. Emergency and Legally Required Standby Power Supply System: White lettering

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on red background, unless otherwise required by the Authority Having Jurisdiction (AHJ).

c. Optional Standby Supply Power System: White lettering on purple background, unless otherwise required by the Authority Having Jurisdiction (AHJ).

2. Backed with adhesive material formulated for the type of surface, intended use and installed location.

B. Nameplates for Dry, Interior Locations:

1. Engraving stock, melamine 3-layer plastic laminate.
2. Minimum 1/16-inch (1.6-mm) thick for signs up to 20 sq. inches (129 sq. cm)
3. Minimum 1/8-inch (3.2-mm) thick for signs larger than 20 sq. inches.

C. Nameplates for Damp/Wet Interior and Exterior Locations:

1. Weather-resistant, UV Resistant, minimum 1/8-inch (3.2-mm) thick.

D. Refer to Contract Drawings for typical nameplate details.

E. Refer to Paragraph "Equipment Identification Nameplates" under Part 3 of this Section for installation requirements.

2.4. SAFETY SIGNS

A. Comply with 29 CFR, Chapter XVII, Part 1910.45.

2.5. MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength: 50 lb (22.3 kg) minimum.
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.

1. Primer for Galvanized Metal: Single-component acrylic formulated for galvanized surfaces.
2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 EXECUTION

3.1. INSTALLATION

A. General:

1. Where mixed voltages are used in one building (e.g., 480 volts, 208 volts), each piece of equipment, including but not limited to, switchboard(s), panelboard(s), transformer(s), safety switches, enclosed controllers, outlet/pull/junction boxes, etc., on each system must be labeled for voltage in addition to other requirements listed herein.

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2. All branch circuit panelboards must be identified with the same designation used in the circuit directory in the Source Switchboard or Distribution Panelboards serving the same.
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 wiring device faceplates and electrical equipment shall be installed plumb and neatly on all equipment.
6. Install nameplates/labels parallel to equipment lines.
7. Install nameplates/labels on equipment fronts/covers unless otherwise noted.
8. Install nameplates/labels on inside face of equipment door/cover, including junction boxes, where exposed in finished spaces.
9. Secure nameplates to inside of recessed panelboards in finished locations.
10. Embossed tape will not be permitted for any application.
11. Stenciling is prohibited.
12. Labels: All labels shall be permanent and be machine-generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.
13. Label size shall be appropriate for the conductor/cable size(s), and wiring device faceplate layout. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the conductor/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. Miscellaneous Identification:

1. Individual circuit breakers, in distribution panelboards and switchboards: 1/4-inch (6 mm) text; identify circuit and load served, including location.
2. Individual circuit breakers, enclosed switches, and motor starters: 1/2-inch (13mm) text and 1/4-inch (6 mm) text; identify load served, circuit and voltage.
3. Junction boxes: 1/4-inch (6 mm) text; identify load served, circuit and voltage.

C. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

D. 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.

E. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

F. Self-Adhesive Identification Products: Clean surfaces before applying.

G. Caution Labels for Boxes and Enclosures: Provide pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background.

H. Circuit Identification Labels on Boxes:

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. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system. Refer to Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables”, for additional requirements.

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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, pull boxes, switchboards, 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 Nameplates

1. 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.
2. Install on each piece of equipment provided with factory installed disconnecting means, e.g. ERV units, where a separate external disconnecting means is not provided under Division 26.
3. Install on each variable frequency drive serving pumps, fans, etc. provided by others where a separate motor controller is not provided under Division 26.
4. Unless otherwise noted, nameplates shall identify equipment designation(s), voltage rating, and source (including source locations).
5. Nameplates for disconnect switches, motor starters, etc…, shall indicate the designation of the load served as the “equipment designation”.
6. In general, nameplates 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 ½ inch high lettering. Remaining lines of text, which shall indicate voltage ratings and source information shall utilize ¼ inch high lettering. Refer to the Drawings for nameplate examples.
7. Apply nameplates to each unit of the following categories of equipment:

    a. Panelboards.
    b. Transformers.
    c. Enclosed Switches.

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d. Enclosed Circuit Breakers.
e. Motor Controllers.
f. Generators.
g. Transfer Switches.
h. Electrical Cabinets and Enclosures.
i. Lighting Control Devices. (Enclosed Contactors, Control Panels, etc.)
j. Fire Alarm Control Panel.
k. Access Doors and Panels for Concealed Electrical Items.

N. Conduits Containing Electrical Feeders:

1. All conduits containing electrical feeders shall be identified with W.H. Brady B-500 vinyl cloth pipe markers or equivalent. Systems shall be identified as follows:

a. Labels shall be applied whenever a conduit enters or leaves a switchboard, panelboard, or a junction or pull box, and at each side of penetrations of walls or floors.
b. Apply Y-35 series individual numbers and letters to indicate feeder circuit designation followed by feeder voltage.

O. Fire Alarm: Junction box covers shall be painted red, except in finished spaces where they shall be painted to match adjacent surfaces. Box covers shall have a type written label to read “Fire Alarm” in accordance with requirements of NFPA 72.

P. Provide NEC, ANSI, and OSHA-approved DANGER - HIGH VOLTAGE warning signs on all doors of dedicated electrical rooms or closets. Where doors are located in finished areas, locate sign on the inside of the door. Coordinate mounting requirements with the Engineer. Minimum sign dimension shall be 15-inch x 11-inch.

Q. Surfaces shall be cleaned and painted, if specified, before applying markings.

R. Place markings so that they are visible from the floor.

S. Protect finished identification to ensure that markings are clear and legible when project is turned over to the Owner.

END OF SECTION

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SECTION 260573 - POWER SYSTEM STUDIES

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. SCOPE

A. Power system studies shall be performed on and include all portions of the electrical distribution system. The power system studies shall include the following:

1. Short-circuit analysis with protective device evaluation
2. Protective device time-current coordination analysis
3. Arc flash hazard analysis

B. West Pavilion:

1. The power system study for the West Pavilion shall begin at the overcurrent protective device ahead of the new pad-mounted utility transformer, to the 480Y/277V main distribution panelboard and continue through the 480Y/277V and 208Y/120V distribution systems to the branch panelboards, including dry-type transformers.

C. Greenhouse:

1. The power system study for the Greenhouse shall begin at the overcurrent protective device ahead of the pad-mounted utility transformer, to the 480Y/277V main switchboard being provided under Bid Pack B, and continue through the 480Y/277V and 208Y/120V distribution systems to the new branch panelboards, including dry-type transformers.
2. The power system study shall also include the on-site emergency/standby power supply system, including the on-site generators, transfer switch(es), and associated electrical distribution equipment.

D. The short-circuit analysis shall, at a minimum, include determining the available fault current at the following equipment:

1. Service equipment in accordance with NEC Article 110.16(B).
2. Panelboards in accordance with NEC Article 408.6.
3. Air-conditioning and refrigeration equipment in accordance with NEC Article 440.10.

E. The arc flash hazard analysis shall be per the requirements set forth in the current version of NFPA 70E – Standard for Electrical Safety in the Workplace, and shall be performed according to the latest edition of IEEE Standard 1584, the IEEE Guide for Performing Arc-Flash Calculations.

1.3. REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.

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2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Power Circuit Breakers Rated on a Symmetrical Current Basis.
4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 – National Electrical Code, latest edition.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.

1.4. SUBMITTALS

A. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the study may cause delays in equipment shipments, approval from the Engineer may be obtained for a preliminary submittal of data to ensure that the selection of device ratings and characteristics will be satisfactory to properly select the distribution equipment. The formal study will be provided to verify preliminary findings.

B. The results of the short circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. Electronic PDF copies of the report shall be provided upon request.

C. The report shall include the following sections:

1. Executive Summary including Introduction, Scope of Work and Results/ Recommendations.
2. Short-Circuit Methodology Analysis Results and Recommendations.
3. Short-Circuit Device Evaluation Table
4. Protective Device Coordination Methodology Analysis Results and Recommendations.
5. Protective Device Settings Table
6. Time-Current Coordination Graphs and Recommendations
7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
8. Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus

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location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

D. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Engineer and Owner, and other information specified.

1.5. QUALITY ASSURANCE

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered State of Delaware Professional Electrical Engineer skilled in performing and interpreting the power system studies. Report shall be signed and sealed by the Engineer..

B. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

C. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.

D. Engineering Analysis and Coordination Study shall be performed by one of the following, or an approved and qualified equal.

1. AB Engineering, LLC
   303 Dressage Court
   West Chester, PA 19382
   Telephone: 610-765-1290
   Fax: 610-785-1319
   Contact: Alton Baum, P.E.
   Contact: Chris Fultz
2. Coordinated Power Engineering, Inc.
   1340-G Charwood Road
   Hanover, MD 21076
   Telephone: 410-694-9494
   Fax: 410-694-0085
   Contact: Carl E. Rager, P.E.
3. IETC
   5410 Mt. Pigsah Road
   York, PA 17406
   Telephone: 717-252-4730
   Fax: 717-252-4793
   Contact: William N. Luddy, P.E.
4. Keystone Engineering Group, Inc.
   590 East Lancaster Avenue, Suite 200
   Frazer, PA 19355
   Telephone: 610-407-4100
   Fax: 610-407-4101
   Contact: Philip M. Gonski, P.E.
5. Potomac Testing, Inc.
   1610 Professional Blvd, Suite A
   Crofton, MD 21114
   Telephone: 301-352-1930
   Toll-Free: 1-800-331-2022
   Contact: Paul Gill, P.E.
6. Premium Power Services.
   505 School House Road

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Kennett Square, PA 19348
Telephone: 302-369-5420
Fax: 302-369-5515

7. Reuter Hanney
11620 Crossroads Circle, Suite D-E
Middle River, MD 21220
Telephone: 410-344-0300
Fax: 410-335-4389

8. Schneider Electric
9 East Court, Suite G
Owings Mills, MD 21117
Telephone: 410-559-2917
Contact: Larry Long

PART 2 PRODUCTS

2.1. STUDIES

A. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E – Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D. This study shall also include short-circuit and protective device coordination studies.

2.2. DATA

A. Contractor shall furnish all data as required for the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a list of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source contribution may include present and future motors.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.

D. If applicable, include fault contribution of existing motors in the study. The contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3. SHORT-CIRCUIT ANALYSIS

A. Transformer design impedances shall be used when test impedances are not available.

B. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities.
3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.
4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

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5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

D. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings.
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
3. Contractor shall notify Engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current.

2.4. PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title with descriptive device names.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable.

1. Electric utility's overcurrent protective device
2. Medium voltage equipment overcurrent relays
3. Medium and low voltage fuses including manufacturer's minimum melting current, total clearing, tolerance, and damage bands.
4. Low-voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full load current, magnetizing inrush current, and ANSI through fault protection curves.
6. Medium voltage conductor damage curves.
7. Ground fault protective devices, as applicable.
8. Pertinent motor starting characteristics and motor damage points, where applicable.
9. The largest feeder circuit breaker in each applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

G. Provide the following:

1. A one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series

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connected overcurrent devices and other pertinent system parameters.

3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the devices is located, and the device number corresponding to the device on the system one-line diagram
5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
6. Contractor shall notify Engineer in writing of any significant deficiencies in protection and /or coordination. Provide recommendations for improvements.

2.5. ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis (Section 2.03) and the protective device time-current coordination analysis (Section 2.04).

B. The flash protection boundary and the incident energy shall be calculated at all locations in the electrical distribution system (distribution panelboard, branch panelboards) where work could be performed on energized parts.

C. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

F. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 5 cycles.

H. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides or rear; and shall be based on a device

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located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be check amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584, Section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

L. Provide the following:

1. Results of the Arc-Flash Hazard Analysis shall be submitted to tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
2. The Arc Flash Hazard Analysis shall report incident energy values based on recommended device setting for equipment within the scope of the study.
3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.
4. The Arc-Flash Hazard Analysis shall also include copies of arc-flash hazard warning labels specified in Part 3 of this Section, for all pieces of equipment receiving a label, which shall also be included in the O&M Manual specified in Division 01.

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PART 3 EXECUTION

3.1. FIELD ADJUSTMENT

A. Contractor shall adjust relay and protective device settings according to the recommended setting table provided by the coordination study.

B. Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Contractor shall notify Engineer in writing of any required major equipment modifications.

3.2. ARC FLASH HAZARD LABELS

A. Contractor shall provide a 4.0 in. x 4.0 in. (nominal) Brady thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The labels shall be designed according to the following standards:

1. UL969 – Standard for Marking and Labeling Systems
2. ANSI Z535.4 – Product Safety Signs and Labels
3. NFPA 70 (National Electrical Code) – Article 110.16

C. The labels shall include the following information:

1. Equipment Designation
2. Source Designation
3. Fault Current (kA)
4. System Voltage
5. Flash Protection boundary
6. Personal Protective Equipment category
7. Arc Flash Incident energy value (cal/cm2)
8. Limited and restricted Approach Boundaries
9. Study report number and issue date
10. Name of Company who completed study

D. Labels shall be printed by a thermal transfer type printer, with no field markings.

E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:

1. Floor Standing Equipment – Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
2. Wall Mounted Equipment – Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

F. Labels shall be field installed by Contractor.

3.3. ARC FLASH HAZARD TRAINING

A. The vendor supplying the Arc Flash Hazard Analysis shall train the Owner's qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours).

3.4. AVAILABLE FAULT CURRENT LABELS

A. Contractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester to identify the maximum available fault current at the following equipment:

1. Service equipment in accordance with NEC Article 110.16(B).
2. Panelboards in accordance with NEC Article 408.6.
3. Air-conditioning and refrigeration equipment in accordance with NEC Article 440.10.

B. The labels shall be designed according to the following standards:

1. UL969 – Standard for Marking and Labeling Systems
2. ANSI Z535.4 – Product Safety Signs and Labels
3. NFPA 70 (National Electrical Code) – Article 110.24.

C. The labels shall include the following information:

1. Line 1 – "Maximum Available Fault Current"
2. Line 2 – "_____ Amperes"; Contractor shall field mark maximum available fault

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current available at the line terminals of the equipment.

3. Line 3 – Date of Installation

D. Labels shall be printed by a thermal transfer type printer.

E. Labels shall be field-installed by the Contractor.

END OF SECTION

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SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

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 requirements for commissioning the electrical 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. Lighting Control System(s)

a. Within Control Panels
b. Occupancy/Vacancy Sensors
c. Daylight Sensors
d. Wall Switches/Control Stations
e. Plug-Load Control

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 electrical systems, electrical, communications, 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.

1.4. CONTRACTOR'S RESPONSIBILITIES

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

B. Electrical Contractor:

1. Provide certified and calibrated 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.

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C. 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 electrical 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 electrical and emergency generator 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.

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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.

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.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1. TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that electrical 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 electrical 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. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

4. 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).

5. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

6. 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.

7. Check safety cutouts, alarms, and interlocks with life-safety systems during each mode of operation.

8. Annotate checklist or data sheet when a deficiency is observed.

9. 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.

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b. Report deficiencies and prepare an issues log entry.

3.2. 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.

C. Scope of Electrical Contractor Testing:

1. Testing scope shall include entire electrical installation, from incoming service through distribution systems to each space. It shall include measuring voltages and currents 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 Electrical Contractor shall prepare detailed testing plans, procedures, and checklists for electrical systems, subsystems, and equipment.

E. Electrical System Testing: Electrical Contractor shall prepare a testing plan to verify performance of electrical systems identified under Part 1 of this section. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of wiring to be tested, identified by identification marker. Markers shall be keyed to Drawings for each wiring sector showing the physical location of each item of equipment and electrical wiring test section. Drawings shall be formatted to allow each item of equipment and section of wiring to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all wiring systems have been tested.

F. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the electrical 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.

G. 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 electrical systems to verify proper operation of the electrical

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systems, the system it serves, the service it provides, and its location. 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

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SECTION 260919 - ENCLOSED CONTACTORS

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 enclosed contactors for control of electrical circuits rated 600V or less.

1.3. SUBMITTALS

A. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices. Provide product data on each control device specified.

B. Schedule: Prepare, and submit a contactor and relay schedule. Include the following information in the schedule.

1. Contactor Identification
2. Operator Type (Mechanical or Electrical)
3. Contact Configuration and Rating
4. Circuit Numbers Controlled
5. Enclosure Rating
6. Control Circuit
7. Voltage
8. Location

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Maintenance Data: For enclosed contactors to include in maintenance manuals specified in Division 01. Include instructions on adjusting, repairing, cleaning and lubricating each control device specified.

E. Project Record Documents: Accurately record actual locations of each enclosed contactor, and indicate circuits controlled.

1.4. QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed contactors from a single source with total responsibility for compatibility of components specified in this Section.

B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA-70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.

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C. Comply with NFPA 70, National Electrical Code.

D. Comply with NEMA ICS 2, Industrial Control Devices, Controllers and Assemblies.

E. Comply with ANSI/NEMA ICS 6, Enclosures for Industrial Controls and Systems.

1.5. COORDINATION

A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions.

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. Enclosed Contactors:

a. ABB
b. Automatic Switch Co.
c. Eaton Corporation.
d. General Electric
e. Hubbell
f. Siemens Energy and Automation, Inc.
g. Schneider Electric/Square D Co. (Basis of Design)
h. Zenith Controls, Inc.

2.2. MULTI-POLE LIGHTING CONTACTORS

A. Description: Multi-pole enclosed lighting contactors rated 30A, complying with UL 508 and NEMA ICS 2.

B. Features:

1. Operation: Electrically held.
2. Contact Ampere Rating: UL listed for 30A, consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballasts with 15 percent or less total harmonic distortion of normal load current).
3. Contact Type: Field-convertible double break contacts with N.O. and N.C. indicators. Refer to “Enclosed Contactor Schedule” on the Contract Drawings.
4. Poles: Available in two (2) through twelve (12) pole configurations. Refer to “Enclosed Contactor Schedule” on the Contract Drawings.
5. Control Circuit: 2-wire or 3-wire.
6. Coil Voltage: Match control power source. Refer to “Enclosed Contactor Schedule” on the Contract Drawings. Provide fused control power transformer for each contactor if required to suit power source.

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C. Accessories: Provide enclosed contactors with the following accessories where indicated on the "Enclosed Contactor Schedule" on the Contract Drawings.

1. On/off pushbutton
2. Hand-off-automatic selector switch
3. Red "On" pilot light, green "Off" pilot light
4. Auxiliary contacts (one N.O., one N.C.)

D. Basis of Design: Provide Square D Company Type "L" multi-pole contactors, or approved equal by acceptable manufacturer. Provide enclosure suitable for installed location in accordance with paragraph "Enclosures", this Section.

2.3. ENCLOSURES

A. Description: All contactors shall be mounted in enclosures, flush or surface mounted as required. Provide flush-mounted enclosures for contactors in finished locations.

B. Enclosures shall comply with requirements of NEMA 250 – "Enclosures for Electrical Equipment", and NEMA ICS 6 – "Enclosures Standard".

C. Enclosures shall be provided in accordance with the following requirements in order to meet environmental conditions at the installed location of each motor controller.

1. Dry, Interior Locations: NEMA Type 1.
2. Damp or Wet Locations: NEMA Type 4/4X, water-tight and dust-tight, stainless steel.
3. Laundry and Concession Areas: NEMA Type 4X, water-tight and dust-tight, stainless steel.
4. Corrosive Areas (e.g. Greenhouses, etc.): NEMA 4/4X, water-tight, dust-tight, and corrosion-resistant, glass-polyester.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install equipment level and plumb and according to manufacturer's written instructions.

B. Mount enclosed contactors according to manufacturer's written instructions and requirements in Division 26 Section 260500, "Common Work Results for Electrical".

C. All products and devices shall be installed in accessible locations.

D. Locate electrically held contactors where the eventual vibration and noise they will produce will not be objectionable to building occupants.

E. Provide enclosures for each individual component.

3.2. CONTROL WIRING INSTALLATION

A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables".

B. Wiring Method: Install all wiring in raceway as specified in Division 26 Section 260533,

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"Raceway and Boxes for Electrical Systems", unless run in accessible ceiling space and gypsum board partitions.

C. Bundle, train, and support wiring in enclosures.

D. Ground equipment.

E. Connections: 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.

F. Connect control devices to systems controlled, to achieve proper system operation.

3.3. IDENTIFICATION

A. Provide equipment nameplate(s) to identify equipment designation, power supply circuit, and load(s) controlled for each lighting control device. Refer to the Contract Drawings for additional information.

B. Identify power and control wiring according to Division 26 Section 260553, "Identification for Electrical Systems".

3.4. FIELD QUALITY CONTROL

A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.

B. Inspect control components for defects and physical damage, testing, laboratory labeling, and nameplate compliance with the Contract Documents.

C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.

D. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:

1. Continuity tests of circuits.
2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.

E. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

F. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

G. Reports: Provide written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5. CLEANING

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A. Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.6. DEMONSTRATION

A. Train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of two hours' training.
2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

NOT FOR BIDDING

SECTION 260923 - LIGHTING CONTROL 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 astronomic programmable time clocks.

B. Related Sections include the following:

1. Division 26 Section 262726, “Wiring Devices”, for toggle switches and wall-box occupancy sensors] used as lighting control devices.
2. Division 26 Section 260943, “Network Lighting Controls”, for low-voltage lighting control systems controlling interior and/or exterior lighting.

1.3. SUBMITTALS

A. Product Data: Include dimensions and data on features, components, and ratings for lighting control devices. Provide product data on each control device specified.

B. Shop Drawings: Indicate control device enclosure wiring diagrams and panel layout drawings.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

D. Maintenance Data: For lighting control devices to include in maintenance manuals specified in Division 01. Include instructions on adjusting, repairing, cleaning and lubricating each control device specified.

E. Project Record Documents: Accurately record actual locations of each lighting control device, and indicate circuits controlled.

1.4. QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control devices from a single source with total responsibility for compatibility of lighting control system components specified in this Section.

B. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA-70, Article 100, for their indicated use and installation conditions by a testing agency acceptable to authorities having jurisdiction.

C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.

D. Comply with NFPA 70, National Electrical Code.

E. Comply with NEMA ICS 2, Industrial Control Devices, Controllers and Assemblies.

F. Comply with UL 773A, Non-Industrial Photoelectric Switches for Lighting Control.

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G. Comply with ANSI/NEMA ICS 6, Enclosures for Industrial Controls and Systems.

1.5. COORDINATION

A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions. Include coordination with the following:

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. Time Clocks:

a. Diversified Electronics, Inc.
b. Grasslin Controls Corp.
c. Intermatic, Inc.
d. Leviton Manufacturing.
e. Paragon Electric Co., Inc.
f. Tork, Inc.
g. Zenith Controls, Inc.

2.2. GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: Include in all 120- and 277-V solid-state equipment. Comply with UL 1449 and with ANSI C62.41 for Category A locations.

2.3. TIME CLOCKS – ASTRONOMIC SEVEN DAY TIME SWITCH

A. Description: Astronomic seven day time switch.

B. Features:

1. Scheduling: Twenty (20) ON & OFF set points for individual programs for each day of the week. Minimum setting is one (1) minute.
2. Astronomic: Adjustable from 1 degree to 60 degrees northern or southern latitudes. Offset up to 4 hours and 59 minutes, before or after sunrise.
3. Daylight Saving: Automatic compensation.
4. Leap Year: Automatic compensation.
5. Manual Override: Until the next regularly scheduled ON or OFF, automatic operation then resumes.
6. Clock Format: AM/PM (12 hour).
7. Power Outage Backup: Permanent schedule retention. Super-capacitor provides four (4) days of real time backup.
8. Display: LCD type alphanumeric display.
9. Indication: Load status and power failure indication.

C. Electrical Characteristics:

1. Input Supply: 120-277VAC, 50/60Hz.
2. Number of Channels: Two (2).

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3. Output Dry Contacts: Single-pole, single-throw (SPST).

D. Enclosure: Indoor/outdoor NEMA 3R enclosure with lockable hasp.

E. Basis of Design: Intermatic Model ET2825CP.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install equipment level and plumb and according to manufacturer's written instructions.

B. Mount lighting control devices according to manufacturer's written instructions and requirements in Division 26 Section 260500, “Common Work Results for Electrical”.

C. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounting devices.

D. All products and devices shall be installed in accessible locations.

E. Provide enclosures for each individual component.

3.2. CONTROL WIRING INSTALLATION

A. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Division 26 Section 260519, “Low-Voltage Electrical Power Conductors and Cables”.

B. Wiring Method: Install all wiring in raceway as specified in Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”, unless run in accessible ceiling space and gypsum board partitions.

C. Bundle, train, and support wiring in enclosures.

D. Ground equipment in accordance with Division 26 Section 260526, “Grounding and Bonding for Electrical Systems”.

E. Connections: 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.

F. Connect control devices to systems controlled, to achieve proper system operation.

3.3. IDENTIFICATION

A. Provide equipment nameplate(s) to identify equipment designation, power supply circuit, and load(s) controlled for each lighting control device. Refer to the Contract Drawings for additional information.

B. Identify power and control wiring according to Division 26 Section 260553, “Identification for Electrical Systems”.

3.4. FIELD QUALITY CONTROL

NOT FOR BIDDING

A. Schedule visual and mechanical inspections and electrical tests with at least seven days' advance notice.

B. Inspect control components for defects and physical damage, testing, laboratory labeling, and nameplate compliance with the Contract Documents.

C. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.

D. Verify settings of photoelectric devices with photometer calibrated within previous six months.

E. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:

1. Continuity tests of circuits.
2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

F. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

G. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

H. Reports: Provide written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.5. CLEANING

A. Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.6. DEMONSTRATION

A. Train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of three hours' training.
2. Training Aid: Use the approved final version of maintenance manuals as a training aid.
3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION

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SECTION 260943 - NETWORK LIGHTING CONTROLS

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. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for submittal requirements, general materials, installation requirements, Record Document requirements.
2. Division 26 Section 260553, “Identification for Electrical Systems”, for labeling materials.
3. Division 26 Section 262726, “Wiring Devices”, for line voltage wallbox switches controlling lighting fixtures.
4. Division 26 Section 265100, “Interior Lighting” for interior lighting fixtures and exterior building-mounted lighting fixtures controlled by network lighting controls.
5. Division 26 Section 265600, “Exterior Lighting” for exterior lighting fixtures controlled by network lighting controls.

1.2. SUMMARY

A. This Specification provides the requirements for the installation, programming and configuration of a complete and operational network lighting control system. The system shall include, but not be limited to: server, software, bus supplies, network wall switches, network occupancy sensors, network day-light harvesting sensors, raceway, wire & cable and accessories required to furnish a complete and operational network lighting control system.

B. The network lighting control system shall be a microprocessor-based network system. All digital lighting system components shall be tested and cross-listed as compatible to ensure a fully functional system is setup and installed.

C. Furnish and install a complete network lighting control system as described herein and as shown on the plans to be: wired, connected, and left in first class operating condition. Include sufficient control unit(s), wall stations, sensors, wiring, terminations, electrical boxes & cabinets and all other necessary material for a complete operating system.

1.3. REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE):

1. C62.41 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
2. ANSI C12.20 – Accuracy Standards

B. International Organization for Standardization (ISO):

1. 9001 – Quality Management Systems.

C. National Electrical Manufacturers Association (NEMA):

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1. WD1 (R2005) - General Color Requirements for Wiring Devices.
2. WD6 – Dimensional Specifications.

D. Underwriters Laboratories, Inc. (UL):

1. 94 – Flammability Rating
2. 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
3. UL498 – Standard for Attachment Plugs and Receptacles.
4. 508 – Standard for Industrial Control Equipment.
5. UL514C – Standard for Non-metallic Outlet Boxes, Flush Device Boxes, and Covers.
6. 916 – Energy Management Equipment.
7. 924 – Emergency Lighting and Power Equipment
8. 1310 – Class 2 Power Units.
9. 1472 – Solid-State Dimming Controls.

1.4. SYSTEM DESCRIPTION

A. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.

B. The system shall be capable of turning lighting loads on/off as well as dimming lights if lighting load is capable of being dimmed.

C. All control system devices shall be networked together enabling digital communication and shall be individually addressable.

D. The system shall be capable of enabling stand-alone groups of devices to function in some default capacity even if network connectivity to the greater system is lost.

E. System shall facilitate remote operation via a computer connection.

1.5. SUBMITTALS

A. Submit under provisions of Division 01.

B. Specification Conformance Document: Indicate whether the submitted equipment:

1. Meets specification exactly as stated.
2. Meets specification via an alternate means and indicate the specific methodology used.

C. Product Data: Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

D. Shop Drawings: Provide a complete set of detailed installation drawings specific to this project that include assemblies, schedules and details as required to fully define the installation, testing, startup and other elements necessary to create a complete lighting management control system in accordance with this Specification, including:

1. Schematic (one-line diagram) of system.
2. Large scale floor plans – Indicate location, orientation, and coverage area of each sensor, group designations, etc.
3. Address Drawing – Reflected Ceiling Plan (RCP) indicating all static addresses for all addressable devices, including lighting fixtures, control devices, sensors, relays, network devices, etc.

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4. Wiring Diagrams and Schematics – Provide detailed wiring diagrams for each room type. Generic diagrams are not acceptable. Coordinate nomenclature and presentation with a block diagram, and differentiate between manufacturer-installed and field-installed wiring.

E. Samples:

1. Samples showing available color and finish selections for controls shall be submitted to the Architect.
2. Provide one sample of each field-connected device to the Division 26 Contractor for their familiarization.

F. Certifications: Submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

G. Sequence of Operation: To describe how each area operates and how any building wide functionality is described.

1.6. CLOSEOUT SUBMITTALS

A. Start-up and Commissioning Closeout Documentation

1. Lighting Control System Manufacturer to provide enhanced start-up documentation that details the start-up procedure being performed including a process to follow, details on tests performed and an area that documents any test results.
2. Contractor shall submit startup/commissioning worksheets, which must be completed prior to factory start-up.

B. Software and Firmware Operational Documentation

1. Software operating and upgrade manuals.
2. Program software backup: On a compact disc complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

C. Record Documents

1. Drawings showing the actual installed hardware and configuration to include: power circuits, control device identification, schedules of control functions, and static addresses for routers, LED drivers, controllers, sensors, and other lighting control devices.

D. Operation and Maintenance Data

1. For lighting controls to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 include the following Software manuals.

a. Adjustments of scene preset controls, fade rates and fade overrides.
b. Operation of adjustable zone controls.
c. Testing and adjusting of emergency lighting and night lighting features.
d. Operation manuals covering the installed lighting management system.
e. A complete set of Record Drawings in both hard copy (minimum 30”x42”) and electronic files in .pdf and .dwg format.

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1.7. QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Minimum five (5) years' experience in manufacture of network lighting control systems.
2. Quality System: Registered to ISO 9001 Quality Standard, including in-house engineering for product design activities.
3. Furnish electrical control equipment for complete installation and single source responsibility of lighting control.
4. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.
5. Manufacturing of all sensors shall occur in the USA. Manufacturing facility must be ROHS compliant.

B. Lighting Control System Components:

1. All applicable products must be UL / CUL Listed or other acceptable national testing organization.
2. Listed by UL specifically for the required loads. Provide evidence of compliance upon request.
3. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.
4. All sensors and related relays shall be compatible with the specific lighting types controlled.
5. All sensors shall be of the same manufacturer, mixing brands of sensors is not acceptable
6. All sensors and controlled modules connected to more than 50 VAC shall be listed by Underwriters Laboratories.
7. All sensors and related equipment shall be manufactured in the United States of America.
8. All sensors and related equipment shall have a five-year warranty.

C. Installer Qualifications:

1. Installers shall be factory-trained by the network lighting control system manufacturer.

1.8. DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Include installation, programming, and maintenance instructions.

1.9. PROJECT CONDITIONS

A. System components shall have ten-year operational life while operating continually at any temperature in an ambient temperature range of 0 degrees C (32 degrees F) to 40 degrees C (104 degrees F) and 90 percent non-condensing relative humidity.

B. Do not install equipment until the above conditions can be maintained in spaces to receive equipment.

C. Do not install products under environmental conditions outside manufacturer's absolute limits.

D. Lighting control system must be protected from dust during installation.

E. Components shall be designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

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1.10. WARRANTY

A. Provide manufacturer's warranty covering 5 years from date of purchase with factory startup.

1. Enhanced 5-year limited parts warranty, including:

a. Years 1-2:
i. 100 Percent Replacement Parts for Manufacturer Lighting System Components
ii. 100 Percent Manufacturer Labor Coverage to Troubleshoot and Diagnose a Lighting Issue
iii. First-Available Onsite or Remote Response Time
b. Years 3-5: 100% Replacement Parts Coverage

1.11. EXTRA MATERIALS

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end-user, qualified dealer or installer.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:

1. Occupancy/Vacancy Sensors: Quantity equal to one for every 20 of each type installed, but no fewer than one unit of each type.
2. Daylight Sensors: Quantity equal to one unit for every 20 sensors installed, but no fewer than one unit.
3. Power Packs: Quantity equal to one unit for every 50 modules installed, but no fewer than one of each type.
4. Infrared Partition Sensors: One of each type installed.
5. Wall Switches: Quantity equal to one unit for every 30 wall switches installed, but no fewer than one of each type.
6. Emergency Lighting Interfaces: Quantity of two of each type installed.

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 the following:

1. nLight/Acuity Controls
2. Lutron Electronics, Inc.
3. Hubbell Lighting Controls (Basis of Design)
4. Cooper (Eaton) Lighting Controls
5. WattStopper
6. Leviton Manufacturing Co, Inc.
7. Encelium

2.2. GENERAL SYSTEM REQUIREMENTS

A. Lighting control system will have: a networked backbone to allow for remote or time-based operation, intelligent lighting control devices capable of communicating on a digital network, and a system capable of operating in standalone lighting control zones.

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B. Intelligent lighting control devices shall consist of but not be limited to: occupancy sensors, photocell sensors, relays, dimming outputs, low voltage switches, manual switch stations, manual dimming stations, graphic wall control, and intelligent lighting fixtures.

C. System shall be capable of integrating directly with intelligent LED luminaires in a fashion that integration to the system be achieved through the use of interconnecting Cat5 cable.

D. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher-level network backbone.

E. All devices within the lighting control system shall be daisy-chained together with Cat5 low voltage cabling in any order

F. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

G. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or if the management software becomes unavailable.

H. All switching and dimming for a specific lighting zone shall take place within the device located in the zone itself to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

I. System shall have a primary network control device that is capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

J. System shall have a network communication device that routes communication between control zones and distributes power across up to 8 directly connected zones.

K. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.

L. System shall be capable of operating a lighting control zone according to a sequence of operation. Operating modes should be utilized only in manners consistent with local code.

1. Auto-On / Auto-Off (via occupancy sensors)
2. Manual-On / Auto-Off
3. Auto-to-Override On
4. Manual-to-Override On
5. Auto On/Predictive Off
6. Multi-Level On (multiple lighting levels per manual button press)

M. Control software shall enable logging of system performance data and presenting information in a web-based graphical format or downloadable .CSV file.

N. Control software shall enable integration with a BMS via BACnet IP.

2.3. CENTRALIZED SYSTEM CONTROL

A. System shall have a centralized processor capable of communicating and controlling downstream system control devices and linking into an Ethernet.

B. Control modules shall be powered by low voltage, and have a backlit LCD display screen.

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C. User control shall be made via finger-touch buttons with no moving parts. Buttons shall be capable of being locked for security.

D. Devices shall have RJ-45 ports for connection to other backbone devices or for connection directly to lighting control zones.

E. Devices shall automatically detect all downstream devices.

F. Devices shall have a standard and astronomical internal time clock capable of providing time based command to all devices downstream of control module.

G. Devices shall have an RJ-45 10/100 BaseT Ethernet connection.

H. Devices shall be capable of using a dedicated or DHCP assigned IP address.

2.4. CENTRALIZED COMMUNICATION DEVICES

A. Devices shall have multiple RJ-45 ports.

B. Devices shall be capable of aggregating communication from multiple lighting control zones for purpose of minimizing backbone wiring requirement back to centralized system control.

C. Devices shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a Cat5 connection.

D. Devices shall be capable of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.5. POWER PACKS

A. Power packs shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Power supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary relay packs shall switch low voltage circuits only.

B. Power packs shall accept and switch 120VAC or 277 VAC, be plenum rated, and provide Class 2 power for multiple sensors.

C. All power packs shall have two (2) RJ-45 ports.

D. Power packs shall securely mount to junction location through a threaded ½ inch chase nipple. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads.

E. Power packs shall incorporate a Class 1 relay and an AC electronic switching device. The AC electronic switching device shall make and break the load, while the relay shall carry the current in the on condition. This system shall provide full 20 Amp switching of all load types, and be rated for 400,000 cycles.

F. Power packs shall be single circuit, or two circuits. When two circuit power packs, the power packs must be wired directly to circuit breaker. Otherwise, power packs may be wired on the line or load side of the local switch.

G. Power packs for plug load control shall be rated for switching 20-Amperes.

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H. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

I. Slave modules shall be available for switching additional circuits. Slave module has same construction and specification as control module except without power supply function.

2.6. OCCUPANCY SENSORS

A. Occupancy sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

B. Sensors shall utilize passive infrared technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions.

C. For applications where a second method of sensing is necessary to adequately detect maintained occupancy, sensors with an additional technology shall be used.

D. Sensor shall be capable of mounting in multiple locations:

1. Ceiling Mount
2. Corner Mount
3. Wall Mount with on/off switch
4. Fixture Mount

E. Sensor shall be available with different sensing technologies:

1. Passive Infrared (PIR).
2. Microphonics
3. Ultrasonic

F. Low voltage sensors shall receive communication and Class 2 low voltage power via standard Cat5 low voltage cabling with RJ-45 connectors.

G. Line voltage sensors shall be capable of switching 120/277 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, and ¼ HP motors.

H. All sensors shall have two (2) RJ-45 Ports.

I. Sensors shall turn lights on only upon infrared detection.

J. Sensors shall indicate detected motion via a red LED.

K. Sensor controls shall be behind cover to resist tampering.

L. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.

M. Sensors with dimming can control 0-10 VDC dimmable LED drivers by sinking up to 20 mA of Class 2 current.

N. The occupancy sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

O. Sensors in damp and/or high humidity locations, e.g. rooms with showers, shall be suitable for use in high humidity environments.

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P. Sensors in wet locations, e.g. outdoors, shall be equipped with watertight/weatherproof enclosures and rated for use in low temperature/high humidity environments.

2.7. DAYLIGHT CONTROLS

A. Low voltage photocell shall accept 12 to 24 VAC or VDC and provide a relay for interface with remote switching system. Sensors shall interface with occupancy sensors, directly with power pack or other system as shown. Sensors shall control 0 to 10 VDC dimmable LED drivers by sinking up to 20 mA of class 2 current.

B. Low voltage dimming sensors set point shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

C. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

D. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space.

E. Dual zone option shall be available for photocell, dimming, or combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.

F. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, and ¼ HP motor load.

G. Line voltage versions of the above described dimming sensors shall be capable of powering off 120/277 VAC.

H. All sensors shall have two (2) RJ-45 jacks.

2.8. WALL SWITCHES, DIMMERS, AND SCENE CONTROLLERS

A. All switches shall recess into a single-gang switch box and fit a standard decorator style opening.

B. Communication and low voltage power shall be delivered to each device via standard Cat5 low voltage cabling with RJ-45 connectors.

C. All switches shall have two (2) RJ-45 ports.

D. All switches shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.

E. Devices with mechanical push-buttons shall be made available with custom button labeling.

F. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusions as to which of two buttons controls which load is eliminated.

G. Devices shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.

H. Devices shall be capable of selecting a lighting profile be run by the system's upstream processor

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so as to implement selected lighting profile across multiple zones.

I. Switch finishes shall be as selected by Architect.

J. Refer to details and the “Network Wall Switches Schedule” of the Contract Drawings for specific requirements.

2.9. RELAY AND DIMMING PANELS

A. Panels shall incorporate up to forty-eight (48) field-configurable latching relays at 120/277 VAC or twenty-four (24) dual phase 208/480 VAC relays. Relays shall be rated to switch up to 30A ballast loads at 277 VAC.

B. All relays shall be individually programmable, and shall have local manual override lever.

C. Panels shall have one (1) 0-10 VDC dimming output for each relay.

D. Power shall be powered from an integrated 120/277 VAC supply.

E. Panel shall have two (2) RJ-45 ports and be capable of operating as a networked device.

F. Panels shall have hinged keylock covers and field-installed voltage barrier(s) for normal/emergency use, or mixed voltage use.

G. Panels shall be UL924 listed for switching emergency circuits.

2.10. AUXILIARY INPUT / OUTPUT DEVICES

A. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.

B. Devices shall have two (2) RJ-45 ports.

C. Communication and low voltage power shall be delivered to each device via standard Cat5 low voltage cabling with RJ-45 connectors.

D. Devices shall have a dimming control output that can control 0-10 VDC dimmable LED drivers by sinking up to 20 mA of current.

E. Devices shall have an input that read a 0-10 VDC signal from an external device.

F. Device shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, or run a local/remote control profile.

G. A specific I/O device shall sense state of low voltage outdoor photocells.

2.11. BUILDING MANAGEMENT SYSTEM COMPATIBILITY

A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.

B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems

C. BACnet IP gateway software shall translate and forward lighting relay and other select control

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commands from BMS system to networked control devices.

2.12. MANAGEMENT SOFTWARE

A. Every device parameter shall be available and configurable remotely from the software.

B. The following status monitoring information shall be made available from the software for all devices for which is applicable:

1. Current Occupancy Status
2. Current PIR Status
3. Current Microphonic Status
4. Remaining Occupancy Time Delay
5. Current Photocell Reading
6. Current Photocell Inhibiting State
7. Photocell Transitions Time Remaining
8. Current Dim Level
9. Device Temperature
10. Device Delay Status

C. The following device identification information shall be made available via the software:

1. Model Number
2. Model Description
3. Serial Number
4. Manufacturing Date Code
5. Custom Label
6. Parent Network Device

D. Software shall provide at least three permission levels for users.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine substrate areas and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Lighting Management System.

B. Examine rough-in for the network lighting controls to verify actual locations of conduit connections before equipment installation.

C. Examine walls, floors, ceilings, etc. for suitable conditions where network lighting control equipment will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION

A. Install equipment in accordance with manufacturer’s installation instructions.

B. Provide complete installation of system in accordance with Contract Documents.

C. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

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D. Secure equipment to building structural elements and support according to requirements of Division 26 Section 260529, “Hangers and Supports for Electrical Systems”.

E. In order for the system to be fully commissioned and operating to specification, a database will need to be created. It is critical that the manufacturer receive information on load and control functionality so that the database can be written and fully tested by the manufacturer.

F. Define each dimmer's/relay’s load type, assign each load to a zone, and set control functions.

G. Occupancy/Vacancy Sensors:

1. Install system components in accordance with Manufacturer’s instructions. Sensor locations are approximate and are designed according to the specified manufacturer.
2. Arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensors and installation criteria.
3. Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). Provide additional sensors as required to properly and completely cover the respective room.
4. Sensors shall be mounted where they will not receive light directly from a light source or reflecting source.
5. Sensors shall be mounted at least 4 feet from HVAC vents to avoid air current interference.
6. Sensors in damp and/or high humidity locations, e.g. rooms with showers, shall be suitable for use in high humidity environments.
7. Sensors in wet locations, e.g. outdoors, shall be equipped with watertight/weatherproof enclosures and rated for use in low temperature/high humidity environments.
8. Mounting of passive infrared and dual technology sensors where columns, doors, walls, or other obstructions will block the sensor's field of view should be avoided.
9. Passive infrared coverage should not extend through doorways. Masking inserts shall be installed for PIR coverage rejection to prevent false tripping.
10. Sensors shall be positioned so that lights are activated when a person is 2 feet or less through any doorway.
11. Sensors installed in spaces without ceilings shall be installed at the same elevation as the suspended lighting fixtures in the space.

H. Daylight Sensors:

1. In order for the exterior daylight sensor to respond to daylight during the entire daylight period, the sensor should face north so that in the morning it will see daylight from the east and in the evening it will see daylight from the west. Directing the sensor due north also minimizes direct lighting exposure to the sensor which could overload the sensor.
2. Interior sensors work mainly with diffused light, as such, they have a much higher lighting gain than exterior sensors. Electric light sources can affect these sensors unless the sensors are shielded from the light given off by electric light sources.
3. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaires.

I. Label all wiring, cables and enclosures in accordance with Division 26 Section “Electrical Identification”.

J. Systems Integration:

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1. Equipment Integration Meeting Visit

    a. Facility Representative to coordinate meeting between Facility Representative, Lighting Control System Manufacturer and other related equipment manufacturers to discuss equipment and integration procedures.

K. Wiring Method:

1. Bus control wire shall be run in accordance with the requirements of this spec, local jurisdiction requirements, or Manufacture's written requirements whichever is more stringent.
2. Conductors to Class 2 occupancy sensors or photo-sensors not exceeding 12 feet may be installed in accordance with NEC Article 725 for Class 2 circuits and the support requirements of this Section.
3. Class 2 control cable over 12 feet in length shall be run in conduit or bundled and run in accordance with communication cable requirements.
4. Free-run Class 2 cable shall be supported at a minimum of every 6 feet and shall be run above ductwork and other equipment at the truss level to reduce the exposure to damage.
5. Cable supports shall use double wire ties or equivalent methods that prevent direct contact between the cable and sharp and/or hard surfaces such as running thread rods, pipe supports, and suspended ceiling wires.
6. Cable supports shall not pinch or overly tighten the cable.
7. Cable shall not be supported by ductwork, ceiling tiles, or other equipment.
8. Connections to sensors and other devices shall be strain relieved to the device or a nearby support.
9. When mounted in a ceiling tile the cable shall include at least 6 feet of coiled cable to allow tiles to be relocated.
10. Comply with manufacturer's written instructions for wiring installation or this spec whichever is more stringent.
11. Install bus wire with the minimum number of splices.

L. Wiring Within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to equipment manufacturer's written instructions.

M. Surge Protection: Install field-mounted transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

N. Equipment Grounding: Provide low-impedance "hard" copper earth grounding to ballasts, fixtures, and control mounting boxes in accordance with ballast, lamp, and control manufacturer's requirements. Floating fixture strike plates and high-impedance "safety grounds" are generally not acceptable and standard UL listed safety grounds may not be sufficient.

O. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. IDENTIFICATION

A. Identify components, and power and control wiring in accordance with Division 26 Section 260553, "Identification for Electrical Systems".

B. Identify all ceiling mounted controls in blank covered boxes with network number, device address, and type of control located in box.

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C. Label each network wiring pair within 6 inches of connection to control network bus supply or termination block. Each control network wire pair shall be labeled in accordance with Division 26 Section 260553, “Identification for Electrical Systems”, and shall include the electrical power panel name and circuit number with which the wire pair is pulled.

3.4. SERVICE AND SUPPORT

A. A Digital-Network Lighting Control System requires multiple site visits for proper startup. The first site visit ensures that the contractor is trained to install the system correctly. The second visit starts up the system and ensures that the system is operating per specification. The third visit trains the owner/end user on system operation and functionality.

B. Startup and Programming

1. Provide factory certified field service engineer to make minimum of three site visits to ensure proper system installation and operation under following parameters

a. Qualifications for factory certified field service engineer:
   i. Minimum experience of 2 years training in the electrical/electronic field.
   ii. Certified by the equipment manufacturer on the system installed.
b. Make first visit prior to installation of wiring. Review the following:
   i. Low voltage wiring requirements.
   ii. Separation of power and low voltage/data wiring.
   iii. Wire labeling.
   iv. Lighting Management Panel locations and installations.
   v. Control locations.
   vi. Computer jack locations.
   vii. Load circuit wiring.
   viii. Network wiring requirements.
   ix. Connections to other equipment.
   x. Installer responsibilities.
   xi. Power Panel locations.
c. Make second visit upon completion of installation of Network Lighting Control System:
   i. Verify connection of power wiring and load circuits.
   ii. Verify connection and location of controls.
   iii. Energize Lighting Management Panels and download system data program.
   iv. Address devices.
   v. Verify proper connection of panel links (low voltage/data) and address panel.
   vi. Download system panel data to dimming/switching panels
   vii. Check dimming panel load types and currents and supervise removal of by-pass jumpers.
   viii. Verify system operation control by control.
   ix. Verify proper operation of manufacturers interfacing equipment.
   x. Verify proper operation of manufacturers supplied PC and installed programs.
   xi. Configure initial groupings of ballast for wall controls, daylight sensors and occupant sensors.
   xii. Initial calibration of sensors.
   xiii. Obtain sign-off on system functions.
d. Make third visit to demonstrate and educate Owner’s representative on system

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capabilities, operation and maintenance. See requirements below.

2. Startup

a. Software configuration
i. Naming and association of areas and lighting zones.
b. After Hours Start-up
i. Provide factory certified Field Service Engineer to perform manufacturer's start-up procedures outside normal working hours (Monday through Friday, 7a.m. to 5 p.m.)

C. Training of customer representatives for Lighting Management Software

D. Provide factory direct technical support hotline 24 hours per day, 7 days per week.

3.5. FIELD QUALITY CONTROL

A. Manufacturer Services

1. Aim and Focus Visit

a. Facility Representative to coordinate on-site meeting with Lighting Control System Manufacturer and Architect/Engineer to make required lighting adjustments to the system for conformance with the Architect/Engineer's original design intent.

B. Complete installation and startup checks in accordance with manufacturer's written instructions to include the following:

1. Prefunction - Compliance inspection of all materials, controls, light fixtures.
2. Activate light fixtures prior to control system activation and verify that all light sources are operating at 100%.
3. Test that control bus wiring is free of wire-ground and wire-wire shorts and AC line voltage before connecting to the Bus Supply.

C. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

D. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

E. Reports: Prepare written reports of tests, inspections, verifications and observations indicating and interpreting results. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Verify normal operation of each fixture after installation.

H. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to backup source and retransfer to normal.

I. If adjustments are made to lighting control system, retest to demonstrate compliance with standards.

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3.6. DEMONSTRATION & TRAINING

A. Training Visit

1. Lighting Control System Manufacturer to provide 2 days (minimum 12 hours) additional on-site system training to site personnel.

B. On-Site Walkthrough

1. Lighting Control System Manufacturer to provide a factory certified Field Service Engineer to demonstrate system functionality to the Commissioning Agent.

C. Video Recordings

1. Provide video recordings of on-site system training sessions in accordance with Division 26 Section 260500, “Common Work Results for Electrical”.

3.7. MAINTENANCE

A. Capable of providing on-site service support within 24 hours anywhere in continental United States.

B. Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

C. System Optimization Visit

1. Lighting Control System Manufacturer to visit site six (6) months after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with the current use of the facility.

END OF SECTION

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SECTION 261120 - UTILITY INCOMING SERVICE PROVISIONS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

A. The general provisions of the Contract, including the General Requirements, apply to the work specified in this Section.

B. Related sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”.
2. Division 26 Section 260573, “Power System Studies”.
3. Division 26 Section 260533, “Raceways and Boxes for Electrical Systems”.
4. Division 26 Section 260543, “Ducts and Raceways for Electrical Systems”.
5. Division 26 Section 260526, “Grounding and Bonding for Electrical Systems”.

1.2. DESCRIPTION OF WORK

A. The Contractor shall provide all materials and labor required by the utility for service provisions.

B. The Contractor shall provide all materials and labor for complete empty conduit power, telephone and CATV distribution systems as shown on the drawings and as specified herein.

1.3. UTILITY COMPANY COORDINATION

A. Contact Miss Utility (1-800-257-7777) prior to any excavation or underground work. The Contractor shall verify the location and depth of all utilities. Provide test pits to verify location and depth of all existing utilities crossing new incoming services.

B. Contact serving utility companies immediately upon award of Contract. Do not install related equipment until fully coordinated with appropriate utilities.

C. Provide all Construction Schedules, dates of requested services, outage windows, equipment locations, etc., necessary for utility work.

D. The Contractor shall coordinate the electric and telephone services points of entry to be within twenty (20) feet (7.0 m), or as required to comply with NEC Article 800-11.

E. The Contractor shall ascertain, from the utility companies, the exact amount of work required in connection of the utilities. Work required which is not provided by the utility companies shall be provided by the Contractor.

F. Provide and coordinate all temporary services with utility companies.

G. The Contractor shall coordinate the required separation distances for all utilities.

H. The Contractor shall obtain all permits and permissions required.

1.4. SUBMITTALS

A. Certificate of Compliance: Contractor shall submit a document certifying that work complies with

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all utility company requirements including the following:

1. Construction Standards of each Utility Company.
2. Trench and cover Depth.
3. Spacing and Support of Utilities.
4. Installation of underground marking tape.
5. Pull cords and Mandrels.

B. Photographs: Contractor shall submit photographs of each utility installation at each of the above described levels of completion and attach photographs to Certificate of Compliance for verification. Submit a minimum of six (6) color 4-inch x 6-inch photographs for each utility service.

C. Submit Certificate of Compliance (and photographs if required) to each utility company for verification and approval.

D. Include Certificate of Compliance**,** photographs, and utility company approvals in O&M Manual.

E. The Contractor shall provide and submit all required documentation to each utility company, including service application, site plan and coordination drawings.

1.5. QUALITY ASSURANCE

A. Comply with the requirements of Delmarva Power Electric Service Manual.

B. Comply with the requirements of NFPA 70, National Electrical Code.

C. Comply with the NECA Standard of Installation.

D. Comply with NFPA 70E, National Electrical Safety Code.

E. Contractor shall have experience with not less than 5 comparable projects for which the Contractor completed service provisions with each utility. Contractor shall be familiar with all current utility requirements and guidelines.

F. Obtain utility company inspector's approval for all work.

PART 2 PRODUCTS

2.1. ELECTRIC UTILITY COMPANY PROVISIONS

A. The electric utility company is Delaware Electric Cooperative (DEC).

B. The point of contact at the electric utility company is:

1. Name: Troy Dickerson, PE
2. Email: TDickerson@delaware.coop
3. Phone Number: (302) 349-3125

C. Coordinate service entrance equipment and layout with power company prior to ordering or installing any service entrance equipment.

D. Furnish and install all incoming raceway.

E. Coordinate cable, conduit, lug sizes, etc., for proper interface between utility-owned/installed

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equipment and Contractor-installed equipment.

F. Provide pad for utility company's transformer as required by the Utility. If utility company furnishes pre-cast transformer pad, schedule pick up/delivery with utility company.

G. Provide grounding and clearances as required by the Utility.

H. Contractor shall furnish and install all incoming raceway and service entrance cables. If the power company plans to install cable and/or conduit, the Contractor is responsible for proper coordination of cable, conduit, lug sizes, etc., for proper interface between utility-owned/installed equipment and Contractor-installed equipment.

I. The Contractor shall ascertain from the utility companies, the available short circuit fault current.

J. Equipment for Utility Company's Electric Metering:

1. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
2. Meter Sockets: Comply with requirements of electrical power utility company.
3. Housing: NEMA 250, Type 3R enclosure.

K. All mainline disconnects, tap boxes, C/T cabinets, meter sockets, and other service equipment shall be approved by the utility company prior to ordering.

2.2. TYPICAL INCOMING SERVICE PROVISIONS

A. Pull Cords: ¼-inch nylon pull cord with 500 lb. minimum tensile strength in each conduit.

B. Conduit, Elbows, and Couplings: UL Schedule 40, EB-35, DB-60, DB-120, or ANSI/ASTM F-512 as required by utility for the specific application.

C. Spacers: Every 4 feet of conduit.

D. Splice Boxes: Purchase from utility company. Provide as required.

E. Utility Holes: Purchase from utility company. Provide as required.

F. Underground Marking: Provide detectable warning tape over all conduits.

G. Bends: Minimum 5 foot radius (horizontal) and 36-inch radius (vertical).

H. Concrete for encasement: As specified in Division 26 Section 260543, “Underground Ducts and Raceways for Electrical Systems”, unless otherwise noted on the Drawings, with air entrainment and pea gravel.

I. Backfill: Virgin soil/select backfill only. Backfill shall be stone dust, rock-free earth, or top soil with no stones larger than 1-1/2-inches in diameter permitted.

J. Miscellaneous Materials: Provide bushings, bell ends, conduit plugs and other miscellaneous materials as required by utility companies.

PART 3 EXECUTION

3.1. INSTALLATION

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A. Mandrel: Contractor shall pull a mandrel (1/2-inch smaller in diameter than the conduit, and six inches long) through each conduit.

B. Pull Cords: Pull cords shall be left in all conduits, after mandrel pull.

C. Coordination: Coordinate location of telephone and CATV wall spaces, raceways, and boxes, as necessary, to interface installation of telephone and CATV systems with other work.

D. Bushings: Provide conduit bushing at each end of all conduits.

E. Bell Ends & Plugs: Provide bell ends and plugs for each conduit.

F. Sealing Conduits: Provide duct sealant in each conduit after utility cable is installed.

3.2. UTILITY COMPANY ELECTRIC-METERING EQUIPMENT

A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company. Provide lugs as required by utility.

3.3. PREPARATION

A. Contractor shall provide conduits at all street or road crossings for all utility facilities.

B. Provide a level area at final grade for all transformer, pedestal, and utility equipment locations.

C. Coordinate utility line separation requirements between electric, water, sewer, gas, telephone and CATV.

D. Contractor shall clear area for all utility cables of rubble, debris, stumps, and other obstructions.

END OF SECTION

NOT FOR BIDDING

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

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. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for general and installation materials and methods.
2. Division 26 Section 260526, “Grounding and Bonding for Electrical Systems”, for grounding requirements specific to separately derived systems.
3. Division 26 Section 260553, “Identification for Electrical Systems”, for identification materials for labeling transformers, including, but not limited to equipment nameplates.
4. Division 26 Section 260573, “Power System Studies”, for engineering analysis involving transformers specified herein.

1.2. SUMMARY

A. This Section includes dry-type distribution and high harmonic/non-linear load transformers rated 1000 V, and less.

1.3. SUBMITTALS

A. Product Data: Include data on features, components, ratings, dimensions, weight, and performance for each type of transformer specified. Include dimensioned plans, sections, and elevation views. Show minimum clearances and installed devices and features.

B. Wiring Diagrams: Detail wiring and identify terminals for tap changing and connecting field-installed wiring.

C. Product Certificates: Signed by manufacturers of transformers certifying that the products furnished comply with requirements.

D. Field Test Reports: Indicate and interpret test results for tests specified in Part 3 of this Section.

E. Maintenance Data: For transformers to be included in the Operation and Maintenance Manuals specified in Division 01 and Division 26 Section 260500, “Common Work Results for Electrical”.

F. Project Record Documents: Record actual transformer locations.

1.4. QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to requirements specified in Division 01 Section “Quality Control”, an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907; or shall be a full-member company of the International Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International

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Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3 of this Section.

B. Listing and Labeling: Provide transformers 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.

1.5. DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

B. Store and protect equipment in a dry location with uniform temperature. Cover ventilation openings to keep dust out.

1.6. WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

1.7. EXTRA MATERIALS

A. Touchup Paint: Provide one (1) standard size canister of manufacturer’s touch-up paint for every five (5) transformers, finish to match standard enclosure finish as specified herein. Furnish at least one (1) canister of touch-up paint.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers: No other manufacturers are acceptable.

1. Square D Company. (Basis of Design)
2. Eaton/Cutler-Hammer.
3. Acme Electric Corp.; Transformer Division.
4. General Electric (GE)
5. Hammond Power Solutions (HPS)
6. Powersmiths.

2.2. TRANSFORMERS, GENERAL REQUIREMENTS

A. Description: Factory-assembled and tested, air-cooled units of types specified, designed for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

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C. Coils: Continuous copper windings without splices, except for taps.

D. Coil Conductors: Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies.

E. Internal Coil Connections: Brazed or pressure type.

F. Enclosure: Class complies with NEMA 250 for the environment in which installed. Comply with NEMA ST 20.

G. Nameplates: Include transformer connection data and overload capacity based on rated allowable temperature rise.

H. Basic Impulse Level: 10 kV for transformers less than 300 kVA.

2.3. ENERGY EFFICIENT GENERAL PURPOSE TRANSFORMERS

A. Description

1. Dry-type distribution transformers for general loads, single and/or three-phase, with primary and secondary voltages of 600 V and less and capacity ratings 15kVA through 750kVA.

B. Standards

1. Transformers 750kVA and smaller shall be listed by Underwriters Laboratories.
2. Conform to the requirements of ANSI/NFPA 70.
3. Transformers are to be manufactured and tested in accordance with NEMA ST20 and UL 1561.
4. Transformers shall be low loss type with minimum efficiencies per US Department of Energy (DOE) 2016 Standards, as defined in the Code of Federal Regulations, 10 CFR 431.192.

C. Manufacturers

1. Approved manufacturers shall be registered firms in accordance with ISO 9001 SIC3612 (US); which is the design and manufacture of low voltage dry type power, distribution and specialty transformers.

D. Ratings Information

1. Transformers 25kVA and larger shall have a minimum of 4 – 2.5% full capacity primary taps. Exact voltages and taps to be as designated on the plans or the transformer schedule.
2. All insulating materials are to exceed NEMA ST20 standards and be rated for 220 degrees C UL component recognized insulation system.
3. Transformers 15kVA and larger shall be 150 degrees C temperature rise above 40 degrees C ambient.
4. The maximum temperature of the top of the enclosure shall not exceed 50 degrees C rise above a 40 degrees C ambient.

E. Construction

1. Transformer coils shall be of continuous wound construction and shall be impregnated with non-hygroscopic, thermosetting varnish.
2. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux

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densities are to be kept well below the saturated point to prevent core overheating. Cores for transformers greater than 500kVA shall be clamped utilizing insulated bolts through the core laminations to ensure proper pressure throughout the length of the core. The completed core and coil shall be bolted to the base of the enclosure, but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

3. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.
4. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be ANSI 49.

F. Sound Levels

1. Sound levels shall be warranted by the manufacturer not to exceed the following: 15 to 50 KVA - 45dB; 51 to 150kVA – 50dB; 151 to 300kVA – 55dB; 301 to 500kVA – 60dB; 501 to 700kVA – 62dB; 701 to 1000kVA – 64dB; 1001 to 1500kVA – 65dB; 1501 to 2000kVA – 66dB

2.4. BUCK-BOOST TRANSFORMERS

A. Description: Insulating autotransformers with a single winding with two end terminals, and one or more terminals at intermediate tap points, which are used to slightly adjust an application's voltage up or down.

B. Ratings / Electrical Characteristics:

1. Contractor shall select primary and secondary voltages and VA rating based on application and load being served. The following options shall be available at a minimum:

a. 120V x 240V primary with a 12/24V or 16/32V secondary
b. 240V x 480V primary with a 24/48V secondary
c. 50VA to 3kVA

2. Temperature Rise:

a. 50VA through 150VA - 55°C
b. 250VA through 500VA - 80°C
c. 750VA through 3kVA - 115°C

C. Transformers shall be designed, manufactured and tested in accordance with the following standards:

1. UL 506 - "Specialty Transformers"
2. ANSI Z535.3 - "American National Standard for Criteria for Safety Symbols"
3. NEMA ST20 - "Dry Type Transformers for General Applications"

D. Enclosure: Transformers shall be equipped with a wall-mounted NEMA 3R rated enclosure designed and constructed for indoor or outdoor use.

E. Basis of Design: Square D Company, Class 7414

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2.5. CONTROL AND SIGNAL TRANSFORMERS

A. Units comply with NEMA ST 1 and are listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide capacity exceeding peak load by 50 percent minimum.

C. Description: Self-cooled, 2 windings.

2.6. FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

B. Outdoor Units: Comply with ANSI C57.12.28.

PART 3 EXECUTION

3.1. INSTALLATION

A. Comply with safety requirements of IEEE C2.

B. Arrange equipment to provide adequate spacing for access and for circulation of cooling air.

C. Identify transformers and install warning signs according to Division 26 Section 260553, “Identification for Electrical Systems”.

D. 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.

E. Install transformers in accordance with NECA SI, as indicated on the Drawings, and Manufacturer's published instructions, at locations as indicated on the Drawings.

1. Use Manufacturer-approved mounting brackets for transformers supported from building structure.
2. Securely anchor transformers to concrete pad for floor-mounted transformers.
3. Provide working clearances in conformance with NFPA 70.
4. Provide primary and secondary protection using fuses or circuit breakers as indicated on the Drawings.

F. Set transformers plumb and level.

G. Use minimum two (2) foot length flexible conduit for connections to transformer case. Make conduit connections to side panel of enclosure.

H. Mount transformers on vibration isolating pads suitable for isolating transformer noise from building structure.

I. Provide minimum 4-inch high concrete pad for floor-mounted transformers. Refer to Division 26 Section 260500, “Common Work Results for Electrical”, for installation requirements.

J. Verify mounting supports are properly sized and located, including concealed bracing in walls.

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3.2. GROUNDING

A. Separately Derived Systems: Comply with requirements of National Electrical Code Article 250.30 – The grounding electrode conductor (GEC) connection shall be made at the source of the separately derived system (i.e. the transformer) in the transformer enclosure, where the system bonding jumper shall also be installed. Provide supply-side bonding jumper from transformer to first disconnecting means or overcurrent device after the transformer.

B. Comply with Division 26 Section 260526, “Grounding and Bonding for Electrical Systems”, for materials and installation requirements.

C. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

3.3. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection:

1. Inspect for defects and physical damage, labeling, and compliance with requirements of drawings and schedules.
2. Clean transformers using Manufacturer’s approved methods and materials.
3. Verify that transformer nameplates are installed and accurate.
4. Verify that transformer phase identification nameplates are installed.
5. Verify that transformer arc flash hazard labels are installed.
6. Check mounting, area clearances, and alignment and fit of components.
7. Check tightness of bolted electrical connections with calibrated torque wrench.
8. Refer to manufacturer’s instructions for proper torque values.
9. Verify that neutral bar is bonded to ground bar with appropriately sized bonding jumper.
10. Verify that equipment ground bar is bonded to transformer enclosure. Securing ground bar to vent opening is not acceptable.

B. Transformer Electrical Tests: Include the following minimum inspections and tests according to manufacturer's written instructions to ensure transformer is operational within industry and manufacturer's tolerances, is installed according to the Contract Documents, and is suitable for energizing. Comply with IEEE C57.12.91 for test methods and data correction factors.

1. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in the original Contract Documents.
2. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
3. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
4. Insulation Resistance Testing: Perform megohm meter tests of primary and secondary winding to winding and winding to ground, as follows:

a. Minimum Test Voltage: 1000 Vdc.
b. Minimum Insulation Resistance: 500 megohms.
c. Duration of Each Test: 10 minutes.
d. Temperature Correction: Correct results for test temperature deviation from 20 degrees C standard.
e. Compare test results with specified performance or manufacturer’s data. Correct deficiencies identified by tests and retest.
f. Prepare reports certified by testing agency identifying equipment checked and

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describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

5. Infrared Scanning: Perform an infrared scan of all electrical connections in each transformer, as follows:

   a. Remove equipment covers so terminations are accessible to scanner.
   b. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.
   c. Provide calibration record for device.
   d. Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.
   e. Prepare reports certified by testing agency identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

6. Test Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

3.4. CLEANING

A. On completion of installation, inspect components. Remove paint splatters and other spots, dirt, and debris. Repair scratches and mars on finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.5. ADJUSTING

A. Record transformer secondary voltages at each transformer for at least 48 hours of typical occupancy. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written test report recording output voltages and tap settings.

C. Occupancy Adjustments: When requested within twelve (12) months of Substantial Completion, provide on-site assistance in readjusting transformer tap settings to suit actual occupied conditions. Provide up to two (2) visits to the project site for this purpose at no additional cost. Make voltage recordings at equipment/outlets selected by Owner, and record transformer secondary voltages for up to 48 hours.

END OF SECTION

NOT FOR BIDDING

SECTION 262416 - PANELBOARDS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for general materials and installation methods.
2. Division 26 Section 260553, “Identification for Electrical Systems”, for identification materials for labeling panelboards, including, but not limited to equipment nameplates.
3. Division 26 Section 260573, “Power System Studies”, for engineering analysis involving panelboards specified herein, including but not limited to short-circuit analysis.
4. Division 26 Section 262418, “Load Centers”, for load centers rated 240V and less.

1.2. SUMMARY

A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

B. Provide design and engineering, labor, material, equipment, related services and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for panelboards as required for the complete performance of the work, and as shown on the Drawings and as specified herein.

C. Panelboards shall be fully or series rated for the AIC identified on the panelboard schedules on the Contract Drawings. Panelboards shall be tested, listed, and labeled for the available short circuit current.

D. Minimum short-circuit current ratings for panelboards shall be verified by short circuit analysis specified under Division 26 Section 260573, “Power System Studies”, prior to ordering equipment.

1.3. REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

B. American Society of Testing Materials (ASTM):

1. ASTM E 329, “Standard Specification for Agencies Engaged in the Testing and/or inspection of Materials Used in Construction.”

C. Federal Specifications (FS):

1. FS W-C-375, “Circuit Breakers, Molded Case, Branch Circuit and Service.”

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D. International Electrical Testing Association (NETA):

1. NETA ATS, “Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.”

E. International Organization for Standardization (ISO):

1. ISO 9001, “Quality Management Systems – Requirements.”

F. National Electrical Contractors Association (NECA):

1. NECA 407, “Standard for Installing and Maintaining Panelboards.”

G. National Electrical Manufacturers Association (NEMA):

1. NEMA PB 1, “Panelboards.”
2. NEMA PB 1.1, “General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.”
3. NEMA PB 1.2, “Application Guide for Ground Fault Protective Devices.”

H. National Fire Protection Association (NFPA):

1. NFPA 70, “National Electrical Code.”
2. NFPA 70B, “Electrical Equipment Maintenance.”
3. NFPA 70E, “Standard for Electrical Safety in the Workplace.”

I. Underwriters Laboratories, Inc. (UL):

1. UL 50, “Standard for Enclosures for Electrical Equipment.”
2. UL 67, “Standard for Panelboards.”
3. UL 489, “Standard for Molded-Case Circuit Breakers and Circuit Breaker Enclosures.”
4. UL 943, “Standard for Ground-Fault Circuit Interrupters.”
5. UL 1449, “Standard for Surge Protective Devices.”

1.4. SUBMITTALS

A. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications.

1. Submit product data for each type of panelboard, overcurrent protective device, surge protective device, ground fault protector, accessory, and component indicated.
2. Include dimensions and manufacturer’s technical data on features, performance, electrical characteristics, ratings, and finishes of individual protective devices and auxiliary components.

B. Shop Drawings: Include the following for each panelboard:

1. Dimensioned Plans: Show dimensioned enclosure plans and elevations, including required clearances and service space.
2. Component and Device Lists: Show tabulations of installed devices, features and voltage rating.
3. Single-Line Diagram: Show main- and branch-bus current ratings and short-time and short-circuit ratings of panelboards.
4. Nameplate Legends: Submit sample equipment nameplates for panelboards.

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C. Quality Control Submittals: Submit field quality control test reports certified by testing agency.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article. Include certificates for field testing agency, signed by Contractor, certifying that agency complies with requirements specified in Quality Assurance Article below.

E. Contract Closeout Submittals:

1. Operation and Maintenance Data: Submit operation and maintenance data for panelboards to include in operation and maintenance manuals specified in Division 01.
2. Warranty Data: Submit manufacturer's standard warranty documents.
3. Panelboard Circuit Directories: For installation in panelboards. Submit final versions in operation and maintenance manuals.
4. Project Record Data: Record actual locations of panelboards, indicating actual branch circuit arrangement.

1.5. QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of panelboards of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.

B. Installer Qualifications: Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing panelboards similar in type and scope to that required for this Project.

C. Testing Agency Qualifications: In addition to the requirements specified in Division 01 Section Quality Control an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical Testing Association.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3 of this Section.

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 as defined in OSHA Regulation 1910.7.

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1.6. DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

C. Store so condensation will not occur on or in panelboards. Provide temporary heaters as required to avoid condensation.

D. Handle panelboards according to NEMA PB 1.1. Use only factory-installed lifting provisions.

1.7. PROJECT CONDITIONS

A. Environmental Requirements: Do not install panelboards until space is enclosed and weatherproof, wet work space is completely and nominally dry, overhead work is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

B. Verify Dimensions: Verify NEC and all Code clearance requirements by field measurements. Locate panelboards to meet installation tolerances.

C. Determine suitable path for moving panelboard(s) into place considering Project conditions.

D. Revise locations and elevations from those indicated as required to suit Project conditions.

1.8. WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

1.9. EXTRA MATERIALS

A. Keys: Provide two (2) spares of each type of panelboard cabinet lock.

B. Touchup Paint: Provide one (1) standard size canisters of manufacturer's touch-up paint for every ten (10) panelboards, finish to match standard enclosure finish as specified herein. Furnish at least one (1) canister of touch-up paint.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers; no other manufacturers are acceptable:

1. Square D Company. (Basis of Design)
2. Eaton Corp.; Cutler-Hammer Products.
3. General Electric (GE)
4. Siemens Energy & Automation Inc.

B. Replacement circuit breakers for existing panelboards 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.

2.2. FABRICATION AND FEATURES

A. Enclosures: Provide steel enclosures, in compliance with NEMA PB1, suitable for flush- or surface-mounting as indicated on the Drawings. Type as indicated on the Drawings, unless otherwise indicated to meet environmental conditions at installed location as indicated below:

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1. Dry, Interior Locations: NEMA 1
2. Damp, Wet Interior Locations: NEMA 4X Stainless Steel
3. Damp, Wet Exterior Locations: NEMA 4X Stainless Steel
4. Corrosive Environments: NEMA 4X Stainless Steel

B. NEMA 1 enclosures shall be surface or flush mount as indicated in associated schedules or drawings. NEMA 3R enclosures shall be surface mount only.

C. Enclosure Finish for Indoor Units: A minimum of one (1) coat of factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

D. Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush-mounted panelboards shall overlap box, unless otherwise indicated.

E. Panelboard trim shall be dead-front construction covering all energized parts.

F. Buses and Connections: Three phase, four wire, unless otherwise indicated.

1. Bus Composition: Silver-plated or tin-plated copper, hard-drawn, minimum of 98 percent conductivity. Plating shall be applied continuously to bus work. The panelboard bussing shall be of sufficient cross-sectional area to meet UL 67 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown on the Drawings. Coordinate bus short circuit rating with available fault current. Size in accordance with NEMA PB 1.
2. Phase and Neutral Buses: Provide mechanical lugs to accommodate the quantity, size, and material of the conductors shown on the Contract Drawings.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.
4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity the entire length of the panelboard. Provide for future extensions from both ends.
5. Neutral Buses: 100 percent of the ampacity of the phase buses, except as indicated, and equipped with approved pressure connectors for outgoing circuit neutral cables.

G. Future Devices: Equip with mounting brackets, supports, bus connections, and appurtenances for the overcurrent protective device ampere ratings indicated on the Drawings.

H. Directory Frame: Clear plastic cardholder, mounted inside each panelboard door.

I. Service Equipment Approval: Listed for use as service equipment for panelboards with main service disconnect.

J. Special Features: Include the following features for panelboards as indicated:

1. Provide 200 percent rated neutral bus for all computer and non-linear loads.
2. Subfeed: Over-current protective device or lug provision as indicated.
3. Feed-Through Lugs: Provide mechanical lugs to accommodate the quantity, size, and material of the conductors shown on the Contract Drawings.
4. Gutter Barrier: Arranged to isolate section of gutter as indicated.

2.3. OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent protective devices include, but are not limited to, the following:

1. Electronic trip circuit breakers.

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2. Thermal magnetic circuit breakers.
3. Current-limiting circuit breakers.

B. Molded-Case Circuit Breaker Features and Accessories:

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2. Lugs: Mechanical style, suitable for quantity, size/gauge, and material of conductors indicated.
3. Application Listing: Appropriate for application, including switching lighting loads (Type SWD) or heating, air-conditioning, and refrigerating equipment (Type HACR).
4. Handle Padlock Attachment: Circuit breakers in panelboards shall be equipped with fixed handle padlock attachment to allow padlocking the circuit breaker in the ON or OFF position at the following locations:

    a. Main circuit breakers in all panelboards.
    b. Branch or sub-feed circuit breakers serving other panelboards.
    c. Branch or sub-feed circuit breakers serving transformers.
    d. Other locations as indicated on the Contract Drawings.

5. Handle Clamp Attachment: Circuit breakers in panelboards shall be equipped with removable handle clamp attachments to prevent accidental operation of the circuit breaker at the following locations:

    a. Branch circuit breakers serving emergency lighting and exit signs.
    b. Branch circuit breakers serving fire alarm equipment.
    c. Branch circuit breakers serving telecommunications equipment.
    d. Branch circuit breakers serving refrigerators.
    e. Branch circuit breakers serving electric heating cables.
    f. Other locations as indicated on the Contract Drawings.

6. Shunt Trip: Trips the circuit breaker from a remote location by means of a trip coil energized from a separate circuit.

    a. 12/24 Vac/Vdc coil set to trip at 75 percent of rated voltage for shunt trip coils interlocked with the fire alarm system, e.g. circuit breakers serving foodservice equipment under kitchen ventilation hoods.
    b. 120 Vac coil set to trip at 55 percent of rated voltage for shunt trip coils interlocked with emergency pushbuttons, e.g. lab panelboards.

7. Ground Fault Protection: Integral to circuit breaker with adjustable pickup and time delay settings, push-to-test feature, and ground-fault indicator.

2.4. DISTRIBUTION PANELBOARDS

A. Interior

1. Continuous main current ratings as indicated on Contract Drawings not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests in accordance with UL 67.
2. Provide UL listed short-circuit current ratings (SCCR) as indicated on the Contract Drawings, not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main circuit breaker panelboards shall be suitable for use as Service Equipment when application

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requirements comply with UL 67 and NEC Articles 230.VI and VII.

3. Minimum short-circuit current ratings for distribution panelboards shall be verified by short circuit analysis specified under Division 26 Section 260573, "Power System Studies", prior to ordering equipment.
4. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
5. The bussing shall be fully rated with sequentially phased branch distribution. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel mounting pan by fasteners.
6. Interior trim shall be of dead-front construction to shield user from all energized parts.
7. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
8. A solidly bonded equipment ground bar shall be provided.
9. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. Gutter mounted neutral will not be acceptable.

B. Main Circuit Breakers – Electronic Trip Molded Case Type

1. Electronic trip, molded case, 80% (unless otherwise indicated) rated circuit breaker with Micrologic® interchangeable ammeter trip unit with the following time/current response adjustments:

    a. Long Time Pickup
    b. Long Time Delay
    c. Short Time Pickup
    d. Short Time Delay
    e. Instantaneous Settings

2. Circuit breakers where the highest continuous current trip setting can be adjusted to 1200A or higher, shall be equipped with arc energy reducing maintenance setting, in compliance with National Electrical Code Article 240.87.
3. All adjustments shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
4. Circuit breaker trip system shall be microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13th) harmonic.
5. Sensor ampere ratings shall be as indicated herein or on the Drawings.
6. Local visual trip indication for overload, short circuit and ground fault trip occurrences.
7. Long time pickup indication shall signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker.
8. Provide phase loss/failure relay that will trip main circuit breaker on loss of any single phase for distribution panelboards used as service entrance equipment. Main circuit breaker shall not trip during total power outage or loss of all three phases.
9. Basis of Design: Square D Company, Micrologic® Power Trip Units.

C. Group Mounted Circuit Breakers Through 1200A

1. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
2. Circuit breaker(s) equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breaker(s) shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breaker(s) of different frame sizes shall be capable of being mounted across from each other.
3. All unused spaces provided, unless otherwise specified, shall be fully equipped for future

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devices, including all appropriate connectors and mounting hardware.

4. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.

D. Electronic Trip Molded Case Circuit Breakers

1. Electronic trip, molded case, 80% (unless otherwise indicated) rated circuit breaker(s) with Micrologic® interchangeable ammeter trip unit and the following time/current response adjustments:

   a. Long Time Pickup
   b. Long Time Delay
   c. Short Time Pickup
   d. Short Time Delay
   e. Instantaneous Settings

2. Circuit breakers where the highest continuous current trip setting can be adjusted to 1200A or higher, shall be equipped with arc energy reducing maintenance settings, in compliance with National Electrical Code Article 240.87.
3. All adjustments shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
4. Circuit breaker trip system shall be micro-processor based true RMS sensing designed with sensing accuracy through the thirteenth (13th) harmonic.
5. Sensor ampere trip ratings shall be as indicated on the Drawings.
6. Local visual trip indication for overload, short circuit and ground fault trip occurrences.
7. Long time pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.

E. Thermal Magnetic Molded Case Circuit Breakers

1. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
2. Ampere ratings shall be as shown on the Contract Drawings.
3. Ampere interrupting capacity ratings shall be as shown on the Contact Drawings, but not less than 18,000 AIC RMS symmetrical amperes at rated voltage.

F. Enclosures

1. Type 1 Enclosures

   a. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Zinc-coated galvannealed steel will not be acceptable.
   b. Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.
   c. Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
   d. Trim front door shall be 4-piece surface and shall have rounded corners and edges free of burrs.
   e. Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike.

G. Basis of Design – Square D Company, I-LINE Distribution Panelboards.

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2.5. BRANCH CIRCUIT PANELBOARDS

A. Interior

1. Minimum short-circuit current ratings shall be as indicated on the Contract Drawings, but not less than 10,000 AIC RMS symmetrical amperes for 120/208V panelboards, and 18,000 AIC RMS symmetrical amperes for 277/480V panelboards.
2. Minimum short-circuit current ratings shall be verified by short circuit analysis specified under Division 26 Section 260573, “Power System Studies”, prior to ordering equipment.
3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat rise tests conducted in accordance with UL 67. Bus bar plating shall run the entire length of the bus bar.
4. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Article 230.
5. All current carrying parts shall be insulated from ground and phase to phase by high dielectric strength thermoplastic.
6. Interior trim shall be of dead front construction to shield user from energized parts. Dead front trim shall have pre-formed twist-outs covering unused mounting space.
7. Interiors shall be field convertible for top or bottom incoming feed.
8. Main circuit breakers shall be vertically mounted, unless otherwise indicated.
9. Sub-feed circuit breakers shall be vertically mounted.
10. Interior leveling provisions shall be provided for flush mounted applications.
11. Main lug interiors up to 400 amperes shall be field convertible to main breaker.

B. Main Circuit Breakers

1. Main circuit breakers shall have an over-center, trip free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and instantaneous magnetic trip elements in each pole. Each thermal element shall be true RMS sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.
2. Two and three pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push to trip button for maintenance and testing purposes.
3. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL listed for reverse connection without restrictive line or load markings.

C. Branch Circuit Breakers

1. Molded case branch circuit breakers shall have bolt-on type bus connectors.
2. Circuit breakers shall have an over-center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and instantaneous magnetic trip elements in each pole. Two and three pole circuit breakers shall have common tripping of all poles.
3. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI TRIP indicator appearing in the clear window of the circuit breaker housing.
4. Circuit breakers serving transformers or other panelboards shall be equipped with factory-installed, fixed, handle padlock attachment to allow padlocking circuit breakers in the OFF only position.

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D. Enclosures

1. Type 1 Enclosures

a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
b. Boxes shall have removable end-walls with knockouts located on one end. Boxes shall have welded interior mounting studs.
c. Fronts shall meet strength and rigidity requirements per UL 50 standards. Front shall be finished with ANSI 49 gray baked enamel electrodeposited over cleaned phosphatized steel.
d. Panelboards shall have hinged front cover with entire front trim hinged to box with standard door within hinged front cover.
e. Front shall not be removable with the door locked.
f. Doors on front shall have rounded corners and edges shall be free of burrs.
g. A clear plastic directory card holder shall be mounted on the inside of the door.
h. All lock assemblies shall be keyed alike, one (1) key shall be provided with each lock.

2. Type 3R/5/12 Enclosures

a. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be finished with ANSI 49 gray baked enamel electrodeposited over cleaned phosphatized steel.
b. Doors shall be gasketed and be equipped with a locking vault handle.
c. A clear plastic directory card holder shall be mounted on the inside of the door.
d. All lock assemblies shall be keyed alike, one (1) key shall be provided with each lock.

3. Type 4/4X Enclosures (Stainless Steel)

a. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be finished with Type 316s stainless steel.
b. Doors shall be gasketed and be equipped with a locking vault handle.
c. A clear plastic directory card holder shall be mounted on the inside of the door.
d. All lock assemblies shall be keyed alike, one (1) key shall be provided with each lock.

E. Basis of Design: Square D Company NF Series Panelboards for 480Y/277V power supply systems, and Square D Company NQ Series Panelboards for 208Y/120V and 120/240V power supply systems.

2.6. SURGE PROTECTIVE DEVICES

A. Description: Integrated Surge Protective Devices (SPDs) in panelboards.

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

1. Square D Company - "IMA" Series
2. Eaton Corporation; Cutler-Hammer Products
3. Siemens Energy & Automation, Inc.
4. General Electric (GE)

C. The manufacturer of the SPD shall be the same as the manufacturer of the electrical distribution

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equipment in which the SPDs are installed and shipped.

D. Standards - Most recent editions of:

1. Underwriters Laboratories:

   a. UL 1449 - "Surge Protective Devices"
   b. UL 1283 - "Electromagnetic Interference Filters"

2. ANSI/IEEE C62.41.1-2002, C62.41.2-2002, C62.45-2002
3. National Electrical Code: Article 285 - "Surge Protective Devices, 1 kV or Less"

E. Listing Requirements:

1. SPD shall bear the UL Mark and shall be Listed to most recent editions of UL 1449 and UL 1283. "Manufactured in accordance with" is not equivalent to UL Listing and does not meet the intent of this Specification.

F. SPD shall be UL labeled with 200kA Short Circuit Current Rating (SCCR). Fuse ratings shall not be considered in lieu of demonstrated withstand testing of SPD, per 2008 NEC Article 285.6

G. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including Neutral-Ground (N-G), shall be protected by internal overcurrent and thermal over-temperature controls.

H. SPD shall be UL labeled with 20kA I-nominal (I-n) for compliance to UL 96A - "Installation Requirements for Lightning Protection Systems" for Master Label Certificate, and NFPA 780 - "Standard for the Installation of Lightning Protection Systems."

I. Minimum surge current capability (single pulse rated) per phase shall be as follows:

1. Distribution Panelboards: 240kA
2. Branch Panelboards: 120kA

J. SPD shall provide surge current paths for all modes of protection: Line-Neutral (L-N), Line-Ground (L-G), and Neutral-Ground (N-G) for Wye systems; Line-Line (L-L), and Line-Ground (L-G) in Delta and impedance grounded Wye systems.

K. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120V	700V	700V	1200V	700V
480Y/277V	1200V	1200V	1800V	1200V

L. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	MCOV	Allowable System Voltage Fluctuation (%)
208Y/120V	150V	25%
480Y/277V	320V	15%

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M. SPD shall be constructed of one self-contained suppression module per phase.

N. Visible indication of proper SPD connection and operation shall be provided. SPD shall include LED indicator lights which shall indicate which phase as well as which module is fully operable.

O. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module.

P. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.

Q. SPD shall be equipped with an audible alarm which shall activate when any one of the surge current modules has reached an end-of-life condition. An alarm on/off switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.

R. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.

S. Terminals shall be provided for necessary power and ground connections.

T. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory loss upon loss of AC power.

U. SPD shall have a warranty period of ten (10) years from date of invoice and shall include unlimited replacement of suppression modules within the warranty period. Warranty shall be the responsibility of the electrical distribution equipment manufacturer and shall be supported by their respective field service division.

2.7. IDENTIFICATION

A. Nameplates: Engraved nameplates shall be provided for all panelboards. Nameplates shall give item designation and circuit number as well as frame size and appropriate trip rating. Furnish Master Nameplate giving panelboard designation, voltage ampere rating, short circuit rating, manufacturer's name, general order number and item number.

B. Panelboards used as service-entrance equipment shall be labeled as the same.

C. Refer to Division 26 Section 260553, "Identification for Electrical Systems", for additional information.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of panelboards.

1. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. Verify dimensions of panelboard and working space clearances.

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3.2. INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.

C. Panelboard dead fronts shall remain intact except where tabs are removed for circuit breakers. Install filler plates in unused pole spaces not filled by a circuit breaker that are accidentally opened. Do not remove all tabs in dead front and fill the same with filler plates.

D. Provision for Future Circuits at Flush-Mounted Panelboards: Stub 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future and/or 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade, in accordance with the following schedule:

Total Number of Single Pole Spares and Spaces	Number of 1-inch Empty Conduits
1 – 3	Two
4 – 6	Three
7 – 9	Four
10 – 12	Five
13 – 20	Ten
21 – 32	Fifteen

E. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

F. Two or three pole circuit breakers shall be common trip type. Single pole breakers with handle ties will not be permitted.

G. Tandem circuit breakers will not be permitted.

H. Provide ground buses in panelboards as indicated on the Drawings. Ground bus shall be similar in all respects to neutral bus.

I. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, Application Guide for Ground Fault Circuit Interrupters.

J. Provide handle clamps for all branch circuit breakers serving telephone and communications equipment, refrigerators, exit signs, fire alarm system controls, etc. to prevent accidental operation.

K. Branch circuit breakers serving electric water coolers shall be GFCI type for personnel protection (5mA).

L. Branch circuit breakers serving receptacles and appliances located under kitchen ventilation hoods shall be equipped with shunt-trip mechanisms.

M. Height: Six-feet, six-inches to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above the floor. Top breaker maximum height not to exceed 6 feet 7 inches per NEC Article 404.8.

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N. Do not energize or connect service-entrance equipment and panelboards to their sources until surge protective devices are properly installed and connected.

3.3. GROUNDING

A. Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus as indicated.

3.4. CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, 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.

B. Neutral and ground conductors shall be isolated and terminated only at their respective bus bars. There shall only be one neutral-ground connection in service-entrance equipment by means of a removable main bonding jumper. Neutral and ground terminations at one bus bar shall not be acceptable.

3.5. IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section 260553, “Identification for Electrical Systems”.

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws. Refer to Division 26 Section 260553, “Identification for Electrical Systems” for nameplate requirements.

C. Panelboard Circuit Directories.

1. Panelboards shall have accurate typed circuit directories indicating exactly what each branch circuit serves.
2. The Contractor shall provide up to date circuit directories in new and existing panelboards, indicating all deletions and additions, and to note the date of all changes on the directory.
3. The circuit directories shall reflect the actual room numbers. Directories indicating the reference room numbers on the contract drawings or in the panelboard schedule shall not be acceptable.
4. The circuit directories shall include the name, address, and contact information for the Electrical/Division 26 Contractor.
5. If at any time after occupancy the circuit directories are found to be incorrect due to negligence by the installer, then the Contractor shall trace out circuits, and correct the directories at no additional cost to the Owner.

3.6. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Clean devices using Manufacturer’s approved methods and materials.
3. Verify that panelboard nameplates are installed and accurate.
4. Verify that panelboard phase identification nameplates are installed.
5. Verify that panelboard arc flash hazard labels are installed.
6. Exercise and perform operational tests of all mechanical components and other operable

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devices in accordance with manufacturer's instruction manual.

7. Check panelboard mounting, area clearances, and alignment and fit of components.
8. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
9. Perform visual and mechanical inspection and related work for over-current protective devices.
10. Verify that all neutral conductors are bonded to the system ground at the service-entrance prior to installation of the surge protective device.
11. Verify that neutral-ground bonds do not exist at locations that are not service entrances or separately derived power sources.

B. Panelboard Electrical Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in the original Contract Documents.
2. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
3. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
4. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.
5. Make continuity tests of each circuit. Refer to Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables" for testing specific to feeder conductors.
6. Perform ground resistance test on system and equipment ground connections
7. Test main and sub-feed overcurrent protective devices.
8. Test ground fault devices in accordance with NETA ATS 7.14.
9. Test phase loss relay(s) at service-entrance equipment to verify that phase loss relays are fully operational.
10. NETA Testing:

    a. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers, for all devices rated 100-amperes and larger.
    b. Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.
    c. Prepare reports certified by testing agency identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

11. Infrared Scanning: Perform an infrared scan of all electrical connections in each panelboard, as follows:

    a. Remove equipment covers so terminations are accessible to scanner.
    b. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.
    c. Provide calibration record for device.
    d. Compare test results with specified performance or manufacturer's data. Correct deficiencies identified by tests and retest.
    e. Prepare reports certified by testing agency identifying equipment checked and

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describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

12. Test Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.
13. Submit all test reports to the Architect for review and approval.
14. Provide copy of all test reports in the O&M manual.

3.7. ADJUSTING

A. Set field-adjustable circuit-breaker trip ranges as indicated in coordination study provided under Division 26 Section 260573, “Power System Studies”.

3.8. CLEANING

A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.9. PROTECTION

A. Provide final protection and maintain conditions in a manner that shall ensure that the panelboard(s) shall be without damage at time of Substantial Completion.

3.10. DEMONSTRATION AND TRAINING

A. Provide a minimum of four (4) hours of training and demonstration of panelboard operations, settings, adjustment, and maintenance.

A. Topics to be covered include, but are not limited to, the following:

1. Operation of electronic trip circuit breakers.
2. Operation of arc energy reduction maintenance switches.

END OF SECTION

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SECTION 262418 - LOAD CENTERS

PART 1 GENERAL

1.1. RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for general materials and installation methods.
2. Division 26 Section 260553, “Identification for Electrical Systems”, for identification materials for labeling load centers, including, but not limited to equipment nameplates.
3. Division 26 Section 260573, “Power System Studies”, for engineering analysis involving load centers specified herein, including but not limited to short-circuit analysis.
4. Division 26 Section 262416, “Panelboards”, for distribution and branch circuit panelboards rated 600V and less.

1.2. SUMMARY

A. This Section includes load centers and associated auxiliary equipment rated 240 V and less.

B. Provide design and engineering, labor, material, equipment, related services and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for load centers as required for the complete performance of the work, and as shown on the Drawings and as specified herein.

C. Load centers shall be fully or series rated for the AIC identified on the load center schedules on the Contract Drawings. Load centers shall be tested, listed, and labeled for the available short circuit current. Documentation must be provided to support series ratings with submittal package.

D. Minimum short-circuit current ratings for load centers shall be verified by short circuit analysis specified under Division 26 Section 260573, “Power System Studies”, prior to ordering equipment.

1.3. SUBMITTALS

A. Product Data: For each type of load center, accessory item, and component specified.

B. Shop Drawings: For each load center. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:

1. Enclosure type with details for types other than NEMA 250, Type 1.
2. Bus configuration and current ratings.
3. Short-circuit current rating of load center.
4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
5. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.

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C. Load Center Schedules: For installation in load centers.

E. Contract Closeout Submittals:

1. Operation and Maintenance Data: Submit operation and maintenance data for load centers to include in operation and maintenance manuals specified in Division 01.
2. Warranty Data: Submit manufacturer's standard warranty documents.
3. Load Center Circuit Directories: For installation in load centers. Submit final versions in operation and maintenance manuals.
4. Project Record Data: Record actual locations of load centers, indicating actual branch circuit arrangement.

1.4. QUALITY ASSURANCE

A. 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 as defined in OSHA Regulation 1910.7.

B. Comply with NFPA 70, National Electrical Code.

C. Comply with NEMA AB1, Molded Case Circuit Breakers.

D. Comply with NEMA PB1, Panelboards.

E. Comply with NEMA PB1.1, Instructions for Safe Installation, Operation & Maintenance of Panelboards Rated 600 Volts or Less.

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PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, supply equipment from one of the following manufacturers; no other manufacturers are acceptable:

1. Square D Company. (Basis of Design).
2. Eaton Corp.; Cutler-Hammer Products.
3. Siemens Energy & Automation Inc.

2.2. FABRICATION AND FEATURES

A. Enclosures: Provide steel enclosures, in compliance with NEMA PB1, suitable for flush- or surface-mounting as indicated on the Drawings. Type as indicated on the Drawings, unless otherwise indicated to meet environmental conditions at installed location as indicated below:

1. Dry, Interior Locations: NEMA 1
2. Damp, Wet Interior Locations: NEMA 3R
3. Damp, Wet Exterior Locations: NEMA 3R

B. NEMA 1 enclosures shall be surface or flush mount as indicated in associated schedules or

drawings. NEMA 3R enclosures shall be surface mount only.

C. Enclosure Finish for Indoor Units: A minimum of one (1) coat of factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

D. Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted load centers shall be same dimensions as box. Fronts for flush-mounted load centers shall overlap box, unless otherwise indicated.

E. Load center trim shall be dead-front construction covering all energized parts.

F. Buses and Connections: Single phase/three wire, or three phase/ four wire, as indicated on the Contract Drawings:

1. Bus Composition: Silver-plated or tin-plated copper, hard-drawn, minimum of 98 percent conductivity. Plating shall be applied continuously to bus work. The load center bussing shall be of sufficient cross-sectional area to meet UL 67 temperature rise requirements. The phase and neutral through-bus shall have an ampacity as shown on the Drawings. Coordinate bus short circuit rating with available fault current. Size in accordance with NEMA PB 1.
2. Phase and Neutral Buses: Provide mechanical lugs to accommodate the quantity, size, and material of the conductors shown on the Contract Drawings.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.
4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity the entire length of the load center. Provide for future extensions from both ends.
5. Neutral Buses: 100 percent of the ampacity of the phase buses, except as indicated, and equipped with approved pressure connectors for outgoing circuit neutral cables.

G. Future Devices: Equip with mounting brackets, supports, bus connections, and appurtenances for the overcurrent protective device ampere ratings indicated on the Drawings.

H. Directory Frame: Clear plastic cardholder, mounted inside each load center door.

I. Service Equipment Approval: Listed for use as service equipment for load centers with main service disconnect.

J. Basis of Design: Square D Company QO Load Centers.

2.3. OVERCURRENT PROTECTIVE DEVICES

A. Overcurrent protective devices include, but are not limited to, the following:

1. Thermal magnetic circuit breakers.

B. Molded-Case Circuit Breaker Features and Accessories:

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2. Lugs: Mechanical style, suitable for quantity, size/gauge, and material of conductors indicated.
3. Application Listing: Appropriate for application, including switching lighting loads (Type SWD) or heating, air-conditioning, and refrigerating equipment (Type HACR).

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4. Handle Padlock Attachment: Circuit breakers in load center shall be equipped with fixed handle padlock attachment to allow padlocking the circuit breaker in the ON or OFF position at the following locations:

   a. Main circuit breakers in all load centers.
   b. Other locations as indicated on the Contract Drawings.

5. Handle Clamp Attachment: Circuit breakers in load centers shall be equipped with removable handle clamp attachments to prevent accidental operation of the circuit breaker at the following locations:

   a. Branch circuit breakers serving emergency circuits.
   b. Other locations as indicated on the Contract Drawings.

6. Ground Fault Protection: Integral to circuit breaker with adjustable pickup and time delay settings, push-to-test feature, and ground-fault indicator.

2.4. LOAD CENTERS

A. Interior

1. Minimum short-circuit current ratings shall be as indicated on the Contract Drawings, but not less than 10,000 AIC RMS symmetrical amperes for 120/208V and 120/240V load centers.
2. Minimum short-circuit current ratings shall be verified by short circuit analysis specified under Division 26 Section 260573, "Power System Studies", prior to ordering equipment.
3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on branch circuit breakers. The bussing shall be fully rated. Load center bus current ratings shall be determined by heat rise tests conducted in accordance with UL 67. Bus bar plating shall run the entire length of the bus bar.
4. Load centers shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Article 230.
5. All current carrying parts shall be insulated from ground and phase to phase by high dielectric strength thermoplastic.
6. Interior trim shall be of dead front construction to shield user from energized parts. Dead front trim shall have pre-formed twist-outs covering unused mounting space.
7. Interiors shall be field convertible for top or bottom incoming feed.
8. Main circuit breakers shall be vertically mounted, unless otherwise indicated.
9. Main lug interiors up to 400 amperes shall be field convertible to main breaker.

B. Main Circuit Breakers

1. Main circuit breakers shall have an over-center, trip free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and instantaneous magnetic trip elements in each pole. Each thermal element shall be true RMS sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.
2. Two and three pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push to trip button for maintenance and testing purposes.
3. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit

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breakers shall be UL listed for reverse connection without restrictive line or load markings.

C. Branch Circuit Breakers

1. Molded case branch circuit breakers shall have plug-on type bus connectors.
2. Circuit breakers shall have an over-center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and instantaneous magnetic trip elements in each pole. Two and three pole circuit breakers shall have common tripping of all poles.
3. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI TRIP indicator appearing in the clear window of the circuit breaker housing.
4. Circuit breakers serving transformers or other load centers shall be equipped with factory-installed, fixed, handle padlock attachment to allow padlocking circuit breakers in the OFF only position.

D. Enclosures

1. Type 1 Enclosures

a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
b. Boxes shall have removable end-walls with knockouts located on one end. Boxes shall have welded interior mounting studs.
c. Fronts shall meet strength and rigidity requirements per UL 50 standards. Front shall be finished with ANSI 49 gray baked enamel electrodeposited over cleaned phosphatized steel.
d. Load centers shall have hinged front cover.
e. Doors on front shall have rounded corners and edges shall be free of burrs.
f. A clear plastic directory card holder shall be mounted on the inside of the door.

2. Type 3R/5/12 Enclosures

a. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be finished with ANSI 49 gray baked enamel electrodeposited over cleaned phosphatized steel.
b. Doors shall be gasketed and be equipped with a locking vault handle.
c. A clear plastic directory card holder shall be mounted on the inside of the door.
d. All lock assemblies shall be keyed alike, one (1) key shall be provided with each lock.

E. Basis of Design – Square D Company, QO Series Load Centers.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install load centers and accessory items according to NEMA PB 1.1.

B. Mounting: Plumb and rigid without distortion of box.

C. Install filler plates in unused spaces.

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D. Wiring in load center gutter: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

E. Two pole circuit breakers shall be common trip type. Single pole breakers with handle ties will not be permitted.

F. Tandem circuit breakers will not be permitted.

G. Provide ground buses in load centers as indicated on the Drawings. Ground bus shall be similar in all respects to neutral bus.

H. Branch circuit breakers (or switches) serving control power circuits shall be equipped with lock clips to prevent accidental operation.

3.2. GROUNDING

A. Make equipment grounding connections for load centers as indicated.

B. Provide ground continuity to main electrical ground bus as indicated.

3.3. CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, 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.

B. Neutral and ground conductors shall be isolated and terminated only at their respective bus bars. There shall only be one neutral-ground connection in step down transformer equipment by means of a removable main bonding jumper. Neutral and ground terminations at one bus bar shall not be acceptable.

3.4. IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section 260553, “Identification for Electrical Systems”.

B. Nameplates: Label each load center with engraved laminated-plastic or metal nameplates as detailed on the Contract Drawings. Refer to Division 26 Section 260553, “Identification for Electrical Systems”, for nameplate requirements.

C. Circuit Directories:

1. Load centers shall have accurate typed circuit directories indicating exactly what each branch circuit serves.
2. The Contractor shall provide up to date circuit directories in new and existing load centers, indicating all deletions and additions, and to note the date of all changes on the directory.
3. The circuit directories shall reflect the actual room numbers. Directories indicating the reference room numbers on the contract drawings or in the load center schedule shall not be acceptable.
4. The circuit directories shall include the name, address, and contact information for the Electrical/Division 26 Contractor.
5. If at any time after occupancy the circuit directories are found to be incorrect due to negligence by the installer, then the Contractor shall trace out circuits, and correct the

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directories at no additional cost to the Owner.

D. Field mark load centers utilizing series ratings per NEC Article 240.86(A).

3.5. FIELD QUALITY CONTROL

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and load center schedules.
2. Clean devices using Manufacturer's approved methods and materials.
3. Verify that load center nameplates are installed and accurate.
4. Verify that phase identification nameplates are installed.
5. Verify that arc flash hazard labels are installed.
6. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
7. Check load center mounting, area clearances, and alignment and fit of components.
8. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
9. Perform visual and mechanical inspection and related work for over-current protective devices.
10. Verify that neutral-ground bonds do not exist at locations that are not service entrances or separately derived power sources.

E. Load Center Electrical Testing: After installing load centers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in the original Contract Documents.
2. Inspect accessible components for cleanliness, mechanical and electrical integrity, and damage or deterioration. Verify that temporary shipping bracing has been removed. Include internal inspection through access panels and covers.
3. Inspect bolted electrical connections for tightness according to manufacturer's published torque values or, if not available, those specified in UL 486A and UL 486B.
4. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.
5. Make continuity tests of each circuit. Refer to Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables" for testing specific to feeder conductors.
6. Perform ground resistance test on system and equipment ground connections
7. Test main and sub-feed overcurrent protective devices.
8. Test ground fault devices in accordance with NETA ATS 7.14.
9. Infrared Scanning: Perform an infrared scan of all electrical connections in each load center, as follows:

a. Remove equipment covers so terminations are accessible to scanner.
b. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values.
c. Provide calibration record for device.
d. Compare test results with specified performance or manufacturer's data. Correct

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deficiencies identified by tests and retest.

e. Prepare reports identifying equipment checked and describing results of tests. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

10. Test Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.
11. Submit all test reports to the Architect for review and approval.
12. Provide copy of all test reports in the O&M manual.

3.6. CLEANING

A. Upon completion of installation, inspect interior and exterior of load centers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.7. PROTECTION

A. Provide final protection and maintain conditions in a manner that shall ensure that the load centers shall be without damage at time of Substantial Completion.

END OF SECTION

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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. Straight-blade receptacles.
2. GFCI receptacles.
3. Locking receptacles.
4. Tamper-Resistant receptacles.
5. Weather-Resistant receptacles.
6. Toggle switches.
7. Wall-box occupancy sensor switches.
8. Wall-box timer switches.
9. Device plates.
10. Cord and plug sets.
11. Emergency pushbuttons.
12. Retractable cord reels.

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1.3. DEFINITIONS

A. ELV: Electronic Low Voltage.

B. EMI: Electromagnetic Interference.

C. GFCI: Ground-Fault Circuit Interrupter.

D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

E. PIR: Passive Infrared.

F. RFI: Radio-Frequency Interference.

G. TR: Tamper-Resistant.

H. US: Ultra- Sonic.

I. 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.
    d. WD7: Occupancy Motion Sensors Standard

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. 514A: Metallic Outlet Boxes.
    d. 514B: Fittings for Conduit and Outlet Boxes.
    e. 514C: Non-Metallic Outlet Boxes, Flush-Device Boxes, and Covers
    f. 943: Ground-Fault Circuit Interrupters

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1.6. COORDINATION

A. Receptacles for Equipment Furnished with Cord and Plug Sets: Match plug configurations.

B. Cord and Plug Sets: Match equipment requirements.

1.7. EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

1. USB Receptacles: One (1) for each ten (10) installed, but not less than two (2) of each type.

2. GFCI Receptacles: One (1) for each ten (10) installed, but not less than two (2) of each type.
3. Wallbox Occupancy Sensor Switches: One (1) for each ten (10) installed, but not less than two (2) of each type.
4. Wallbox Timer Switches: One (1) for each ten (10) installed, but not less than one (1) of each type.
5. Emergency Pushbuttons: One (1) for each ten (10) installed, but not less than two (2) of each type.

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 Division
b. Pass & Seymour/Legrand; Wiring Devices Division
c. Leviton Manufacturing Co., Inc.
d. Eaton/Cooper; Wiring Devices Division
e. Lutron Electronics, Inc.

2. Wall-box Occupancy Sensor Switches:

a. Watt Stopper
b. Lutron Electronics, Inc.
c. Sensor Switch
d. Hubbell, Inc; Wiring Devices Division
e. Pass & Seymour/Legrand
f. Leviton Manufacturing Co, Inc.
g. Eaton/Cooper; Wiring Devices Division

3. Wall-box Timer Switches:

a. Intermatic
b. Lutron Electronics, Inc.
c. Hubbell, Inc; Wiring Devices Division
d. Pass & Seymour/Legrand
e. NSI Industries (Tork)
f. Leviton Manufacturing Co, Inc.
g. Eaton/Cooper; Wiring Devices Division

4. Retractable Cord Reels:

a. Hubbell Inc., Wiring Devices Division
b. Pass & Seymour/Legrand
c. Reelcraft Industries
d. Ericson Manufacturing Company
e. Appleton Electric Company
f. KH Industries

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5. Emergency Pushbuttons:

a. Safety Technology International, Inc. (STI)
b. Square D Company
c. Crouse-Hinds

2.2. STRAIGHT BLADE RECEPTACLES

A. General Requirements

1. Straight blade receptacles shall have the following basic features:

a. One-piece brass mounting strap with integral ground for low resistance of fault currents.
b. Auto-ground clip to assure positive ground.
c. Impact-resistant nylon face and thermoplastic base housing.
d. #10 large head brass terminal and ground screws; back- and side-wired.

B. Tamper-Resistant Duplex Convenience Receptacles

1. Tamper-resistant duplex convenience receptacles shall be extra heavy-duty, specification grade, 20A, 125V, with the following features:

a. “TR” marking on face as required by UL standard.
b. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects.

2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell HBL5362TR, Pass & Seymour TR63, or approved equal by listed manufacturer.

C. Weather-Resistant Duplex Convenience Receptacles

1. Weather-resistant duplex convenience 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, Federal Specification W-C-596 and 2011 NEC 406.9.
3. Hubbell HBL5362WR, Pass & Seymour WR5362, or approved equal by listed manufacturer.

D. Tamper-Resistant Duplex USB Charger Receptacles

1. Decorator style tamper-resistant duplex convenience receptacles shall be heavy-duty, specification grade, 20A, 125V, with the following features:

a. 5Vdc output, minimum 5 amperes
b. One (1) Type “A” port and one (1) type “C” port
c. “TR” marking on face as required by UL standard.
d. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign

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objects.

2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498, UL1310, and Part 15 of FCC regulations.
3. Comply with battery charging specification USB BC1.2.
4. Compatible with USB 2.0/3.0 devices, including Apple® products.
5. Hubbell USB20AC5, Pass & Seymour TR20USBAC6, or approved equal by acceptable manufacturer.

E. Tamper-Resistant Half-Controlled Plug Load Controllable Duplex Receptacles

1. Tamper-resistant half-controlled plug load controllable duplex convenience receptacles shall be extra heavy-duty, specification grade, 20A, 125V, with the following features:

   a. Permanent controlled receptacle marking on one (1) receptacle face, in compliance with 2014 NEC Article 410.6(E), CA Title 24, and ASHRAE Energy Efficiency Standard 90.1.
   b. Factory-broken split-circuit tab, allowing for half of the receptacle to be controlled.
   c. "TR" marking on face as required by UL standard.
   d. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects.

2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell HBL5362C1, Pass & Seymour 5362CH Series, or approved equal by listed manufacturer.

F. Tamper-Resistant Dual-Controlled Plug Load Controllable Duplex Receptacles

1. Tamper-resistant dual-controlled plug load controllable duplex convenience receptacles shall be extra heavy-duty, specification grade, 20A, 125V, with the following features:

   a. Permanent controlled receptacle marking on each receptacle face, in compliance with 2014 NEC Article 410.6(E), CA Title 24, and ASHRAE Energy Efficiency Standard 90.1.
   b. "TR" marking on face as required by UL standard.
   c. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects.

2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
   Hubbell HBL5362C2, Pass & Seymour 5362CD Series, or approved equal by listed manufacturer.

G. Tamper-Resistant Single Convenience Receptacles

1. Tamper-resistant single convenience receptacles shall be extra heavy-duty, specification grade, 20A, 125V, with the following features:

   a. "TR" marking on face as required by UL standard.
   b. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects.

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2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell HBL5361TR, Pass & Seymour TR5351, or approved equal by listed manufacturer.

H. Corrosion-, Dust-, and Moisture-Resistant Duplex Convenience Receptacles

1. Corrosion-, dust-, and moisture-resistant duplex convenience receptacles shall be heavy-duty, specification grade, 20A, 125V, with the following features:

a. Nickel plated steel device strap.
b. Copper “hot” side termination screws.
c. Nickel plated “neutral” side termination screws.
d. Stainless steel bracket screws.
e. Integral neoprene gasket protecting device slots.
f. UV-resistant yellow nylon face for longer life under adverse environmental conditions.

2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498, Federal Specification W-C-596 and 2011 NEC 406.9.
3. Pass & Seymour CR6307, or approved equal by listed manufacturer.

I. Special Purpose Receptacles

1. Special purpose receptacles shall have ratings and NEMA configurations as indicated on the Drawings, or as required to match equipment plug configuration, and shall be black with device plate to match outlet type.

2.3. 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; back- and side-wired.

2. GFCI receptacles shall also have the following functions to comply with UL standard 943:

a. An auto-monitoring function that will allow for periodic automatic testing (self-test) of the GFCI device and its ability to respond to a ground fault. If a problem is detected one or more of the following will happen:
   i. Power will be denied (trip with the inability to reset).
   ii. Trip with the ability to reset, subject to the next auto-monitoring test cycle or repeatedly trip.
   iii. Visual and/or audible indication
b. Provisions to ensure that receptacle type GFCIs that contain separate line and load terminals, and that is powered through its load terminals, shall not reset and supply power to its receptacle face or line terminals if mis-wired. This applies both

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during its initial installation and after reinstallation following a correctly wired installation. If the device is provided with special instructions for removal and reinstallation, the instructions shall be followed during testing.

B. Tamper-Resistant Duplex GFCI Receptacles

1. Tamper-resistant duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V with the following features:

   a. “TR” marking on face as required by UL standard.
   b. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects.

2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell GFTRST20, Pass & Seymour 2097TR, or approved equal by listed manufacturer.

C. Tamper-Resistant Fully-Controlled Duplex GFCI Receptacles

1. Tamper-resistant fully-controlled duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V with the following features:

   a. Permanent controlled receptacle marking on each receptacle face, in compliance with 2020 NEC Article 406.3(E), CA Title 24, and ASHRAE Energy Efficiency Standard 90.1.
   b. “TR” marking on face as required by UL standard.
   c. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects.

2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell GFTRST20WMC, Pass & Seymour 2097TRCDI, or approved equal by acceptable manufacturer.

D. Tamper-Resistant Weather-Resistant Duplex GFCI Receptacles

1. Tamper-resistant 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.
   c. “TR” marking on face as required by UL standard.
   d. Thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects.

2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell GFWRST20, Legrand/P&S 2097TRWR, or approved equal by listed manufacturer.

2.4. LOCKING RECEPTACLES

A. Single Locking Receptacles

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1. Single locking receptacles shall be extra heavy-duty, specification grade, 20A, 125V: Comply with NEMA WD1, NEMA WD6 configuration L5-20R, UL 498 and Federal Specification W-C-596.

B. Isolated Ground Locking Receptacles

1. Isolated ground locking receptacles shall be extra heavy-duty, specification grade, 20A, 125V, with the following features:

a. Green grounding screw connected directly to the grounding contacts.
b. Insulation barrier construction to isolate ground contacts from the mounting strap.
c. "IG" triangle on the face of the receptacle.

2. Comply with NEMA WD-1, NEMA WD-6 configuration L5-20R, UL 498 and Federal Specification W-C-596.
3. Hubbell IG2310, Legrand/P&S IGL520-R, or approved equal by listed manufacturer.

C. Special Purpose Receptacles

1. Special purpose receptacles shall have ratings and NEMA configurations as indicated on the Drawings, or as required to match equipment plug configuration, and shall be black with device plate to match outlet type.

2.5. 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), HBL1223 (three-way), HBL1224 (four-way), Pass & Seymour PS20AC1 (single-pole), PS20AC2 (two-pole), PS20AC3 (three-way), PS20AC4 (four-way), or approved equal by listed manufacturer.

C. Illuminated Toggle Switches (Light On with Load Off)

1. Illuminated toggle switches shall be quiet-type, extra heavy-duty, horsepower-rated, industrial grade, 120/277V, 20A, with clear illuminated toggle, lighted with load off.
2. Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.
3. Hubbell HBL1221ILC (single-pole), HBL1223ILC (three-way), Pass & Seymour PS20AC1-CSL (single-pole), PS20AC3-CSL (three-way), or approved equal by listed manufacturer.

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D. Pilot Lighted Switches (Light On with Load On)

1. Pilot lighted switches shall be quiet-type, extra heavy-duty, horsepower-rated, industrial grade, 120/277V, 20A, with red illuminated toggle, lighted with load on.
2. Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.
3. Hubbell HBL1221PL (single-pole), HBL1222PL (two-pole), HBL1223PL (three-way), Pass & Seymour PS20AC1RPL (single-pole), PS20AC2RPL (two-pole), PS20AC3RPL (three-way), or approved equal by listed manufacturer.

E. Lockable Switch Handle Guards

1. Provide handle guards with provisions for padlocking at all toggle switches serving as disconnecting means and where indicated on the Drawings.
2. Handle guards shall be steel construction, and shall mount directly over standard switch faceplates.
3. Provide Square D Class 2510 FL1, or approved equal by listed manufacturer.

2.6. WALL-BOX OCCUPANCY SENSOR SWITCHES

A. Wall switch sensors shall be capable of detection of motion at desk-top level up to 300 square feet, and gross motion up to 1,000 square feet.

B. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

C. Sensors shall be dual technology type using a combination of passive-infrared and ultrasonic detection method to distinguish between occupied and unoccupied conditions for area covered.

D. Sensors shall feature built-in light level sensing for field-adjustable ambient light override.

E. All sensors shall be capable of operating normally with any electronic ballast and PL lamp systems.

F. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioning or heating fans.

G. All sensors shall have readily accessible, user adjustable controls for time delay and sensitivity. Controls shall be recessed to limit tampering.

H. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005 percent tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

I. All sensors shall provide a method of indication to verify that motion is being detected during testing and that the unit is working.

J. All sensors shall have no leakage current to load, in manual or in Auto/Off Mode, for safety purposes and shall have voltage drop protection.

K. All sensors shall have UL rated, 94V-0 plastic enclosures.

L. All sensors located in damp/wet locations and dry indoor locations subject to high humidity (i.e. Shower Rooms) shall be suitable for low temperature (down to -4oF/-20oC) and high humidity, and shall be corrosion resistant to moisture.

M. Sensor finishes shall match finish of toggle switches as specified herein.

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2.7. WALL-BOX TIMER SWITCHES

A. Electronic Countdown Timer

1. Description: Electronic automatic shut-off wall timer.
2. Features:

a. Adjustable Time Delay: 15/30/60 minutes, 2/4 hours.
b. Single button timer selection
c. LED indication
d. Silent operation
e. Requires neutral conductor
f. cULus listed.
g. Conforms to NEMA WD-1 and WD-6.

3. Ratings:

a. 0-1800W, 1/4HP at 120 VAC, 60 Hz.

4. Loads:

a. Lighting: Incandescent, fluorescent, compact fluorescent (CFL), magnetic low-voltage (MLV), electronic low-voltage (ELV).
b. Motors: Up to 1/4 horsepower.

5. Basis of Design: Intermatic Catalog No. EI215W (finish to match other wiring devices specified herein).

B. Astronomic Programmable Timer

1. Description: 24-Hour Programmable Timer.
2. Features:

a. Real time clock with day/date calendar.
b. Lighted manual ON/OFF switch for visibility in darkened rooms.
c. Easy to read LED display.
d. Programming buttons accessible without removing wall plate.
e. Eight programs can be assigned to any day or combination of days of the week.
f. Automatically calculates sunrise and sunset times based on latitude and longitude.
g. Audible or visible occupant warning before automatic off.
h. Power failure memory.
i. Zero crossing circuitry.
j. cULus listed.
k. Conforms to NEMA WD-1 and WD-6.
l. 5-year warranty.

3. Ratings:

a. 0-800W, 1/6HP at 120 VAC, 60 Hz.
b. 0-1200W, 1/6HP at 277 VAC, 60 Hz.

4. Loads:

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a. Lighting: Incandescent, fluorescent, compact fluorescent (CFL), magnetic low-voltage (MLV), electronic low-voltage (ELV).
b. Motors: Up to 1/6 horsepower.

5. Basis of Design: Pass & Seymour Catalog No. RT-200.

2.8. 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: White.
2. Wiring Devices connected to Standby Power System: White with engraved nameplate to read “Emergency”.
3. Special Receptacles: Black.

2.9. 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 Unfinished Spaces: Galvanized steel, unless otherwise noted.
2. Material for Finished Spaces: 0.04-inch-thick, Type 302, satin-finished stainless steel, except as otherwise indicated.
3. Plate-Securing Screws: Metal with heads colored to match plate finish.

B. Device plates shall be factory engraved to clearly identify receptacles on GFCI-protected circuits. Lettering shall be ¼” high, filled with black paint and read “GFCI”.

C. Device plates shall be factory engraved to clearly identify receptacles which are on generator circuits. Lettering shall be ¼” high, filled with red paint and read “EMERGENCY”.

D. Covers for Receptacles and Switches in Damp Locations: Heavy-duty die-cast zinc/aluminum construction with gasketed, hinged lid, listed and labeled for use in “damp locations.” All components shall have baked-on electrostatic, polyester, powder paint finish for superior corrosion resistance. Covers 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 receptacles shall comply with NEC Article 406.9(A). Covers for switches shall comply with NEC Article 404.4.

1. Horizontal Receptacles - Pass & Seymour Model No. CA26H or approved equal by Hubbell, Intermatic or other listed manufacturer.
2. Vertical Receptacles – Pass &Seymour Model No. CA26V, or approved equal by Hubbell, Intermatic, or other listed manufacturer.
3. Toggle Switches – Pass and Seymour Model No. CA1, or approved equal.

E. Covers for Receptacles in Damp and Wet Locations: Heavy-duty die-cast zinc/aluminum construction with hinged lockable lid, designed to be weatherproof while the device is in use, and listed and labeled “extra duty” for use in “wet locations”. All components shall have baked-on electrostatic, polyester, powder paint finish for superior corrosion resistance. Covers shall comply with NEC Article 406.9(B).

1. Duplex/GFCI Receptacles – Pass & Seymour Model No. WIUCAST1 or approved equal

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by Hubbell, Intermatic, or other listed manufacturer.

F. Covers for Switches in Damp and Wet Locations: Heavy-duty die-cast zinc/aluminum construction with actuating levers and shall mount directly over the switch. Covers shall have permanent hasp for pad-locks. Covers shall comply with NEC Article 404.4 and shall be UL listed for use in wet locations.

1. Toggle Switches – Crouse –Hinds Model No. DS185, or approved equal.

G. Dustproof Covers for Devices in Hard-Use Areas: Brushed 302 stainless steel dust covers designed for corrosive environments and hard-use areas, with stainless steel springs.

1. Duplex Receptacles – Pass & Seymour Model WP8 (vertical), Pass & Seymour Model WPH8 (horizontal), or approved equal by Hubbell, or other listed manufacturer.
2. GFCI Receptacles – Pass & Seymour Model WP26 (vertical), Pass & Seymour Model WPH26 (horizontal), or approved equal by Hubbell, or other listed manufacturer.
3. Toggle Switches – Pass & Seymour Model WP1 (one gang), Pass & Seymour Model WP2 (two gang), or approved equal by Hubbell, or other listed manufacturer.
4. Network Light Switches - Pass & Seymour Model WP26, or approved equal by Hubbell, or other listed manufacturer.

H. Lockable Dustproof Covers for Devices in Hard-Use Areas: Brushed 302 stainless steel dust covers designed for corrosive environments and hard-use areas, with stainless steel springs and keyed cam-style lock.

1. Duplex Receptacles – Pass & Seymour Model WP8-L, or approved equal by Hubbell, or other listed manufacturer.
2. GFCI Receptacles – Pass & Seymour Model WP26-L, or approved equal by Hubbell, or other listed manufacturer.
3. Toggle Switches – Pass & Seymour Model WP1-L, or approved equal by Hubbell, or other listed manufacturer.
4. Network Light Switches - Pass & Seymour Model WP26-L, or approved equal by Hubbell, or other listed manufacturer.

2.10. 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.

2.11. RETRACTABLE CORD REELS – HEAVY DUTY

A. Description: Factory-fabricated retractable cord reel with receptacle connector body and the following features:

1. Corrosion-resistant cast aluminum construction, white powder coat finish.
2. Factory-assembled, modular type collector ring and brush block assembly.
3. Lifetime lubricated bearings.
4. Removable cover(s) for access to springs and ring/brush assembly.

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5. Adjustable, four-roller cord outlet guide.
6. Built-in cord locking ratchet to hold cord at desired length. Ratchet can be disengaged to provide constant cord tension.
7. Type SJO cord with conductors to match requirements (voltage, ampacity, quantity) of equipment being connected. 12/3 SJO unless otherwise indicated on the Cord Reel Schedule on the Contract Drawings.
8. Connector Ends: As indicated on the Cord Reel Schedule on the Contract Drawings, from the following options:

    a. Single straight blade receptacle, NEMA configuration as noted.
    b. Single twist-lock receptacle, NEMA configuration as noted.
    c. One (1) or two (2) 20A duplex receptacles in yellow or black outlet box
    d. GFCI module and one (1) 20A duplex receptacle in yellow outlet box
    e. GFCI module and two (2) 20A duplex receptacles in yellow outlet box

9. Receptacle connector body: Nylon body with integral cable clamping jaws and blade configuration to match equipment being connected.

B. Hubbell inREACH Series, or approved equal by listed manufacturer.

2.12. RETRACTABLE CORD REEL ENCLOSURES

A. Description: Plenum-rated cord reel enclosures shall have the following features:

1. Steel enclosure, white powder coat surface finish, with brackets for mounting with threaded steel rod, and a hinged door with opening for cord reel end.
2. UL 2416 Listed; Compliant with plenum requirements per NEC Article 300.22
3. 75 lbs load capacity
4. 4 inch square electrical box included
5. Pre-punched knockout hole

B. Provide enclosures for retractable cord reels in the kitchen and other locations as indicated on the Retractable Cord Reel Schedule on the Contract Drawings.

C. Basis of Design: Hubbell HBLIPRBOX Series.

2.13. EMERGENCY PUSHBUTTONS

A. Features:

1. Button activation shall be Push-to-Activate, Turn-to-Reset.
2. Interchangeable or replaceable Normally Open (N.O.) or Normally Closed (N.C.), Single-Pole, Single-Throw (SPST) gold-plated contact blocks rated for three (3) amps at 600 VAC or one (1) amp at 250VDC.
3. Pushbuttons shall include one N.O. and one N.C. contact, unless otherwise indicated on the Contract Drawings.
4. Pushbuttons shall hold up to three (3) sets of isolated contacts.

B. Construction:

1. Housing shall be molded of polycarbonate rated for temperature range of -40 degrees to 250 degrees Fahrenheit.
2. Housing color shall be yellow, unless otherwise indicated.

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3. Pushbutton shall be provided with stainless steel backplate and matching polycarbonate spacer (as required), both having a 5VA flammability rating.

C. Labeling:

1. Pushbuttons shall be provided with a vinyl label that is customized to suit each application, including, but not limited to the following:

a. “Water Heater Shut-Down”

D. Cover:

1. Pushbutton covers shall have the following features:

a. Molded from thick clear polycarbonate material.
b. UV stabilized.
c. 94V-2 flammability rating.
d. Stainless steel torsion spring to maintain cover in a closed position.
e. Mounting hardware and gasket.

E. Quality Assurance

1. Pushbuttons shall be tested and approved or listed by:

a. Underwriter Laboratories (UL) and Canadian Underwriter Laboratories No. S7255.
b. Complies with UL 2017.
c. UL listed for indoor and outdoor use, when used with appropriate weather cover.

2. Pushbuttons shall be ADA Compliant.

F. Warranty

1. Pushbuttons shall be provided with lifetime guarantee against breakage of polycarbonate in normal use.
2. Pushbuttons shall be provided with one year guarantee on electro-mechanical and electronic components.

G. Basis of Design:

1. Emergency pushbuttons shall be Stopper Station with Mini Stopper cover, as manufactured by Safety Technology International, Inc. (STI), or approved equal.

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.

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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 – GENERAL

A. Install devices and assemblies plumb, level, and secure.

B. Arrangement of Devices:

1. 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.
2. 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.

C. Protect devices and assemblies during painting.

D. Installation of Device Plates/Covers:

1. Install device plates when painting is complete.
2. Install device plates to suit device type and location.
3. Provide device plates factory engraved "GFCI" for wiring devices protected by a GFCI circuit breaker, e.g. receptacles for electric water coolers and refrigerators.
4. Provide device plates factory engraved "EMERGENCY" for wiring devices served by the emergency power supply system, unless otherwise indicated herein or on the Contract Drawings.
5. Provide damp location covers for wiring devices in damp interior locations, and for floor mounted receptacle outlets in kitchens.
6. Provide wet location covers for wiring devices in exterior locations.
7. Provide lockable dustproof covers for wiring devices in dry interior locations subject to physical damage where security is required, e.g. light switches in corridors and gymnasium, etc..
8. Provide dustproof covers for wiring devices in dry interior locations subject to physical damage, e.g. gymnasiums, and in dry interior locations subject to dust, e.g. masonry labs, carpentry labs, etc.

E. Coordinate cord and plug connected equipment for type and ratings required.

3.3. INSTALLATION – RECEPTACLES

A. 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 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.

B. 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 NEC Article 210.8(B).

1. Bathrooms/Toilet Rooms

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2. Kitchens
3. Rooftops
4. Outdoors
5. Within six (6) feet (1.8m) of sinks, plumbing fixtures and water piping.
6. Indoor wet locations.
7. Locker rooms with associated showering facilities.
8. Mechanical rooms, electrical rooms, and similar areas where electrical hand tools or portable lighting equipment are to be used.

C. Where multiple receptacles are indicated on the Contract Drawings as GFCI type receptacles, each device must be a GFCI type receptacle. Protecting standard receptacles downstream from one GFCI receptacle is not acceptable.

D. All non-locking type, 125 volt, 15 ampere and 20 ampere receptacles installed in the following locations shall be listed tamper-resistant receptacles in accordance with NEC Article 406.

1. Education Facilities

E. Receptacles on emergency circuits shall be clearly identified, with a circuit label indicating panelboard and circuit number.

3.4. INSTALLATION – SWITCHES

A. Switches shall be located as indicated on the drawings, arranged singular or in gangs within 18" of the door jamb on the strike side of the door openings. Verify the door swings with the Architectural Drawings prior to rough-in.

B. Install life safety system switches separate from the normal power switches. Do not include in the multiple gang configuration.

C. Emergency shut-down push-buttons for gas-fired equipment shall be provided at all means of egress from rooms in which gas-fired equipment is installed.

3.5. INSTALLATION – WALL-BOX OCCUPANCY SENSOR SWITCHES

A. Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations.

B. The following areas shall have one hundred (100%) percent coverage for minor (small resolution) motion:

1. Desks in office areas

C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. Provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem-solving diagnosis of the occupancy-sensing devices and systems.

1. Sensors installed in damp locations such as near showers, in wet locations, or where exposed to rain shall be equipped with watertight/weatherproof enclosure.
2. Mounting of passive infrared and dual technology sensors where columns, doors, walls, or other obstructions will block the sensor's field of view should be avoided.
3. Passive infrared coverage should not extend through doorways. Masking inserts shall be

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installed for PIR coverage rejection to prevent false tripping.

D. Install system components in accordance with Manufacturer's instructions. Sensor locations are approximate and are designed according to the specified manufacturer.

E. Sensors shall be positioned so that lights are activated when a person is 2 feet or less through any doorway.

F. Prior to energizing circuits, wiring shall be tested for electrical continuity and short circuits to ensure proper polarity of connections is maintained.

3.6. IDENTIFICATION

A. Comply with Division 26 Section 260553, "Identification for Electrical Systems".

1. Switches: Switches shall be labeled as to lights/load controlled and with circuit number and panel identification.
2. Receptacles: All device plates shall be labeled to 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. Labels shall be clear with black lettering. 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.
5. Faceplate labels shall be installed such that they are readable and do not cover any portion of the faceplate securing screw(s) or the wiring device itself.

3.7. 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.

3.8. 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.

3.9. 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

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. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 26 Section 260553, “Identification for Electrical Systems”, for labeling materials.
2. Division 26 Section 262816, “Enclosed Switches & Circuit Breakers”, for enclosed fusible disconnect/safety switches.

1.2. SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600Vac and less for use in the following:

a. Control circuits.
b. Enclosed switches.

2. Spare fuse cabinets.

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. ACTION 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 type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

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a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
5. Coordination charts and tables and related data.

1.5. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in Operation and Maintenance manuals. In addition to items specified under Division 01, include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limitation characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
4. Coordination charts and tables and related data.

B. Record Drawings: Record the equipment nameplate rating and actual fuse rating and location of fuses on the record drawings.

1.6. MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Furnish quantity equal to 20 percent of each 600 ampere and smaller fuse type and size installed, but not less than one (1) set of three (3) of each type and size. Furnish three (3) of each 601 Ampere and larger fuse type and size installed.
2. Fuse Pullers: Furnish two (2) fuse pullers.

1.7. QUALITY ASSURANCE

A. Comply with NFPA 70 for components and installation.

B. 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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Comply with NFPA 70.
5. Comply with National Electrical Manufacturer's Association NEMA FU-1 Low Voltage Cartridge Fuses.
6. Comply with IEC269.
7. Comply with CANENA Standard 248.
8. Comply with UL 198.

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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. Bussmann; Eaton Corporation
2. Littelfuse, Inc.
3. Mersen (formerly Ferraz Shawmut)

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2. CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

B. Fuses shall feature a solid state visual open fuse indicator, metal-embossed date and catalog number for identification.

C. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3. SPARE FUSE CABINETS

A. Description: Wall-mounted, locking utility cabinet(s) with hinged door and shelves for spare fuses.

B. Construction: 16 or 14 gauge steel, ANSI 61 gray polyester powder paint finish inside and out.

C. Dimensions: Cabinet shall be of proper size for orderly storage of spare fuses and fuse pullers stored in the same, plus space for 15 percent spare capacity.

D. Fuse Pullers: Provide one (1) fuse puller for each size and type fuse stored in each spare fuse cabinet.

E. Basis of Design: Provide shelf style locking utility cabinets as manufactured by Hoffman/Pentair, or approved equal by Cooper/Bussman.

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PART 3 EXECUTION

3.1. EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. FUSE APPLICATIONS

A. Main Service and Feeders Less than 600A: Class J, time delay, 600 Volt, 0-600 Amp, and 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.

B. Motor Branch Circuits: Class RK1, time delay, 250 Volt or 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.

1. The following guidelines apply for motors protected by properly sized overload relays:

a. 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.
b. 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.

2. The following guidelines apply where fuses are used as the only overload protection for the motor:

a. 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).
b. 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.

3. Fuse sizes for motor protection shall be chosen from fuse manufacturers published data and recommendations.

C. 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-level 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.

D. Other Branch Circuits: Class RK1, non-time delay, 250 Volt or 600 Volt, 0-600 Amp, and 300 kA interrupting rating.

E. Control Circuits: Class CC, current limiting rejection type, rated 0-30 amperes, 600 volts, and 200-kA interrupting rating.

F. Provide fuses of type and rating recommended by equipment manufacturer for packaged and/or specialized equipment.

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

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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.

B. All fuses shall be furnished and installed by the electrical contractor. All fuses shall be of the same manufacturer.

C. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings and open fuse indicators are visible without removing fuses.

D. Provide fuse clips as required.

E. Provide spare fuse cabinet in each building as indicated on the Contract Drawings. Cabinet(s) shall be mounted 5’-6” to top unless otherwise noted on the Contract Drawings.

3.4. IDENTIFICATION

A. Identification: Provide engraved nameplate to read “SPARE FUSES” in 1/2" high lettering on front door of cabinet(s). Refer to Division 26 Section 260553, “Electrical Identification”, for nameplate requirements.

END OF SECTION

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SECTION 262816 - ENCLOSED SWITCHES & CIRCUIT BREAKERS

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. Related Sections include the following:

1. Division 26 Section 262726, “Wiring Devices”, for toggle switches used as disconnecting means.
2. Division 26 Section 262813, “Fuses”, for fuses in enclosed fusible disconnect switches.

1.2. SUMMARY

A. This Section includes individually mounted disconnect switches and circuit breakers used for the following:

1. Service disconnect switches.
2. Equipment disconnect switches.
3. Feeder disconnect switches.
4. Motor disconnect switches.

B. 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, circuit breakers, and accessories specified in this Section. Include the following:

1. Descriptive data and time current curves.
2. Let through current curves for circuit breakers with current limiting characteristics.

C. Submit a schedule of equipment to indicate ratings of disconnects, fuses, circuit breakers, and other electrical characteristics for each item of equipment.

D. Maintenance data for disconnect switches and circuit breakers to include in the operation and maintenance manual specified in Division 01.

E. Field test reports indicating and interpreting test results.

1.4. QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to the requirements specified in Division 01 Section Quality Control, an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical

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Testing Association (NETA).

1. Testing Agency's Field Supervisor: Person currently certified by NETA or the National Institute for Certification in Engineering Technologies, to supervise on site testing specified in Part 3.

B. Source Limitations: Obtain disconnect switches and circuit breakers from one source and by a single manufacturer.

C. Comply with NFPA 70 for components and installation.

D. 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.

1.5. WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

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.
d. General Electric (GE)

2. Enclosed Circuit Breakers:

a. Square D Company. (Basis of Design)
b. Eaton Corporation; Cutler Hammer.
c. Siemens Energy & Automation, Inc.
d. General Electric (GE)

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2.2. DISCONNECT SWITCHES

A. Enclosed, Non-fusible Switch: Heavy duty, NEMA KS 1, Type HD, with lockable handle 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.

B. Enclosed, Fusible Switch, 800 A and Smaller: Heavy duty, NEMA KS 1, Type HD, clips to accommodate specified fuses, fuse pullers, 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. Enclosures: 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 3R, Type 304 stainless steel, attached by molded hinges and stainless steel hinge pins.
2. Laundry and Concessions Areas: Type 4X, Type 304 stainless steel, attached by molded hinges and stainless steel hinge pins.
3. Corrosive Locations (e.g. greenhouses, etc.): Type 4X, non-metallic, fiberglass reinforced polyester.

2.3. ENCLOSED CIRCUIT BREAKERS

A. Enclosed, Molded Case Circuit Breakers: NEMA AB 1, with lockable handle.

B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting rating to meet available fault current, minimum of 10,000 symmetrical rms amperes.

C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air conditioning, and refrigerating equipment.

D. Circuit Breakers, 250 Ampere Frame and Smaller: Factory sealed thermal magnetic trip units.

E. Circuit Breakers, 400 Ampere Frame and Larger: Electronic trip units with field adjustable, short time and continuous current settings.

F. Current Limiting Trips: Where indicated, let through ratings less than NEMA FU 1, Class RK 1.

G. Molded Case Switch: Where indicated, molded case circuit breaker without trip units.

H. Lugs: Mechanical lugs and power distribution connectors for number, size, and material of conductors indicated.

I. Shunt Trip: Where indicated. Provide voltage rating as required.

J. Accessories: As indicated.

K. Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.

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1. Outdoor Locations: Type 3R.
2. Laundry and Concessions Areas: Type 4X, stainless steel.
3. Corrosive Locations (e.g.: Greenhouses, etc): Type 4X non-metallic

L. Provide full capacity neutral lug or 200 full capacity neutral for non-linear loads and equipment grounding lug.

PART 3 EXECUTION

3.1. INSTALLATION

A. Install disconnect switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

B. Install disconnect switches and circuit breakers level and plumb. Provide mounting brackets, wall bracing, and accessories as required.

C. Install disconnect switches and circuit breakers to have adequate working space in accordance with Article 110.26 of the National Electrical Code. Disconnect switches and circuit breakers shall not be installed beneath ductwork, piping, etc.

D. Install wiring between disconnect switches, circuit breakers, and associated control and indication devices.

E. Provide fuses for all fusible safety switches as indicated and required by the load being served. Coordinate fuse ratings with mechanical equipment electrical characteristics.

F. 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.

G. Weatherproof enclosures shall be provided for all disconnect switches and circuit breakers exposed to the elements whether called for or not.

H. Disconnect Switches and circuit breakers shall be labeled for service entrance use, if so required, where used for service entrance whether called for or not.

I. Disconnect Switches and circuit breakers 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 disconnect switches and circuit breakers 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. CONNECTIONS

A. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.

B. Tighten electrical connectors and terminals according to manufacturers' published torque tightening

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values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3. IDENTIFICATION

A. Identify each disconnect switch and circuit breaker according to requirements specified in Division 26 Section 260553, “Identification for Electrical Systems”. All switches shall be provided with engraved nameplates which clearly identify the equipment served, circuit designation, and circuit voltage/phase.

B. Each disconnect means shall be legibly marked as required by Code (including integral disconnect units furnished with motors, appliances, feeders, and branch(es).

3.4. FIELD QUALITY CONTROL

A. Visual and mechanical inspection: Include the following inspections and related work.

1. 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.
7. Verify that fuses are facing out and that fuse ratings and blown fuse indicators are visible without removing fuses.

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3.5. ADJUSTING

A. Adjust/replace fuses in disconnect switches if required to properly coordinate with overcurrent protection requirements of equipment served and with upstream and downstream protective devices.

B. Set field adjustable circuit breaker trip ranges as recommended in overcurrent protection coordination study specified in Division 26 Section 260573, “Power System Studies”.

3.6. 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

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.

B. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for Mechanical - Electrical coordination requirements.
2. Division 26 Section 260500, “Common Work Results for Electrical”, for general materials and installation methods.
3. Division 26 Section 260553, “Identification for Electrical Systems” for labeling materials.

1.2. SUMMARY

A. This Section includes AC motor-control devices rated 600 V and less that are supplied as enclosed units.

1.3. DEFINITIONS

A. N.C.: Normally closed.

B. N.O.: Normally open.

1.4. SUBMITTALS

A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

C. Maintenance Data: For products to include in the operation and maintenance manuals specified in Division 01.

D. 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.

E. Qualification Data for Field Testing Agency: Certificates, signed by Contractor, certifying that agency complies with requirements specified in Quality Assurance Article below.

F. 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.

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B. Field Testing Agency Qualifications: An independent testing agency with experience and capability to satisfactorily conduct testing indicated without delaying the Work. Evaluation criteria shall be according to ASTM E 699.

C. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

D. Comply with NFPA 70.

E. 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.

F. 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.

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).

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. Motor 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

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motors shall terminate in the conduit fittings on the motors, the final connection being made with flexible metal conduit (FMC) in dry locations and with Liquid-Tight Flexible Metal Conduit (LFMC) in damp/wet locations.

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. WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer shall warrant equipment to be free from defects in materials and workmanship for the lesser of one (1) year from date of installation or eighteen (18) months from date of purchase.

1.10. 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. Overload Relays: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Pilot Lights: Equal to 10 percent of quantity installed for each type, but no fewer than two of each type. Where lamps are field replaceable, furnish spare lamps only.

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.
4. Allen-Bradley Company; Industrial Control Group.
5. Crouse-Hinds ECM; Cooper Industries, Inc. Division.
6. General Electric (GE).

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

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for fractional horsepower induction motors, with thermal overload unit. Manual motor controllers shall be equipped with 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. Dry/Interior Locations: Motor controllers shall have ANSI/NEMA ICS 6, Type 1 enclosures. Provide flush-mounted enclosures for units located in finished areas. Provide handle guard with locking provisions in the "off" position on all enclosures. Provide Square D, Class 2510 Type F motor controllers with 2510 FL1 handle guard, or approved equal for dry, interior locations.

D. Damp/Wet and Corrosive Locations: Motor controllers shall have ANSI/NEMA ICS 6, Type 4 water-tight and dust tight die-cast zinc enclosures. Provide Square D, Class 2510 Type FW motor controllers and Square D 9001SKY111 control station with Hand-Off-Auto label plate, 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 toggle operator. Provide size and number of poles as required for a complete installation of the equipment being connected.

B. Dry/Interior Locations: Motor switches shall have ANSI/NEMA ICS 6, Type 1 enclosures. Provide flush-mounted enclosures for units located in finished areas. Provide handle guard with locking provisions in the "off" position on all enclosures. Provide Square D, Class 2510 Type K motor switches with 2510 FL1 handle guard, or approved equal.

C. Damp/Wet and Corrosive Locations: Motor controllers shall have ANSI/NEMA ICS 6, Type 4 water-tight and dust tight die-cast zinc enclosures. Provide Square D, Class 2510 Type KW motor switches, or approved equal.

2.4. MOTOR DISCONNECT SWITCHES

A. Description: Manually operated, full voltage, UL508 horsepower rated, enclosed motor disconnect switch, 60 ampere, 3 pole, 600 volt rating without thermal overload unit. Motor Disconnect Switch shall be equipped with a handle interlock to prevent the cover from being removed while in the “on” position.

B. Enclosure: Water-tight, NEMA 4X, polycarbonate enclosure, surface mounting, for either interior or exterior locations. Cover shall have a clear “on/off” indication with a front pad-lockable handle which complies with OSHA lockout/tagout requirements.

C. Furnish Square D, Class 3100, Type MD Motor Disconnect Switch or approved equal.

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

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of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Provide fractional-horsepower manual motor controllers for single-phase motors, unless otherwise indicated.

D. Provide combination magnetic motor controllers for three-phase motors, unless otherwise indicated.

E. Hand-Off-Automatic Selector Switches: In covers of motor controllers started and stopped by automatic controls or interlocked with other equipment.

F. Provide heaters and/or fuses correlated with full load nameplate current of motors provided. Set adjustable overload devices to suit motor provided.

G. 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 motor controller. This provides "no damage" protection for the motor controller, under low and high level fault conditions, as required by IEC Publication 947-4.

3.2. INSTALLATION

A. Install motor controllers in locations as indicated, according to manufacturer's written instructions.

B. Install motor controllers level and plumb. Provide mounting brackets, wall bracing, and accessories as required.

C. Install motor controllers to have adequate working space in accordance with Article 110.26 of the National Electrical Code. Motor controllers shall not be installed beneath ductwork, piping, etc.

D. Install independently mounted motor-control devices according to manufacturer's written instructions.

E. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

F. 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 260529, "Hangers and Supports for Electrical Systems".

3.3. IDENTIFICATION

A. Identify motor-control components and control wiring according to requirements specified in Division 26 Section 260553, "Identification for Electrical Systems".

B. All motor controllers shall be provided with engraved nameplates which clearly identify the equipment served, circuit designation, and circuit voltage/phase.

3.4. CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables".

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic control devices where available.

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3.5. CONNECTIONS

A. Connect motor controllers and components to wiring system and to ground as indicated and instructed by manufacturer.

B. 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. Visual and Mechanical Inspection: Include the following inspections and related work.

1. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with drawings and schedules.
2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer’s instructions.
3. Check tightness of electrical connections of devices with calibrated torque wrench. Use Manufacturer’s recommended torque values.
4. Clean devices using Manufacturer’s approved methods and materials.
5. Verify proper fuse types and ratings in fusible devices.
6. Verify that fuses are facing out and that fuse ratings are readable without removing fuses.
7. Verify proper overload types and ratings in devices with overload protection.
8. Verify proper operation of pilot lights.
9. Verify proper operation of hand-off-automatic selector switches.
10. 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.

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: Engage a factory-authorized service representative to demonstrate motor controllers and train Owner's maintenance personnel.

1. Conduct a minimum of 4 hours 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

NOT FOR BIDDING

SECTION 263600 - TRANSFER 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. Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

1.3. ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, power sources, and load.

1.4. INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Field quality-control reports as specified herein.

1.5. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section, "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6. QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

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1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3 of this Section.

C. Source Limitations: Obtain transfer switches and remote annunciator panels through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 110, for transfer switches served by emergency generators.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.7. PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of electrical services.
2. Do not proceed with interruption of electrical service without Architect's, Construction Manager's, and Owner's written permission.

B. Environmental Conditions: Transfer Switches shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

1.8. COORDINATION

A. Coordinate size and location of concrete bases for pad-mounted and floor-mounted transfer switches. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.9. WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of transfer switches and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.10. MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 60 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include

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routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 PRODUCTS

2.1. MANUFACTURERS

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

1. Caterpillar; Engine Div.
2. Emerson; ASCO Power Technologies, LP.
3. ESL Power Systems.
4. GE Zenith Controls.
5. Kohler Power Systems; Generator Division. (Basis of Design)
6. Onan/Cummins Power Generation; Industrial Business Group.
7. Russelectric, Inc.
8. Spectrum Detroit Diesel.
9. Trystar, Inc.

2.2. TRANSFER-SWITCH PRODUCT GENERAL REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

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H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

J. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section 260553, "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Use NEMA 250, Type 12 enclosure if environment is generally dusty.

L. Enclosures: General-purpose NEMA 250, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

1. Type 1 for dry interior locations.
2. Type 4X for damp or wet locations.

2.3. AUTOMATIC TRANSFER SWITCHES

A. Comply with NFPA 110 requirements for emergency power supply system level specified in Division 26 Section 263213, “Engine Generators”.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. Programmed Switch Neutral Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

G. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup

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value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Retransfer Delay Bypass: Momentary position to bypass transfer and re-transfer time delay
6. Test Switch: Simulate normal-source failure.
7. Switch-Position Pilot Lights: Indicate source to which load is connected.
8. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

9. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
10. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
11. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
12. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
13. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

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2.4. MANUAL TRANSFER SWITCHES FOR PORABLE GENERATORS

A. Operation: Manual transfer switch(es) shall consist of two (2) mechanically-interlocked molded case circuit breakers with externally operated handles marked “Primary” and “Alternate”. Cam-style male connectors shall be provided for connecting portable generator cables. Power distribution block and grounding terminals shall be also be provided within a pad-lockable enclosure.

B. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via drawn flange cable entry opening(s) in the bottom of the enclosure for wall mount units, or hinged lower

door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected. The hinged flap door shall allow cable entry only after the main access door has been opened.

C. Manual transfer switch enclosure shall be NEMA Type 3R, constructed of continuous seam-welded, powder coated gavanneal steel. Enclosure shall be powder coated after fabrication; color shall be selected by Architect or Owner.

D. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground, and shall also be provided for neutral if required. Each of the phase cam-style male connectors within the enclosure shall be factory-wired to a molded case circuit breaker. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. The neutral cam-style male connectors, if required, shall be factory wired to a power distribution block. None of the cam-style male connectors shall be accessible unless both molded case circuit breakers are in the "OFF" position and the main access door is open.

E. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.

F. Molded case circuit breakers shall be UL Listed and the short circuit interrupt rating shall be a minimum of 35kAIC at 480VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall be fed from utility power; the other molded case circuit breaker shall be fed from the cam-style male connectors to supply power from a portable generator. Both molded case circuit breakers shall include UL Listed door-mounted operating mechanisms (with provisions for a locking device), preventing the opening of the main access door unless both breakers are in the "OFF" position. Both molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (2) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only one breaker can be closed at any given time.

G. Manual transfer switch shall be suitable for use as service equipment in the USA as defined by the NEC.

H. Manual transfer switch shall include permanently affixed operation instructions.

I. Accessories:

1. Remote Start Terminal Block
2. Heater/Thermostat/De-Humidistat
3. Receptacle – 20A, 120V GFCI Duplex
4. Auxiliary Contacts – (2) N.O. / (2) N.C.

J. Basis of Design – Manual transfer switches shall be StormSwitch as manufactured by ESL Power Systems, Inc. or equal as approved by the Engineer.

2.5. REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall allow monitoring of common alarm, annunciate conditions for indicated transfer switchesremote testing of automatic transfer switches, and monitoring of the normal/emergency source for each emergency and legally required power supply system transfer switch. Annunciation shall include the following:

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1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

C. Basis of Design: Provide RSA III with Four ATS Controls as manufactured by Kohler Power Systems, or approved equal by listed manufacturer.

2.6. SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.1. INSTALLATION

A. Wall-Mounted Transfer Switches: Anchor to wall by bolting.

1. Design each fastener and support to carry load indicated by manufacturer. See Division 26 Section 260529, “Hangers and Supports for Electrical Systems”.

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to Division 26 Section 260553, “Identification for Electrical Systems”.

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2. CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section 260526, "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section 260519, "Low-Voltage Electrical Power Conductors and Cables."

D. Connect engine start monitoring modules in transfer switches to module in generator and to terminals in transfer switches per manufacturer’s instructions.

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E. Connect transfer switch(es) to the fire alarm system as required to indicate the following signals:

1. Switch in non-automatic position.

F. Connect auxiliary contact(s) in manual transfer switch(es) to annunciator system to indicate when permanent emergency source is disconnected from the emergency system per National Electrical Code Article 700.3(F)(5).

3.3. FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

D. Testing Agency's Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

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2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. Prior to energizing manual transfer switches for portable generators, the Contractor shall perform the following checks and tests as a minimum:

    a. Verify mounting and connections are complete and secure.
    b. Verify internal components and wiring are secure.
    c. Perform continuity check of all circuits.
    d. Perform 1,000 VDC megger test on feeder, load and ground cables.
    e. Verify deadfront is secure.
    f. With the manual transfer switch deadfront in place and the main access door closed and properly latched, actuate both Operator Mechanisms; verify only (1) breaker at a time can be turned to the "ON" position.
    g. Confirm operation of the manual transfer switch ground receptacle by attaching a plug to the manual transfer switch ground receptacle and then verify that the plug is grounded to the facility ground.
    h. Once utility power has been applied, confirm operation of manual transfer switch by following directions on main access door.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source and each phase of alternate source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

E. Coordinate tests with tests of generator and run them concurrently.

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F. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

G. Remove and replace malfunctioning units and retest as specified above.

H. Prepare test and inspection reports.

I. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4. CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean equipment internally, on completion of installation, according to manufacturer's written instructions.

3.5. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section, "Demonstration and Training."

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment.
2. Review data in maintenance manuals. Refer to Division 01 Section, “Contract Closeout”.
3. Review data in maintenance manuals. Refer to Division 01 Section, “Operation and Maintenance Data”.
4. Schedule training with Owner, through Architect, with at least seven days' advance no-tice.
5. Provide a minimum of four hours of instruction.

END OF SECTION

NOT FOR BIDDING

SECTION 264113 - LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 26 Section 260500, “Common Work Results for Electrical”, for basic electrical installation requirements.
2. Division 26 Section 260526, “Grounding and Bonding for Electrical Systems”, for grounding electrode and grounding connector requirements.
3. Division 26 Section 260533, “Raceways and Boxes for Electrical Systems” for non-metallic conduits for concealing lightning protection system conductors.
4. Division 26, Section 262416, “Panelboards”, for requirements related to internally-mounted surge protection devices (SPDs) in circuit breaker type electrical panelboards.

1.2 ALTERNATES

A. Refer to Division 01 Section “Alternates” for description of work under this Section affected by Alternates.

1.3 SUMMARY

A. This section includes lightning protection systems for buildings and associated structures and includes requirements for lightning protection system components complying with UL96, UL96A, and NFPA 780.

B. Contractor shall provide additional components and labor in order to meet all requirements of a UL Master Labeled Lightning Protection System.

1.4 SYSTEM DESCRIPTION

A. Protect entire greenhouse and west pavilion buildings, including roof projections and roof-mounted equipment.

1. Building Construction: Steel building less than 75 feet (23m) in height.
2. Building Occupancy: Commercial.

B. Provide a complete UL Master Labeled Lightning Protection System for each structure/building.

C. Provide a complete all-inclusive Lightning Protection System Design layout and installation for a complete UL Master Labeled Lightning Protection System.

D. Design Requirements: Lightning Protection Conductor System consisting of air terminals on roofs, roof-mounted mechanical equipment, parapets, bonding of structure and other metal objects, grounding electrodes, and interconnecting conductors.

E. Provide an all-inclusive Lightning Protection System. The Contract Drawings and Specifications

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do not necessarily limit the extent of the system that is required to meet the requirements and the intent of the Engineer and the Contract Documents for a complete system.

1.5 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 01 Specification Sections.

B. Product data for each component: Include data for roof adhesive when used. Submit accurate pictorial views of decorative air terminal components. Provide dimensions and materials of each components and include indication of listing in accordance with UL 96.

C. Provide scaled shop drawings detailing lightning protection system including, but not limited to, air terminal locations, grounding electrodes, conductor sizes and routing, bonding connections to structures, and connections and grounding. Include connection and termination details. The shop drawings shall be Master Labeled stamped. Submit a roof plan and a ground floor plan with all equipment properly dimensioned.

D. Qualification data for firms and persons specified in Quality Assurance Article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

E. Field inspection reports indicating compliance with specified requirements.

F. Project Record Documents - Accurately record the following: Actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

G. Submit a UL compliance certificate indicating compliance with all requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced and LPI-Certified Master Installer to install the Lightning Protection System. The installation shall be under the direct supervision of an LPI-Certified Master Installer.

B. Designer Qualifications: Engage an LPI-Certified Designer to design and lay out the Lightning Protection System.

C. Inspector Qualifications: Engage an LPI-Certified Inspector to perform periodic inspections during installation of the Lightning Protection System.

D. Manufacturers Qualifications: Provide products by firms listed and approved by Underwriters Laboratories, Inc., having had not less than five (5) years' experience in this specialty work under UL procedures.

E. Listing and Labeling: Provide products specified in this Section that are listed and labeled by an organization concerned with product evaluations, and that can determine compliance with appropriate standards for the current production of listed items.

1. Listing and Labeling Agency Qualifications; A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

F. Conform to NFPA 780, Lightning Protection Code.

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G. Conform to UL 96, Standard for Lightning Protection Components.

H. Conform to UL 96A, Installation Requirements for Lightning Protection Systems and provide UL Master Label.

I. Conform to LPI-175, Lightning Protection Installation Standard and provide LPI-certified system.

J. Conform to NFPA 70, National Electrical Code.

K. Conform to the most stringent requirements when more than one standard is specified for products or installation.

1.7 WORKMANSHIP

A. Guarantee all materials and workmanship furnished and installed under this section of the specifications two years from the date of final acceptance of work. The Contractor also agrees that he will, at his own expense, repair and/or replace all such defective materials or effective workmanship which become defective during the term of this guarantee.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate installation of lightning protection system with the installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection system, and building finishes.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturer's offering lightning protection components that my be incorporated in the Work include, but are not limited to, the following:

1. A-C Lightning Security, Inc.
2. Bonded Lightning Protection, Inc.
3. Dillon Lightning Protection Systems, Inc.
4. East Coast Lightning Equipment, Inc.
5. Harger Lightning and Grounding; Harger, Inc.
6. Heary Brothers Lightning Protection.
7. Independent Protection Company, Inc.
8. Robbins Lightning Protection, Inc.
9. Thompson Lightning Protection.
10. Warren Lightning Rod Company.

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Lightning Protection System Products: Manufactured to NFPA 780, LPI-176, Lightning Protection System Material and Components Standard, and UL 96, Lightning Protection Components.

B. Copper materials shall not be installed on or in contact with aluminum roofing, aluminum siding, or other aluminum surface. Aluminum materials shall not be installed on or in contact with copper surfaces.

C. Air Terminals for Roof Mounting: Units with bases especially designed for the specified roof

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materials.

1. Solid with blunt points, extending a minimum of 12 inches above the protected object.

   a. Copper: 3/8 inch diameter
   b. Aluminum: 1/2 inch diameter

2. Air Terminal Bases: Cast bronze with bolt pressure cable connections and shall be securely mounted with stainless steel screws and bolts. Bases on modified bitumen roofs shall be secured with a proper adhesive.

D. Class I Conductors, Minimum Requirements:

1. Main Conductors:

   a. Copper
      i. 57,400 circular mils
      ii. 187 lbs. / 1,000 Linear Feet (LF)
      iii. 17 AWG conductors
   b. Aluminum
      i. 98,600 circular mils
      ii. 95 lbs/1,000 Linear Feet (LF)
      iii. 14 AWG conductors

2. Secondary Conductors:

   a. Copper
      i. 26,240 circular mils
      ii. 17 AWG conductors
   b. Aluminum
      i. 41,100 circular mils
      ii. 14 AWG conductors

E. Counterpoise: Minimum 1/0 AWG stranded copper, tinned for corrosion protection.

F. Ground Rods: Copper clad steel (10 mil finish) with a minimum of 7 percent of the rod weight in the copper cladding.

1. Diameter: 3/4 inch (19 mm).
2. Length: 10 feet (3 m).

G. Ground Plate: Solid copper, not less than 1/16th inch (2mm) thick.

H. Connectors and Splices: Exothermic, conforming to UL 96.

I. Ground Test Well: For accessible connection for testing. Ground test well shall be heavy duty 12-inch length (minimum) with cast iron lid and frame.

J. Roof Penetrations: Through-roof assemblies with solid bars and appropriate roof flashings.

K. Miscellaneous Components: Provide other components required for a complete lightning protection system such as bonding plates, terminal supports, clips, anchors, fasteners, bolts, nuts, screws, etc. All components shall conform to UL 96 for applicable classes.

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1. Bonding plates shall not be less than 8 square inches of surface contact secured in place with stainless steel bolts.

L. Conduit: Provide 1-inch Type 40 PVC conduit for all down conductors. Refer to Division 26 Section 260533, “Raceway and Boxes for Electrical Systems” for product requirements.

M. Waterproof Penetrations: The Contractor shall provide all waterproofing for the through-roof conduits, connectors, and other penetrations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work.

B. Examine surfaces and conditions, with Installer present, for compliance with installation tolerances and other conditions affecting performance of the lightning protection system. Do not proceed with installation until unsatisfactory conditions have been corrected.

C. By beginning work, conditions are accepted with the responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

D. Lightning Protection System shall be provided with UL Master Label Certificate. Turn UL Master Label Certificate over to Owner upon system approval, and include one (1) copy of the same in the Operation and Maintenance Manual(s).

3.2 INSTALLATION

A. Install lightning protection systems according to manufacturer's written instructions.

B. Install components according to LPI-175, UL 96A, and NFPA 780.

C. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops. Run conductors in nonmetallic raceway, Schedule 40, minimum.

D. Conceal interior system conductors and down conductors.

E. Conceal exterior system conductors from normal view from exterior locations at grade within 200 feet (60 m) of building.

F. Support conductors every three (3) feet.

G. Notify Engineer at least 48 hours before concealing lightning protection system components.

H. In all areas where cables come in direct contact with aluminum material, aluminum cables must be used to prevent electrolytic corrosion of the dissimilar metals.

I. Aluminum materials shall not be used within 18-inches of the point where the lightning protection system conductor comes into contact with the earth.

J. If the building has structural steel columns, the structural steel columns may be used as the down-conductors.

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K. Cable Connections: Use approved exothermic-welded connections for all conductor splices and connections between conductors and other components, except those above single-ply membrane roofing.

L. Air Terminals on Specified roofing: Use adhesive recommended by manufacturer of air terminals and approved by manufacturer of roofing material. Comply with adhesive manufacturer's installation instructions. Maximum spacing of 25 feet.

M. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to the Lightning Protection System.

N. Bond ground terminals with counterpoise conductor located below grade.

O. Bond grounded media on building within 12 feet (4 m) of ground with counterpoise conductor located as indicated.

P. Bond grounded media on building within 1 foot (4m) of roof with counterpoise conductor.

Q. Bond grounded media on building within 12 feet (4m) of roof with interconnecting loop at eave level or above.

R. Bond lightning protection system to grounded media on building at every 60 feet (18 m) with intermediate-level interconnection loop conductors.

S. Install the conductors as inconspicuously as practical and with the proper bends. Install conductors avoiding radius bends of less than 8 inches.

T. Install the vertical conductors within the concealed cavity of exterior walls. Route the conductors to the exterior at elevations below the finished grade and make the ground connections to the earth outside of the building or stack perimeter.

U. Where shown, use the structural steel framework or reinforcing steel as the main conductor: Weld or bond the non-electrically-continuous sections together and make them electrically-continuous.

V. Protect copper conductors with stiff copper or brass tubing, which enclose the conductors from the top to the bottom of the tubing, between 300 mm (one foot) below and 2100 mm (seven feet) above the finished grade.

W. Sheath copper conductors, which pass over cast stone, cut stone, architectural concrete, and masonry surfaces with not less than a 2 mm (1/16-inch) thickness of lead to prevent staining of the exterior finish surfaces.

3.3 AIR TERMINAL INSTALLATION

A. Install per UL and NFPA requirements:

1. Rigidly connect to structure.
2. Make electrically continuous with roof conductors by means of pressure connectors or crimped joints.
3. At ends of structures, set 24-inches from end of ridge or edges and corner of roof.
4. Maximum spacing of 25 feet.
5. Prevent overturning by means of tripod or braces.
6. Uniformly space air terminals about the rim of the stack, not more than 24 inches from the corners or more than 8'-0-inches apart.
7. Air terminals on standing seam metal roof systems shall be secured with aluminum or

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stainless steel clamps designed for standing seam metal roofing systems.

3.4 ROOF CONDUCTORS

A. Install per UL and NFPA requirements:

1. Connect directly to roof or ridge at 48-inch intervals.
2. Prevent sharp bends or turns.
3. Minimum bend radius of 8 inches.
4. Provide a downward or horizontal course.
5. All connections shall be electrically continuous.
6. Follow contours of flat roofs, ridges, parapets and edges.

3.5 DOWN CONDUCTORS

A. Installation:

1. Do not pass through non-conducting parts of structure.
2. Interconnect secondary conductors with grounded parts within the building.

B. Down Lead Conductors Run in Raceways:

1. All down lead conductors shall be run in 1-inch Type 40 PVC conduit.
2. All raceways shall be concealed wherever possible.
3. Bends shall be kept to a minimum and where used shall have an angle not to exceed 90 degrees.
4. Openings shall be free and clear.
5. Contractor shall provide conduits at various locations in the outer walls as required.

C. Provide a minimum of two down conductors located as widely separated as possible, at diagonally opposite corners.

D. Down lead cables shall not be brought directly through the roof. Through-roof assemblies with solid rods shall be used for this purpose.

3.6 INTERCONNECTION OF METAL PARTS

A. Metal ventilators shall be rigidly connected to the roof conductor at three places on the ventilator.

B. Metal bodies of conductance shall be protected if not within the zone of protection of the air terminals. All metal bodies having equal to, or greater than, 400 square inches shall be bonded to the lightning protection system using main size conductors and a bonding plate with not less than 3 square inches. Provisions shall be made to guard against corrosion due to joining of dissimilar metals. Provide air terminals on metals that are less than 3/16th-inch thick, which are not in the cone of protection on roof areas, such as ventilators, air conditioning units, etc., all as required by the stated Code.

C. All major rooftop mechanical equipment and isolated metal bodies within 6 feet of system conductors shall be bonded to lightning protections system's main roof conductor with secondary conductors and appropriate bonding devices. Do not penetrate airside housings for anchoring. Seal air and water tight all connections at mechanical equipment.

D. Interconnect conductive and inductive metals as required by the UL 96A Code.

3.7 GROUND CONNECTIONS

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A. Use exothermic welding type connections which form solid metal joints in the main vertical and horizontal conductors, and for connections that are not exposed in the finish work.

B. Provide ground connection for each down conductor.

C. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums.

D. Ground connections shall be protected from mechanical injury.

E. In making ground connections, utilize permanently moist areas as applicable.

F. For the conductors located outside of the building, install the conductors not less than 2 feet (600 mm) below the finished grade.

G. Make connections of dissimilar metal with bi-metallic type fittings to prevent electrolytic action.

H. For structural steel buildings, connect the steel framework of the buildings to the main water pipe near the water system entrance to the building.

I. Connect exterior metal surfaces, located within 900 mm (three feet) of the lightning protection system conductors, to the lightning protection system conductors to prevent flashovers.

J. Do not pierce the structural steel in any manner. Connections to the structural steel shall conform to the UL Publication No. 96A.

K. Install ground connections to earth at not more than 1800 mm (60 foot) intervals around the perimeter of the building.

L. Weld or braze bonding plates, not less than 200 mm (eight inches) square, to cleaned sections of the steel and connect the conductors to the plates.

M. Connections to Lightning Protection System: Bond grounding conductors, including grounding-conductor conduits, to lightning protection down conductors or lightning protection grounding conductors in compliance with NFPA 780.

N. Common Ground Bonding with Lightning Protection System: Bond electric power system ground directly to lightning protection system grounding conductor at closest point to electric service grounding electrode. Use bonding conductor sized same as system grounding conductor and install in conduit.

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3.8 GROUNDING ELECTRODES

A. Provide for each down conductor.

B. Drive into earth minimum of 10 feet. Ground rods shall be not less than 2 feet, nor more than 10 feet from the structure.

C. Ground rods shall be installed such that the top is not less than 2 feet below finished grade.

D. Ground rod resistance shall not exceed 10 ohms. The resistance of the entire grounding system shall not exceed 5 ohms.

E. Provide test wells installed flush with the finished grade.

F. Counterpoise shall be No. 1/0 AWG copper cable and shall be laid around the perimeter of the structure in a trench**.**

3.9 CORROSION PROTECTION

A. Use no combination of materials to form an electrolytic couple that will accelerate corrosion in the presence of moisture, unless moisture is permanently excluded from the junction of such materials.

B. Use conductors with suitable protective coatings where conditions would cause deterioration or corrosion of conductors.

3.10 FIELD QUALITY CONTROL

A. Periodic Inspection: Provide the services of a qualified inspector to perform periodic inspection according to LPI-177, Inspection Guide for LPI Certified Systems.

B. UL Inspection: Provide the services of Underwriters Laboratories, Inc. to perform inspections. Make revisions as required to obtain Master Label Certificate.

C. Certification: Two weeks prior to final inspection, deliver to the Owner four copies of the Certification that the installed lightning protection system has been inspected by a UL representative and has been approved by UL without variation.

D. Prior to commencement of any work, the Contractor shall obtain and deliver to the Owner the application and inspection forms necessary to file application for the LPI Certified System Certificates. As applicable, these forms include: Stage 1 - Grounding Inspection Report; Stage 2 - Concealed Components Inspection Report; and Stage 3 - Final Inspection Report.

E. The Contractor shall perform required inspections at the appropriate times and upon completion of the job shall forward the above Inspection Report forms to the Lightning Protection Institute to obtain the LPI Certified System Certificate.

F. Verify the electrical continuity by measuring the ground resistance to earth at the ground level, at the top of the building or stack, and at intermediate points with a sensitive ohmmeter. Compare the resistance readings. Ground resistance shall not exceed 5 ohms. Submit test results.

END OF SECTION

NOT FOR BIDDING

SECTION 265100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1. RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 26 Section 260943, “Network Lighting Controls” for network lighting control systems controlling interior lighting fixtures.
2. Division 26 Section 262726, “Wiring Devices” for wallbox toggle switches, wallbox occupancy sensor switches, and wallbox timer switches controlling interior lighting fixtures.

1.2. SUMMARY

A. This Section includes interior lighting fixtures, LED light sources, electronic LED drivers, emergency lighting units, and accessories.

B. Provide a lighting fixture for each fixture shown on the Drawings as described in this Specification, of the design and quality indicated herein. Provide fixtures complete, including light sources of the type, lumen output, and CCT indicated.

C. All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this contract shall be furnished by the Contractor.

D. Conformance: Fixtures shall be manufactured in strict accordance with the Contract Drawings and Specifications.

E. Specifications and scale Drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary for the work.

F. Minor details, not usually indicated on the Drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the Drawings.

G. Omissions: The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc., which may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this Specification rests with the Contractor.

1.3. DEFINITIONS

A. CCT: Correlated Color Temperature.

B. CRI: Color Rendering Index.

C. DLC: Design Lights Consortium.

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D. ELCD: Emergency Lighting Control Device.

E. IDA: International Dark-Sky Association.

F. IES: Illuminating Engineering Society.

G. LED: Light Emitting Diode.

H. LPW: Lumens per Watt.

I. Luminaire (Light Fixture): A complete lighting device consisting of light source(s) and driver(s), when applicable, together with parts designed to distribute light, to position and protect light sources, and to connect light sources to power supply.

1.4. SUBMITTALS

A. Product Data: Submit fixture shop drawings in booklet form with separate sheet for each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. Certified results of independent laboratory test for fixtures and lamps for electrical ratings and photometric data. Test data shall include manufacturer and model number for fixture being submitted.
3. Light Sources.
4. Electronic LED Drivers.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.

1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

C. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.

D. Samples for Verification: For lighting fixtures requested for sample submission by the Owner and/or Architect/Engineer. Refer to paragraph “Samples”, in this Section, for additional information.

1. Lamps: Specified units installed.
2. Ballast: 120-V model of specified ballast type.
3. Accessories: Cord and plug.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

F. Record Documents: Accurately record actual location of each luminaire with the associated switching/control arrangement.

G. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 01. Include technical data sheets and parts ordering information. Include testing and maintenance requirements and instructions for emergency lighting equipment.

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H. Lighting Calculations: Submit point-by-point lighting calculations for spaces where fixtures being submitted are not listed on the Interior Lighting Fixture Schedule on the Contract Drawings. All calculations shall strictly conform to IES Standards.

1.5. SAMPLES

A. After shop drawing review and prior to release for manufacturing, the Contractor shall furnish one sample of each fixture in this Specification for which sample requirement is noted.

B. Shipping: The samples shall be complete with specified light sources and compatible drivers, ready for hanging, energizing, and examining, and shall be shipped, prepaid by the Contractor, to the Architect/Engineer, or as otherwise advised.

C. Two weeks from the date received shall be allowed for thorough examination of the samples by the Architect/Engineer.

D. Return: Samples are returnable, the Contractor shall arrange for return, prepaid shipping and pickup of each sample submitted.

E. Samples must be actual working units of materials to be supplied.

F. Samples shall be submitted by the Contractor for each substituted lighting fixture as requested for review by the Owner and/or Architect/Engineer.

1.6. QUALITY ASSURANCE

A. Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction. Provide only UL listed and labeled fixtures with UL listed wiring. Wiring shall be suitable for the fixture temperature listing.

B. Comply with NFPA 70.

C. FM Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM.

D. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

E. Mockups: Provide lighting fixtures for room or module mockups where required by the Architect. Install fixtures for mockups with power and control connections.

1. Obtain Architect's approval of fixtures for mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Remove mockups when directed. Fixtures may be reinstalled in the Work with approval of Architect.
4. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. UL Listing: All fixtures shall be manufactured in strict accordance with the appropriate and current requirements of the Underwriters' Laboratories, Inc. (Standards for Safety), and others as they may be applicable. A UL listing shall be provided for each fixture type and the appropriate label or labels shall be affixed to each fixture in a position concealing it from normal view.

G. Installer: All Installers shall have not less than five (5) years' experience in the installation of

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lighting fixtures of the type and quality shown.

H. Materials, equipment and appurtenances, as well as workmanship provided under this Section, shall conform to the highest commercial standard as specified and as indicated on the drawings.

I. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 410, and 510 as applicable to installation, and construction of interior building lighting fixtures.

J. NEMA Compliance: Comply with applicable requirements of NEMA Standards Publication Numbers LE1 and LE2 pertaining to lighting equipment and LE4 pertaining to recessed luminaires.

K. IES Compliance: Comply with IES RP-1 pertaining to office lighting practices and RP-15, regarding selection of illuminance values for interior office building.

L. UL Compliance: Comply with UL Standards, including UL 486A and B, pertaining to interior lighting fixtures. Provide interior lighting fixtures and components which are UL-listed and labeled and comply with the following UL Standards:

1. UL 1598 – Luminaires (Tri-national standard)
2. UL 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products
3. UL 8753/ULC-S8753 – Standard for Field-Replaceable Light Emitting Diode (LED) Light Engines
4. UL 8754/ULC-S8754 – Holders, Bases, and Connectors for Solid-State (LED) Light Engines and Arrays.
5. UL 924 – Emergency Lighting and Power Equipment

M. NECA/IESNA Compliance: Comply with NECA/IESNA 500 Standard, Installing Indoor Commercial Lighting Systems (ANSI).

1.7. COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction. Provide plaster frames, hangers, trim rings, and fittings, as required for each type of ceiling construction.

B. The Contractor shall coordinate switch and lighting control devices with door swings and other architectural features.

C. The Contractor shall be responsible for providing the required quantity of ballasts to provide the control and operations of the lighting fixtures as indicated by the lighting controls on the Drawings. For example, where two switches are indicated to serve fixtures, then two ballasts per fixture shall be provided.

1.8. WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 5 years

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from date of Substantial Completion.

C. Special Warranties for Electronic Drivers: Written warranty, executed by manufacturer agreeing to replace ballasts and drivers that fail in materials or workmanship within specified warranty period.

1. Special Warranty for Electronic Drivers: Five (5) years from date of manufacture, but not less than four years from date of substantial completion.

1.9. EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Circuit Boards: 1 for every 50 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 50 of each type and rating installed. Furnish at least one of each type.
3. Electronic LED Drivers: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
4. Emergency battery packs: 1 for every 20 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 50 of each type and rating installed. Furnish at least one of each type.

PART 2 PRODUCTS

2.1. MANUFACTURERS

A. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, the products indicated in this Specification.

B. Data listed and model number shown, in this Specification for each fixture type indicate minimum requirements and no exceptions will be made.

2.2. FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

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1. Plastic for lenses and diffusers shall be formed of colorless 100% virgin acrylic as manufactured by Rhom & Haas, Dupont, or as acceptable. The quality of the raw material must equal or exceed IES, SPI and NEMA Specifications by at least 100%--which, as a minimum standard, shall not exceed a yellowness factor of 3 after 2,000 hours of exposure in the Fade-meter or as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 15 years.
2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.
3. Glass used for lenses, refractors, and diffusers in lighting fixtures shall be tempered for high impact and heat resistance; the glass shall be crystal clear in quality with a transmittance of not less than 88%. For exterior fixtures, use tempered Borosilicate glass, Corning #7740, or as acceptable. For fixtures directly exposed to the elements and aimed above the horizontal with a radiant energy of 4.16 watts per square inch, or greater, use Vycor glass.
4. Where optical lenses are used, they shall be free from spherical and chromatic aberrations and other imperfections which may hinder the functional performance of the lenses.
5. Mechanical: All lenses, louvers, or other light diffusing elements shall be removable, but positively held so that hinging or other normal motion will not cause them to drop out.
6. Cleaning: All lenses shall be turned over to the Owner clean and free of dust.

F. Hardware: All hardware (e.g. screws, nuts, washers, latches, etc.) for fixtures located in damp/wet locations shall be stainless steel, unless otherwise indicated on the drawings.

2.3. FIXTURES

A. Refer to “Interior Lighting Fixture Schedule” on the Contract Drawings.

2.4. FINISHES

A. Painted Surfaces: Synthetic enamel, with acrylic, alkyd, epoxy, polyester, or polyurethane base, light stabilized, baked on at 350 degree Fahrenheit minimum, catalytically or photo-chemically polymerized after application. All painted surfaces shall be painted after fabrication.

B. Ceiling opening frames shall either be manufactured of non-ferrous metal, or be suitably rust-proofed after fabrication.

C. Selection: Unless otherwise noted, finishes shall be as selected by the Architect.

D. Undercoat: Except for stainless steel, give ferrous metal surfaces a five-stage phosphate treatment or other acceptable base bonding treatment before final painting and after fabrication.

E. Unpainted non-reflecting surfaces shall be satin finished and coated with a stoved clear lacquer to preserve the surface. Where aluminum surfaces are treated with an anodic process, the clear lacquer coating may be omitted.

F. Unpainted Aluminum Surfaces: Finish interior aluminum trims with an anodized coating of not less than 7 mg per square inch, of a color and surface finish as selected by the Architect. Finish exterior aluminum trims with an anodized coating of not less than 35 mg per square inch or a color and surface finish as selected by the Architect.

G. Porcelain Enamel Surfaces: Apply porcelain finishes smoothly. Finish shall be not less than 7.5 mils thick of non-yellowing, white, vitreous porcelain enamel with a reflectance of not less than 85%.

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H. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects. All parts shall be painted after fabrication.
2. Metallic Finish: Corrosion resistant.

I. White finishes: Minimum of 85 percent reflectance.

2.5. FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section 260500, “Common Work Results for Electrical”, and Division 26 Section 260529, “Hangers and Supports for Electrical Systems”, for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

G. Recessed fixtures shall be removable from below to allow access to outlet/junction boxes in ceiling spaces.

H. Each fixture shall be supplied with necessary straps, supports, or hangers, or other miscellaneous materials and devices to install them in a satisfactory manner to conform to architectural treatment and finishes in area in which they are to be installed. Consult all Mechanical, Architectural and Structural Plans and related Contract Documents to be familiar with all necessary details for proper fixture placement. Failure to do so will not relieve the Contractor of responsibility of furnishing all necessary material, complete to perform function intended for indicated lighting system.

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2.6. LED LIGHT SOURCES

A. Manufacturers: Provide quality LED light sources by the manufacturers listed below, off brand/generic light sources shall not be acceptable.

1. Cree
2. Nichia
3. Osram
4. Philips
5. Samsung

B. Correlated color temperature (CCT): 4,000 Kelvin per ANSI C78.377, unless otherwise indicated on the Contract Drawings.

C. Light sources shall have a maximum deviation of 3-step Macadam Ellipses.

D. Color rendering index (CRI): 80 CRI minimum.

E. L70 rating shall meet or exceed value indicated on the interior lighting fixture schedule.

F. Light sources installed in outdoor environments shall be rated for low temperature applications (0°F, minimum).

2.7. LED ELECTRONIC DRIVERS

A. Manufacturers: Provide quality LED electronic drivers by the manufacturers listed below. Off-brand/generic electronic drivers shall not be acceptable.

1. Advance (Philips Lighting Electronics)
2. eldo LED
3. General Electric (GE) Lighting
4. Lutron Electronics, Inc.
5. Osram Sylvania
6. Samsung
7. Universal Lighting Technologies, Inc.

B. General Requirements:

1. Suitable for operating type and quantity of LED sources indicated at full light output.
2. No PCBs.
3. Suitable for dry and damp locations.
4. Starting temperature: 0 degrees Celsius.
5. 50,000 hour (minimum) design life.
6. Class 2 output UL recognized to UL and CSA requirements.

C. Electrical Requirements:

1. 0-10V dimming standard, 1% minimum unless otherwise noted on the Contract Drawings.
2. Power Factor: 90 percent (0.9) minimum.
3. Total Harmonic Distortion (THD): Less than 20 percent.
4. Sound Rating: A.
5. Short circuit and overload protection standard.
6. Inherent thermal protection standard.

D. Listings:

1. ANSI/UL 8750
2. ANSI C62.41: Category A for transient protection.
3. ANSI C82.16
4. FCC Part 15: Non-consumer equipment EMC.
5. UL 1310: Standard for Class 2 Power Units.

E. Warranty:

1. Minimum five-year warranty.

2.8. EMERGENCY BATTERY PACKS

A. Unless otherwise indicated, features include the following:

1. Conform to UL 924 “Emergency Lighting and Power Equipment”
2. Conform to NFPA 101 and International Building Code (IBC) requirements.
3. Initial Light Output: Provide as indicated.

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4. Illumination time: 90 minutes, minimum.
5. Battery: Long life, high temperature, maintenance-free Nickel-Cadmium battery with test switch.
6. Self-Testing Diagnostics: Provide as indicated.
7. Cold Weather Operation: Provide as indicated.
8. Warranty: Minimum 5 year full product warranty.
9. Manufacturers: Provide specification grade emergency battery ballasts by the Manufacturers listed below. Off-brand/generic ballasts shall NOT be acceptable.

    a. Bodine
    b. Iota
    c. Power Sentry

2.9. EXIT SIGNS

A. General Requirements: Comply with UL 924, “Emergency Lighting and Power Equipment”, and the following:

1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

B. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Light-emitting diodes (LED), 25 + years rated lamp life.

2.10. PROTECTIVE WIRE GUARDS

A. Provide protective wireguards over lighting fixtures subject to physical damage. All new lighting fixtures installed in mechanical and electrical rooms, and in areas subject to physical damage shall be provided with protective guards. Protective guards shall be manufacturer's recommended product for the device being protected or a suitable guard as manufactured by American Time & Signal Company (800-328-8996), Safety Technology International (STI) (800-888-4784), or Institutional Systems Services Corporation (800-524-0537).

B. Devices to be provided with protective guards include, but are not limited to, the following:

1. Lighting Fixtures
2. Exit Signs
3. Emergency Lighting Units
4. Other Devices as required by Owner

C. Guards shall be fabricated from ¼-inch (9-gauge) cold-rolled steel rods, welded together with mounting tabs. Guards shall be finished with a powder-based epoxy to protect against corrosion. Finish color shall match the finishes for the area being installed.

D. Protective Devices shall be considered incidental to the product installed in an area subject to damage as indicated on the drawings and shall be provided at no additional cost to the Owner.

PART 3 EXECUTION

3.1. INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

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B. Support for Fixtures independent of ceiling systems, ducts, and piping.

1. Provide support system rods or wires for each fixture from structure above. Locate not more than 6 inches (150 mm) from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

C. Suspended Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings. Provide alignment fittings as required for uniform, level installation of continuous rows of suspended fixtures.

D. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor’s responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.

E. Setting and Securing: Set units plumb, square, and level with ceiling and walls, and secure according to manufacturer’s printed instructions and approved shop drawings.

F. Support for Recessed and Semi-Recessed Fixtures:

1. Installed units shall not be supported from ceiling support system.
2. Provide positive attachment from fixtures to ceiling grid.
3. Provide #12 gauge safety tie wires to structure above as follows:
   a. Fixtures less than ten (10) pounds: One (1) wire.
   b. Fixtures more than ten (10) pounds and less than fifty (50) pounds: Two (2) wires at diagonally opposite corners.
   c. Fixtures more than fifty (50) pounds or larger than 2’x4’: Four (4) wires, one (1) at each corner.
   d. Linear fixtures: Two (2) wires at each end of fixture, plus two (2) wires every eight (8) feet between.
4. Fixtures of Sizes Less than Ceiling Grid: Center in the acoustical panel. Support fixtures independently with at least two 3/4-inch metal channels spanning and secured to the ceiling tees.
5. Recessed fixtures shall be provided with the proper plaster frame or suitable adapter to receive the finished ceiling construction.
6. Recessed lighting fixtures shall be suitable for the ceiling or wall material and construction in which they will be installed.
7. Recessed mounted lighting fixtures shall be connected to a junction box with flexible conduit. Final connection to light fixture shall be with heat-resistant wire.

G. Each lighting fixture shall be rigidly supported from the building construction and shall include suspension hangers, devices, and extra steel work for fixture support where required.

1. Support all lighting fixtures adequately. Special supports shall be installed as required.

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2. Luminaires shall be furnished with all necessary stems, plaster frames, hangers, for the safe support of the fixture. All supports for fixtures shall be adequate to support weight of the fixtures. All visible hanging devices and appurtenances shall have the same finish as the fixture unless specifically indicated otherwise.

H. Coordinate with the work of other trades to determine modifications required to make fixtures suitable for ceilings as installed and verify the types of ceiling construction prior to fixture fabrication. Determine that the suspension method and the flange arrangement for the fixtures coordinates with the ceiling type and its suspended system. Fixtures which are shipped to the project and do not fit, or which otherwise do not match the ceiling system, shall be returned for correction at no additional cost.

I. Installation shall include receiving, checking, storage in a safe and approved area until they are required for installation, unpacking, assembly of separate fixture components where required, and complete wiring and connection including the provision of associated wiring and connection devices such as fittings, hangers, aligners, box covers, and similar hardware which may be required for certain fixtures, but are not detailed or scheduled with the fixtures.

J. Plaster frames or mounting frames shall be provided for all fixtures which require them and shall be suitable for the ceiling construction in which they will be installed.

K. Trim rings shall be painted to match the finish of the adjacent ceiling surface.

L. Fixtures in equipment rooms shall be positioned clear of equipment interference and yet provide adequate light for working around the equipment.

M. All lighting fixtures, when installed, shall be set free of light leaks, warps, dents, or other irregularities.

N. Pendant-type fixtures shall be hung at heights as required, and as shown on the Drawings.

O. In certain areas shown on the Drawings, the locations of fixtures are approximate only and the exact locations and pendant lengths will be determined by the Architect.

P. If permanent lighting fixtures are to be used in lieu of temporary lighting facilities during the construction period, this shall be done only as permitted by the Owner's Representative, and fixtures shall be cleaned at the time of turnover to the Owner.

Q. Lighting fixtures for general illumination, emergency lighting, and exterior lighting, shall be complete with all required accessories and attachments.

R. Fixtures shall bear UL label and shall be wired and installed in full compliance with applicable codes.

S. The omission of a type or quantity in the Interior Lighting Fixture Schedule on the Contract Drawings shall not relieve the Contractor of the responsibility of installing all required fixtures, of proper type, as shown on the Drawings.

T. Fixtures shall be recessed, surface, or pendant type, as specified and shall include sockets, diffusers, ceiling canopies and stems, hickeys, and all other necessary accessories.

U. Where suspended ceilings with steel channels occur, outlets and fixtures shall be supported on members resting on the channel framework. In no case shall fixtures be supported from plasterboard, plaster, or acoustic material.

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3.2. GENERAL INSTALLATION OF FIXTURES

A. Install interior lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's Standard of Installation, NEMA Standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

B. All recessed fixtures mounted in dry wall or plaster ceilings shall be complete with a suitable plaster frame or trim ring. All fixtures shall be mounted on or in ceilings in accordance with published recommendations of the manufacturers using bar or swing-way hangers, etc. These items shall be furnished as part of the fixture whether called for by catalog number or not.

C. All fixtures shall be installed in strict accordance with NEC Article 410 and shall properly and suitably support the weight of any fixture installed. All fixtures shall be supported independently of ceiling suspension system being attached to building structure.

D. Every lighting fixture shall be of the type for the ceiling construction in or on which it is to be installed. It shall be the Electrical Contractor's responsibility to coordinate this with the Ceiling Contractor.

E. Install surface-mounted fixtures properly to eliminate light leakage between fixture frame and finished surface. Apply small bead of caulk or silicone around perimeter of fixture to conceal gaps between fixture and finished surface.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.3. CONNECTIONS

A. 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.

B. Ground equipment per NEC and manufacturer's instructions.

C. Exit signs and emergency lighting units shall be connected to the un-switched (hot) phase conductor of the lighting branch circuit serving the space, such that exit signs are illuminated at all times and emergency lighting units turn on upon loss of normal power. Switches, control panels, and relays controlling lights in the space shall not affect the operation of exit signs and emergency lighting units.

3.4. FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests: As follows:

1. Verify normal operation of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.

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3. Verify normal transfer to emergency source and retransfer to normal.
4. Report results in writing.

E. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

F. Corroded Fixtures: Replace during warranty period.

3.5. CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

C. Touch up luminaire finish at completion of work.

D. Replace all light sources and/or electrical drivers that fail within three (3) months of Substantial Completion.

3.6. DEMONSTRATION

A. Provide a minimum of four (4) hours of training and demonstration of luminaire operations, adjustment, and maintenance.

END OF SECTION

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SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

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. Foam Duct Sealant.
4. Grout.
5. Plywood Backboards.
6. Common electronic safety and security 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 28 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.

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1.3. CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 28 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.

1.4. 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 and Engineer in advance of scheduled inspections.

E. A foreman, superintendent or other supervisor shall be in attendance for all scheduled inspections

1.5. 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.

1.6. 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 devices, cabling,

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etc.

D. Equipment sizes shown on the Drawings are estimated. Before installing any cabling, conduit, or boxes obtain the exact equipment requirements and install cabling, conduit, boxes or other item of the correct size for the equipment actually installed.

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, Civil, Structural, Food Service, Technology, Mechanical, and Electrical Drawings and Specifications apply to this work. The successful Bidder shall familiarize himself with all other related documents.

1.7. 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. Existing items of equipment are being reconnected under this Division of the Specifications. Successful Bidder shall be responsible for connecting all utilities as shown on the Drawings, to equipment identified as existing.

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.

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1.8. ELECTRONIC SAFETY AND SECURITY WORK UNDER OTHER DIVISIONS

A. Architectural Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under Architectural divisions shall be supplied with control wiring, transformers, contacts, etc.
2. Division 28 shall provide fire alarm connections to such equipment in accordance with applicable codes and standards.
3. Architectural Equipment refers to, but is not limited to the following:

a. Cabinets, Casework and Countertops

i. Do not install fire alarm devices, etc. behind casework, cabinets, etc. Coordinate with approved casework shop drawings.

b. Door Hardware

i. Includes, but is not limited to electric strikes, magnetic hold-open devices, overhead doors, smoke/fire doors, etc.

ii. Verify voltages of door hardware with approved door hardware shop drawings.

iii. Coordinate mounting height and location of magnetic hold-open devices with Architect.

iv. Coordinate fire alarm connections for overhead coiling doors/grilles with approved shop drawings.

v. Coordinate locations of smoke detectors serving fire/smoke doors with architectural drawings.

c. Glazing Systems

i. Includes but is not limited to commercial storefront, curtain walls, skylights, windows, etc.

ii. Do not install fire alarm initiation and notification appliances on glazing systems wherever possible. Where devices must be installed on glazing systems, indicate the same on fire alarm system shop drawings and obtain the permission of the Architect.

B. Civil Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under Civil divisions shall be supplied with control wiring, transformers, contacts, etc.
2. Division 28 shall provide supervisory monitoring of civil equipment listed blow including all wiring related thereto.
3. Civil Equipment refers to, but is not limited to the following:

a. Lift Stations

C. HVAC Equipment and Systems

1. In general, any electrically operated or controlled equipment furnished under HVAC

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divisions shall be supplied with control wiring, transformers, contacts, etc.

2. Division 28 shall provide fire alarm connections to such equipment in accordance with applicable codes and standards.
3. Certain mechanical units are furnished from the factory with motor starters, contactors, transformers, fuses, wiring, etc., required for fans, pumps, etc. When this equipment is supplied from the factory, Division 28 shall coordinate with Division 23 such that only one set of starters, fuses, switches, etc. is provided.
4. In general, control and interlock equipment (including, but not limited to wiring, conduit, trans-formers, relays, contacts, etc.) for HVAC equipment and systems is furnished under Division 23. Division 28 shall install and connect all equipment as necessary.
5. HVAC equipment refers to, but is not limited to the following:

    a. Energy Recovery Ventilators

        i. Provide duct-mounted smoke detectors and remote test stations for units over 2,000cfm.

        ii. Coordinate detector installation with Division 23.

        iii. Coordinate duct-mounted smoke detector sampling tube lengths with duct dimensions.

    b. Gas-Fired Equipment

        i. Provide carbon monoxide detectors in all spaces with gas-fired equipment.

    c. Heat Pumps

        i. Provide duct-mounted smoke detectors and remote test stations for units over 2,000cfm.

        ii. Coordinate detector installation with Division 23.

        iii. Coordinate duct-mounted smoke detector sampling tube lengths with duct dimensions.

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1.9. 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.

1.10. 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. DNREC - Delaware Department of Natural Resources and Environmental Control
6. EPA - Environmental Protection Agency
7. FM - Factory Mutual
8. IBC - International Building Code

9.	IEEE	-	Institute of Electrical and Electronics Engineers
10.	NEC	-	National Electrical Code
11.	NECA	-	National Electrical Contractors Association
12.	NEMA	-	National Electrical Manufacturers Association
13.	NFPA	-	National Fire Protection Association
14.	OSHA	-	Occupational Safety and Health Act
15.	UL	-	Underwriters' Laboratories

B. Electronic safety and security 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. Equipment shall, where a listing is normal for the particular class of equipment, be listed by 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.

1.11. SUBMITTALS

A. Product Data: Include complete descriptive product data for items specified in Part 2 of this Section.

1.12. SUBMITTAL PROCEDURES

A. Refer to Division 01, Section “Submittal Procedures” for requirements in addition to those indicated herein.

B. 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, and/or Engineer, to be in the best interest of the Owner.

C. After acceptance of Material and Equipment List, submit six (6) copies, or more as required under the General Conditions of complete descriptive data for all items as outlined be-low.

D. Electronic submittals shall be prepared as a Portable Document Format (PDF) file and shall include as page 1 the Contractor’s stamp, followed by the submittal contents. Submittal form shall identify the Project, Contractor, Subcontractor or Supplier, and pertinent Contract Document references.

E. Submittals shall consist of specifications, product data sheets, manufacturer’s catalog cuts, dimensional shop drawings, wiring diagrams, installation instructions, samples, and any other information necessary to indicate complete compliance with Contract Documents.

F. Submittals shall include, but not be limited to, the following information: size, type, functional characteristics, compliance with standards in Division 28, required service access which shall be suitable for intended location and use, electrical service connections and requirements, and deviations from Contract Document requirements.

G. Identify submittals, indicating intended application, location and service of submitted items. Refer to Specification sections or paragraphs and Drawings where applicable.

H. Clearly indicate exact type, model number, style, size, operating characteristics, ratings, options and special features of proposed item specifically for application to this project. Submittals of a general nature will not be acceptable.

I. 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

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attention, in writing, to deviation from contract requirements.

J. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and all electrical requirements for equipment submitted. The Contractor shall be responsible for correctness of all submittals.

K. 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.

L. 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.

M. 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.

N. 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.

O. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct submittal. Identify all submittals by the name of the item/system and the applicable Specification Section and/or Drawing number. Grouping of items/systems that are not related shall be unacceptable.

1. Items and Systems

   a. Access Doors

   d. Conduit and Raceways

   e. Fire Alarm System Components

      i. Alphanumeric Annunciator Panel(s)

      ii. Fire Alarm Control Panel

      iii. Graphic Annunciator Panel

      iv. Line Extenders

      v. NAC Panels

      vi. Initiation Devices (Pull Stations, Smoke Detectors, Heat Detectors, etc.)

      vii. Notification Appliances (Horns, Strobes, Speaker Strobes, etc.)

      viii. Wire and Cable

   f. Firestopping Materials

   g. Hangers and Supports

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h. Identification Products

i. Operation and Maintenance Manuals

j. Plywood Backboards

k. Record Drawings

l. Sleeves

m. Software

n. System Labeling Schedules

o. Testing Agency Qualifications

p. Tests and Reports

q. Transformers, Control

r. UPS Systems & Batteries

s. Wiring Diagrams

P. Submit for approval any other submittals 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.

Q. 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 Engineer.

R. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.13. 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. Shop drawings shall include identification of products being installed, compliance with specified standards, notation of coordination requirements, notation of dimensions verified by field measurement, etc. Do not base shop drawings on reproductions of the Contract Documents or standard printed data.

C. Submit shop drawings concurrent with product data. Shop drawings received without associated product data will be returned without review.

D. Submit for approval schematic diagrams of each electrical system installed in the building, including but not limited to Riser Diagrams and Schematic Wiring Diagrams for the following systems:

1. Fire Alarm System

E. Shop Drawing diagrams shall indicate device location, service, type, make, model number and the

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identification number of each device in the particular system. Following approval by all authorities, the diagrams shall be inserted into the O&M Manual specified herein.

F. 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.

G. 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.

H. Refer to individual Specification Sections and Contract Drawings for additional shop drawing requirements.

I. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.14. 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.

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,

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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.

1.15. 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.

1.16. 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 (2) 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.

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1.17. OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare six (6) hardcopies and electronic copies of the Operation and Maintenance Manual and shall deliver these copies of the manual to the Owner. Provide one (1) electronic copy for each hard copy set of the O&M manual.

B. The manual shall be as specified herein. The manual must be approved and will not be accepted as final until so stamped.

C. Hard copies of the manual shall be bound in three ring loose-leaf binders similar to National No. 3881 with the following title lettered on the front and spine of the binder: *Operation and Maintenance Manual – Sussex Technical School District – New Sussex Technical High School – Bid Pack C - Fire Alarm*.

1. Provide divider tabs and table of contents for organizing and separating information. Tab

titling shall be clearly printed under reinforced plastic tabs.

2. If more than one (1) binder is required, volume numbers shall be included on front and spine of each volume.
3. 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.

D. Electronic copies of the manual shall be saved on USB flash drives, and shall be in searchable PDF format with interactive index tabs. Approved electronic copies shall be stored in flash drive zipper cases in front of volume 1 (if applicable) of hard copies of the manual.

E. 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. Directory listing names, addresses, e-mail addresses, and telephone numbers for Architect, Engineer, Construction Manager, Contractor, Sub-contractor(s), equipment suppliers, sales and authorized service representatives.
3. Maintenance operation and lubrication instructions on each piece of equipment furnished.
4. Complete catalog data on each piece of electrical equipment furnished including approved Shop Drawing/Submittal with Engineer's Comments (if any).
5. Manufacturer's extended limited warranties on equipment.
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, starters, etc. shall include wiring diagrams, parts list and assembly drawing.
9. Access panel charts with index illustrating the location and purpose of access panels.
10. Approved Fire Marshal inspection report and fire alarm system record of completion per NFPA 72.
11. Start-up and test reports for equipment.

F. Submit Operation and Maintenance Manual prior to anticipated date of Substantial Completion for Engineer review and approval. Substantial Completion requires that Operation and Maintenance Manuals be reviewed and approved.

1.18. INSTRUCTION

A. Upon completion of all work, thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electronic safety and security equipment and systems.

B. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance.

C. 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.

D. Furnish the necessary technicians, skilled workers, and helpers to operate the electronic safety and security systems and equipment of the entire project for one (1) 8-hour day.

E. Where specified in technical sections, provide longer periods required for specialized equipment.

F. The Operation and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

G. Deliver all instruction materials to the Owner prior to the formal instruction period.

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H. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer.

I. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.19. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Owner.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.

D. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

1.20. INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit and use composite installation and coordination drawings to assure proper coordination and installation of the work. Drawings shall include, but not be limited to the following:

1. Mechanical Rooms indicating duct detectors, remote test stations, carbon monoxide detectors, ductwork, and piping, etc…
2. Electrical Rooms indicating fire alarm control panels, NAC panels, amplifiers, etc. as well as all electrical equipment in each space.

B. Draw plans to a scale not less than ¼ inch equals one foot. Include plans, sections and elevations of the proposed work, showing all equipment (mechanical, plumbing and electrical), conduit and wiring in the areas involved. Fully dimension all work, horizontally and vertically. Show coordination with other work including piping, ductwork and other mechanical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams. Where field connections are shown to factory-wired terminals, furnish manufacturer's literature showing internal wiring of equipment.

D. The complete set of Architectural, Civil, Structural, Food Service, Technology, Mechanical, and Electrical Drawings and Specifications apply to this work. The successful bidder shall familiarize himself with all other related documents to avoid possible demolition and installation conflicts.

PART 2 PRODUCTS

2.1. SLEEVES FOR RACEWAYS AND CABLES

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A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. 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, Non-Shrink 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 ten sile 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).

2.4. BACKBOARDS

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A. Backboards: Plywood, A/C grade, fire-retardant treated, ¾" x 48" x 96" (19 x 1220 x2440 mm) with no added urea formaldehyde.

B. Provide each fire-retardant-treated plywood backboard two feet off the floor to top. Secure back-board with a minimum of eight (8) screws. Plywood backboard shall have one side with exterior glue and one finished smooth side. Mark all backboards and cabinets with appropriate legends (i.e., "COMM").

C. Verify with local codes or AHJ prior to painting fire-retardant-treated plywood backboard with stamped fire rating labels. If allowed by code, paint fire-retardant-treated plywood backboard with coats of durable white enamel (or other finish color as selected by the Architect.

2.5. PROTECTIVE WIRE GUARDS/ VANDAL SHIELDS

A. Provide protective guards over devices subject to physical damage. All devices installed in mechanical and electrical rooms, and other areas subject to damage shall be provided with protective guards. Protective guards shall be manufacturer's recommended product for the device being protected or a suitable guard as manufactured by American Time & Signal Company (800-328-8996), Safety Technology International (STI) (800-888-4784), or Institutional Systems Services Corporation (800-524-0537).

B. Devices to be provided with protective guards include, but are not limited to, the following:

1. Fire Alarm Pull Stations
2. Smoke/Heat Detectors
3. Fire Alarm Audio/Visual Devices (Horns, Strobes, etc…)

C. Wireguards shall be fabricated from ⅛-inch (9-gauge) cold-rolled steel rods, welded together with mounting tabs. Wireguard shall be finished with a powder-based epoxy to protect against corrosion. Finish color shall match the finishes for the area being installed, except guards for fire alarm devices shall match the device finish, e.g. red.

D. Indoor Protective Shield: Factory-fabricated, clear thermoplastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

E. Outdoor Protective Shield: Factory-fabricated, clear thermoplastic enclosure designed for outdoor use with closed cell gasketing and IP54 rating, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

F. Protective Guards/ Vandal Shields shall be considered incidental to the product installed in an area subject to damage as indicated on the drawings and shall be provided at no additional cost to the Owner.

PART 3 EXECUTION

3.1. 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.

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C. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

D. Refer to phasing plans for additional requirements.

E. Where any abandoned conduits in existing floors, walls, [crawl spaces,] [pipe tunnels,] ceilings, etc., conflict with new work, remove abandoned conduits as necessary to accommodate new work.

F. 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.

G. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the Authority(ies) Having Jurisdiction (AHJ).

H. Make provisions and include in bid all costs associated with confined entry/space requirements in all 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 conduit systems to new conduit systems.

J. At completion of project all temporary conduit, wires, etc., shall be removed in their entirety.

K. Existing conduit, equipment, wiring, 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 PCB's.

N. 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.

O. Where required, provide and coordinate removal and re-installation of existing equipment. Take care to protect materials and equipment indicated for reuse. Contractor shall repair or replace items which are damaged. Contractor shall have Owner's representative present to confirm condition of equipment prior to demolition.

P. 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.

Q. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.

R. 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

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while stored.

S. 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.

T. 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.

U. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

V. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

3.2. CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 28. 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 Structural Engineer.

3.3. TEMPORARY FACILITIES

A. General: Refer to the Division 01 Sections for general requirements of temporary facilities.

B. Description: Furnish and install the necessary equipment for temporary fire alarm connections and all temporary wiring as required.

C. Attention is directed to the Occupational Safety and Health Act (OSHA), Americans with Disabilities Act (ADA) and National Electrical Code (NEC) requirements for electrical work on construction sites.

D. Remove all temporary installations and connections after permanent power is established and/or prior to completion of the project.

3.4. OUTAGES

A. 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.

B. Provide a minimum of seven (7) 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.

C. Submit Outage Request Form, attached at the end of this Section, to Owner for approval.

3.5. PHASING

A. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities Having Jurisdiction (AHJ).

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B. Provide dust barriers/partitions, penetration closures, etc, to ensure safety of building occupants and protection of existing surroundings.

3.6. COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY 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 NEC Article 110.

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 requirements for each piece of equipment receiving one or more fire alarm connections.

H. Include any and all items required by the National Electrical Code, NFPA 72, and/or field conditions for the proper connection and installation of each piece of equipment.

I. Make all connections to equipment in accordance with manufacturer's instructions.

J. Right of Way: Give to piping systems installed at a required slope.

K. Coordinate electronic safety and security work under other Divisions in accordance with Part 1 of this Section, Article "Electronic Safety and Security Work Under Other Divisions".

3.7. 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 NEC Article 110.26.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Part 2 of this Section.

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D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26 Section 260528, "Firestopping for Electrical Systems".

3.8. EXCAVATION AND BACKFILLING

A. General:

1. Perform all necessary excavation, or installation of work under Division 28, in whatever materials or conditions encountered, using suitable methods and equipment.
2. Accurately establish required lines and grades and properly locate the work.
3. Determine the locations of all existing utilities before commencing the work.

B. Excavation:

1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, OSHA and other applicable Guidelines.
3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling:

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

3.9. WALL AND FLOOR PENETRATIONS

A. All penetrations of partitions, ceilings, roofs and floors under Division 28 shall be sleeved, sealed, and caulked as specified herein.

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, “Firestopping for Electrical Systems”.

C. Provide conduit escutcheons for all exposed conduit penetrations in finished interior spaces and all exposed exterior penetrations.

D. Conduit 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.

3.10. PENETRATION OF WATERPROOF CONSTRUCTION

A. The Building shall remain watertight at all times.

B. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior

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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.

C. Where conduits penetrate roofs, flash pipe with Stoneman Stormtite, Pate or approved equal, roof flashing assemblies with skirt and caulked counter flashing sleeve.

D. Furnish and install pitch pockets or weather tight curb assemblies where required.

3.11. SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. 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.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements of Division 07 Section "Joint Sealants".

J. 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 260528, “Firestopping for Electrical Systems”.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and joint sealant/grout.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals. Seal interior of each raceway with Foam Duct Sealant as specified herein.

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3.12. 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".

3.13. HANGERS AND SUPPORTS

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.

C. Refer to Division 26 Section 260529, “Hangers and Supports for Electrical Systems”, for additional requirements.

3.14. CONCRETE AND MASONRY WORK

A. Furnish and install concrete and masonry work for items required under Division 28. Perform work in accordance with requirements of Division 03 and other applicable Divisions of these Specifications.

B. Concrete shall achieve compressive strength not less than 3,000 psi after 28 days.

C. Grout shall be non-shrink, high strength mortar, free of iron of 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.

D. Properly align, level, and grout all equipment where necessary.

3.15. CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. Unless otherwise noted on the Drawings, where existing electronic safety and security 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 28 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 28, 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.

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3.16. 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.

3.17. PROVISIONS FOR ACCESS

A. The Contractor shall provide access panels and doors for all concealed equipment, and other devices requiring maintenance, service, adjustment 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. 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. 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.

F. Provide sufficient access and working space for repair and maintenance about all lighting and electrical equipment to permit ready and safe operation and maintenance of such equipment in accordance with OSHA 29 CFR 1910 Subpart D and 1910.303(g).

3.18. 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.

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D. Protect all finishes and restore any finishes damaged as a result of work under Division 28 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 Architect, unless otherwise indicated by the Owner.

H. All exposed conduit, boxes, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

3.19. COLOR SELECTION

A. Color of finishes shall be as selected by the Architect.

3.20. 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.

3.21. 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 electronic safety and security 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.

3.22. TESTING AND ADJUSTMENT

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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. 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 for approval.

END OF SECTION

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OUTAGE REQUEST FORM

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: _____

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SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 GENERAL

1.1. RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 28 Section 280500, “Common Work Results for Electronic Safety and Security”, for general installation requirements for fire-alarm systems.

1.2. SUMMARY

A. Section includes a digital, addressable fire alarm system for the west pavilion and the greenhouse buildings, including, but not limited to the following:

1. Fire-alarm control unit(s).
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Device guards.
7. Remote annunciator(s).
8. Addressable interface devices.
9. Digital alarm communicator transmitter(s).
10. Network communications.

B. The fire alarm system in each new building shall have a network connection to fire alarm control system in the main building, which was provided under Bid Pack B. See Paragraph “Manufacturers”, this Section, for additional information.

1.3. DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

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B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.
12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

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1.5. INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.6. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
i. Equipment tested.
ii. Frequency of testing of installed components.
iii. Frequency of inspection of installed components.
iv. Requirements and recommendations related to results of maintenance.
v. Manufacturer's user training manuals.
h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7. MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
3. Detector Bases: Quantity equal to two percent of amount of each type installed, but no

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fewer than one unit of each type.

4. Keys and Tools: One extra set for access to locked or tamperproofed components.
5. Audible and Visual Notification Appliances: Five of each type installed.
6. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.8. QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Final programming, testing, and commissioning shall be by personnel certified by NICET as fire-alarm Level IV (minimum) technician.

1.9. PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Architect's and Owner's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.10. SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

C. Fire alarm will remain active in the construction area. Protect devices as necessary. If alarm needs to be put into test mode coordinate with Owner’s Representative.

1.11. WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Two year(s) from date of Substantial Completion.

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PART 2 PRODUCTS

2.1. SYSTEM DESCRIPTION

A. The Fire Alarm / Life Safety System supplied under this specification shall be a microprocessor based network system. All Control Panel Assemblies and connected Field Appliances shall be both designed and manufactured by the same company, and shall be tested and cross listed as compatible to ensure that a fully functioning Life Safety System is designed and installed.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

C. All components provided shall be listed for use with the selected system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2. MANUFACTURERS

A. Source Limitations for Fire-Alarm System and Components: All components shall be non-proprietary and shall be available from multiple integrators and shall be able to be installed by integrators independent of the manufacturer.

B. Components shall be compatible with, and operate as an extension of, the existing system for the main building provided under Bid Pack B. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

1. The existing fire alarm control panel is a Notifier (by Honeywell) NFS2-640 control panel, located in the emergency electrical room of the main building.
2. The fire alarm system in the main building is being provided by Advantech. Contact information below:

a. Name: Randy Reynolds, Program Manager
b. Email: rreynnolds@advantechsecurity.net
c. Phone: (302) 674-8405
d. Address: 151 Garrison Oak Drive, Dover, DE 19901

C. System Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Notifier by Honeywell (Basis of Design)
2. Fire-Lite Alarms by Honeywell
3. Silent Knight
4. System Sensor

2.3. SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Carbon monoxide detectors.

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B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Activate voice/alarm communication system.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated HVAC duct systems.
8. Recall elevator to primary or alternate recall floors.
9. Activate emergency lighting control.
10. Activate emergency shutoffs for gas and fuel supplies.
11. Record events in the system memory.
12. Indicate device in alarm on remote annunciator(s).

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Generator Signals:

a. Generator running
b. Generator trouble
c. Transfer switch not in “auto”

2. User disabling of zones or individual devices.
3. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.
11. Hose cabinet door open.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
3. Record the event in system memory.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on remote annunciator(s).

2.4. FIRE ALARM CONTROL UNIT

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A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    d. The FACP shall be listed for connection to a central-station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 3.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:

    a. One dedicated RS 485 port for central-station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
    c. One USB port for PC configuration.
    d. One RS 232 port for voice evacuation interface.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Sound general alarm if the alarm is verified.
4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit:

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1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system and shall automatically release doors upon local smoke detection. Fire drills and alarms in other areas of the building shall not cause the door hold-open devices to release doors.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center or as a special module that is part of fire-alarm control unit**.**

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

    a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    b. Programmable tone and message sequence selection.
    c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
4. Provide emergency communication microphone at fire alarm control unit and at the annunciator location.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.
2. Batteries shall be sized to provide 15 minutes of alarm power and 24 hours of standby power.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate

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response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5. MANUAL PULL STATIONS

A. General Requirements for Manual Pull Stations: Comply with UL 38. Pull stations shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If surface-mounted or installed on curtainwall, provide manufacturer's surface back box.

1. Public/Finished Areas (e.g. corridors, gymnasium, cafeteria, etc.): Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Provide vandal shield for each station as specified under “Device Guards” in this Section.
2. Non-Public/Unfinished Areas (e.g. mechanical/electrical rooms): Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.

B. Manual pull stations in harsh environments, (e.g. outdoors, greenhouses, etc.) shall be listed for use in harsh environments. Stations shall be constructed of die cast material, all components shall be pre-painted or have plated surfaces to inhibit corrosion, and units shall have NEMA 4X enclosure.

2.6. SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.

a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
c. Multiple levels of detection sensitivity for each sensor.
d. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

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2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure (for outdoor installations): NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Weatherized Duct Detector Enclosure (for indoor installations): Provide a weatherized housing for each duct smoke detector that prevents condensation on the device by insulating the detector and providing insulated air from the monitored HVAC duct. Enclosures shall be NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
5. Each sensor shall have multiple levels of detection sensitivity.
6. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
7. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.
8. ATC System Interface: Fully programmable relay/contact for duct detector status to be monitored by the building ATC system.

2.7. CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Locate, mount, and wire according to manufacturer's written instructions.
7. Provide means for addressable connection to fire-alarm system.
8. Test button simulates an alarm condition.

2.8. MULTI-SENSOR DETECTORS

A. Mounting: Twist-lock base interchangeable with smoke-detector bases.

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B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present sensitivity selected.
4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.

1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
3. Heat sensor shall be as described in "Heat Detectors" Article.
4. Each sensor shall be separately listed according to requirements for its detector type.

2.9. HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.10. NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

B. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon or LED strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate.

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1. Rated Light Output:

   a. 15/30/75/110 cd, selectable in the field.
   b. 117/177 cd, or higher, for ADA accessible sleeping areas.

2. Mounting: Wall or ceiling mounted as indicated on the Contract Drawings.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.

E. Voice/Tone Notification Appliances:

1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
3. High-Range Units: Rated 2 to 15 W.
4. Low-Range Units: Rated 1 to 2 W.
5. Speakers shall be high-fidelity type, capable of producing low frequency (520 Hz) signal/tone.
6. Mounting: Wall or ceiling mounted as indicated on the Contract Drawings.
7. Matching Transformers: Tap range matched to acoustical environment of speaker location.

F. Finishes: Mounting faceplates and covers shall be factory finished as follows, unless otherwise required by the authority having jurisdiction (AHJ):

1. Wall Mounted Appliances: White
2. Ceiling Mounted Appliances: White
3. “Alert” Engraved in minimum 1-inch (25mm) high letters in contrasting color.

G. Notification appliances in harsh environments (e.g. outdoors, greenhouses, etc.) shall be UL1638 listed for outdoor applications, shall have sealing gaskets, and an operating temperature range of -32°F to +150°F.

2.11. REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.12. ADDRESSABLE INTERFACE DEVICES

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

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B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay:

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.

2.13. DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter (DACT) shall be acceptable to the remote central station and shall comply with UL 632. DACT shall be connected to IP & cellular communicator as specified herein.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of AC supply.
5. Loss of power.
6. Low battery.
7. Earth fault.
8. 24-hour test signal.
9. Abnormal test signal.
10. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

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2.14. INTERNET AND CELLULAR COMMUNICATOR

A. Basic Performance: Internet and digital cellular/GSM fire alarm communicator shall connect directly to the primary and secondary analog UL Listed fire alarm control panel DACT telephone ports. The communicator shall provide selectable configurable paths: cellular only, IP only, or IP primary with cellular backup. The communicator shall communicate to GSM networks in the area including 2G, 3G, and 4G. The multi-GSM platform shall automatically detect and choose the best network in the area based on signal strength and shall immediately adjust for operation. Communicator shall support both dynamic (DHCP) or public and private static IP addressing. Communicator shall communicate over any type of customer provided Ethernet 10/100 Base network connection (LAN or WAN), DSL modem, or cable modem. Data shall transmit over standard contact-ID protocol and shall be secured with advanced encryption standard AES 256-bit. All circuits shall be power limited per UL864 requirements.

B. Functional Performance: When a fire alarm condition (alarm, supervisory, or trouble) is detected, the Fire Alarm Control Panel goes off-hook to dial the central station. The IP & cellular communicator capture module shall detect the off-hook condition and provide the FACP with a dial tone. When the FACP detects the dial tone, it shall begin dialing the central station. The communicator capture module shall consider the three second period after dialing as the number dialing has been completed. After dialing is completed, the capture module shall return a handshake to the FACP. The FACP shall then send the contact ID reports to the dialer capture module, which in turn sends the contact ID reports to the communications module. When all reports are sent, the FACP shall go on-hook. The IP & cellular communicator shall then transmit the messages to the central station over the GSM network, or IP network if a GSM network is not available.

C. System Capacity and General Operation:

1. The communicator shall include connections to the FACP telephone outputs and shall convert the contact-ID protocol into Ethernet packets.
2. The communicator shall be completely field programmable locally.
3. The communicator shall be capable of transmitting events in contact ID format.
4. Communication shall include vital system status such as:

    a. Independent zone (alarm, trouble, non-alarm, supervisory)
    b. Independent addressable device status
    c. AC (mains) power loss
    d. Low battery
    e. Earth fault
    f. System off normal
    g. 24-hour test signal
    h. Abnormal test signal

5. The communicator shall support independent zone reporting via the Contact ID format. This format shall enable the central station to have details concerning the location of the fire for emergency response. The Communicator shall be capable of providing simulated phone lines to the Fire Alarm Control Panel. The Communicator shall communicate over IP or GSM primary and shall be transparent to the Fire Alarm Control Panel normal operation over phone lines.
6. The Communicator shall be housed in a UL-listed cabinet constructed of steel with provisions for electrical conduit connections into the sides and top.
7. The main power supply shall operate on 120VAC, 60Hz, and shall provide all necessary power for the communicator. The main power supply shall continuously monitor all field wires for earth ground conditions.
8. Overcurrent protection shall be provided on all power outputs.
9. The power supply shall provide an integral battery charger. Upon loss of primary (AC) power to the communicator, the battery shall provide power to the communicator for

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minimum 24 hours standby, 15 minutes of alarm.

2.15. CIRCUIT PROTECTION DEVICES

A. General Requirements for Circuit Protection Devices: Comply with UL 497B, "Protectors for Data Communications and Fire Alarm Circuits" and NFPA 70, "National Electrical Code". Circuit protection devices shall minimize the energy from electrical transients caused by lightning or disturbances on high voltage power lines that can cause damage on low voltage fire alarm circuits.

B. Provide circuit protection for all fire alarm system wiring that is run external to the building, including but not limited to, the following:

1. DC Power (200 mA maximum)
2. Data communications
3. Monitor circuits
4. Audio riser circuits
5. Firefighter telephone circuits
6. DC notification appliance circuits (NACs)
7. Speaker circuit NACs (25 VRMS)

C. Operating Specifications:

1. Line-to-Line Voltage Rating:
   a. Continuous: 38 VDC, 28 VAC RMS
   b. Clamping: 47 V
2. Line-to-Earth Voltage Rating:
   a. Continuous: 45 VDC, 35 VAC RMS
   b. Clamping: 56 V
3. Shield-to-Earth Voltage Rating:
   a. Continuous: 48 VDC, 33 VAC RMS
   b. Clamping: 75 V
4. Line-to-Line Capacitance: 0.006 micro-farads (µF)
5. Continuous Current Rating: 200 mA maximum
6. Series Resistance: 3 ohms (Ω) / line
7. Response Time:
   a. Line-to-Line: <1 nanosecond
   b. Line-to-Earth: <25 nanoseconds
8. Maximum Current:
   a. Line-to-Line: 2000A (10 x 50 µsec pulse)
   b. Line-to-Earth: 2000A (8 x 20 µsec pulse)
   c. Shield-to-Earth: 5000A (10 x 50 µsec)

D. Mechanical Specifications:

1. Dimensions: 2-7/16"W x 1-3/8"D x 1-1/16"H (62mm x 35mm x 27mm)
2. Package: Beige, epoxy encapsulated

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3. Electrical Box Requirement: 4” (102 mm) square box, 2-1/8” minimum depth
4. Temperature Rating: 32°F to 120°F (0°C to 49°C)
5. Humidity Rating: 10-95% relative humidity (RH) at 30 degrees C
6. Signal Leads: Color coded, 18 AWG, 10” long (254 mm)
7. Ground Lead: Green, 14 AWG, 10” long (254 mm)

2.16. NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet or Modbus for connection to building automation system. Coordinate with Division 23 Contractor.

2.17. DEVICE GUARDS

A. Wire Guards: Welded wire mesh of size and shape for each notification appliance, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

B. Vandal Shields: Clear hinged enclosures for manual pull stations

1. Indoor Protective Shield: Factory-fabricated, clear thermoplastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
2. Weatherproof Protective Shield: Factory-fabricated, clear thermoplastic enclosure designed for outdoor use with closed cell gasketing and IP54 rating, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

PART 3 EXECUTION

3.1. EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with

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requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
4. Provide protective shields as specified in Part 2 of this Section for all manual fire-alarm box locations.

E. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
2. Provide a remote test station for each duct smoke detector.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector that is

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not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

K. Provide manufacturer's surface mount adapter skirts to conceal surface mounted outlet boxes and/or extension rings where required for deep devices and devices installed on existing walls where outlet boxes are surface mounted.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

M. Circuit Protection Devices:

1. Fire alarm system wiring that is run external to the building and is protected by circuit protection devices shall be installed in accordance with the individual system component's installation instructions including properly grounded, twisted and shielded pairs, and observance of the following precautions:

a. Circuit protection devices shall be located as close as possible to the point at which the circuits leave or enter the building(s) and shall be installed in dedicated electrical outlet boxes. Outlet boxes shall be painted red and permanently labeled "Fire Alarm".
b. The total maximum wire length shall be determined by the individual application's allowable limit as specified with circuit protection devices, but must not exceed 3270 ft (1 km).
c. The grounding conductor shall be 12 AWG with a maximum length of 28 ft (8.5 m), run in as straight a line as possible and connected to the building grounding electrode system per NFPA 70, the "National Electrical Code".

3.3. PATHWAYS

A. Pathways concealed above accessible ceilings may be routed exposed.

B. Exposed pathways and pathways in non-accessible locations shall be installed in conduit. Refer to Division 26 Section "Raceways and Boxes for Electrical Systems" for additional information.

C. Exposed conduit shall be red in unfinished spaces (e.g. electrical rooms) and shall be painted to match adjacent surfaces in finished spaces. Refer to Division 26 Section, "Identification for Electrical Systems" for additional information.

3.4. CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make

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an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Electronically locked doors and access gates.
3. Alarm-initiating connection to activate emergency lighting control.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Data communication circuits for connection to building management system.
6. Data communication circuits for connection to mass notification system.
7. Supervisory connections at generator control panel to indicate generator running, generator fault, or switch in non-automatic position.

3.5. IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

B. Junction box covers shall be painted red, except in finished spaces where they shall be painted to match adjacent surfaces. Box covers shall have a type written label to read “Fire Alarm” in accordance with requirements of NFPA 72.

C. Each piece of fire alarm equipment with a 120 VAC source circuit shall be labeled to identify the equipment designation, source circuit designation (e.g. EP1A1-1), source circuit voltage (e.g. 120V, 1PH) and source circuit origination (e.g. main electrical room D101).

D. Each Fire Alarm System circuit disconnecting means shall be permanently identified as to its purpose in accordance with the following text printed in white lettering on a red label:

1. “FIRE ALARM” for fire alarm systems.
2. “EMERGENCY COMMUNICATIONS” for emergency communications systems
3. “FIRE ALARM/ECS” for combination fire alarm and emergency communications systems.

E. Install framed instructions in a location visible from fire-alarm control unit.

F. Label each duct detector remote test station to identify equipment monitored, e.g. “AHU-1” and duct type, e.g. “supply” or “return”.

3.6. GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7. FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction and Owner’s representatives.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service

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representative:

1. Visual Inspection: Conduct visual inspection prior to testing.
    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8. MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 24 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

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3.9. SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

B. Provide up to two (2) days of four (4) hours of instruction each for ten (10) persons, to be conducted at the project site with manufacturer’s representative.

END OF SECTION

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