CHRISTINA SCHOOL DISTRICT
Delaware School for the Deaf: Renovation

630 E Chestnut Hill Rd
Newark, Delaware 19713

PROJECT MANUAL

BSA+A PROJECT #: 24.007
CSD CONTRACT #:CHR-26013-DSDRENO

ISSUED FOR BID 02/18/2026

BSA + A

PROJECT MANUAL

CSD Delaware School for the Deaf: Renovation

ARCHITECT
BSA+A / Buck Simpers Architect + Associates, Inc.
954 Justison Street
Wilmington, DE 19801
302.658.9300
fax 302.658.1125

ISSUED FOR BID 02/18/2026

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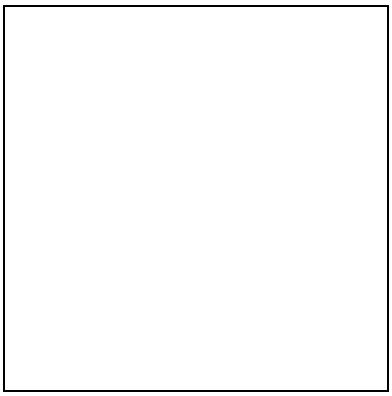
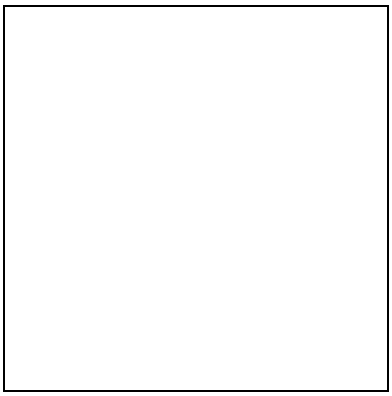
1.1 DESIGN PROFESSIONALS OF RECORD

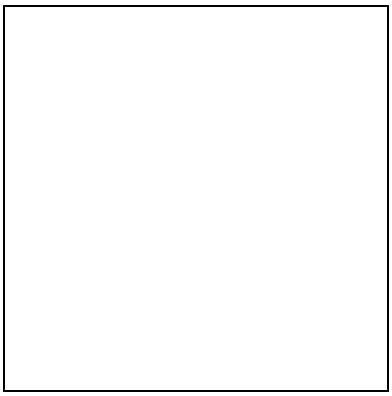
Architect
Timothy Skibicki
Buck Simpers Architects + Associates
954 Justison St.
Wilmington, DE 19801
(302) 638-9300
DE License No. 6636



Civil Engineer
Ted C. Williams
McKim & Creed
200 Continental Dr. Ste 400
Newark, DE 19713
(302) 323-9377
DE License No. 8461



MEP-FP Engineer
David Robert Hoffman
Gipe Associates, Inc.
8719 Brooks Drive,
PO Box 1147
Easton, Maryland 21601
DE License No. 9773



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SECTION 00 11 16

CSD Delaware School for the Deaf: Renovation
630 E. Chestnut Hill Road, Newark, DE 19713
BSA+A Project No. 24.007
CHR-26013-DSDRENO

INVITATION TO BID

Sealed bids for Christina School District Contract Number Contract No. DSD Renovations CHR26013-DSDRENO, will be received for **CSD Delaware School For The Deaf on Wednesday March 25, 2026, by 2:00 PM, at the Eden Support Services Center, 925 Bear Corbitt Road, Bear, DE 19701** at which time they will be publicly opened and read aloud. *Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.*

The project consists of adding an exterior wall to enclose existing service shed, interior renovations are limited to replacement of all drinking fountains, replacement of all light fixtures with LED, HVAC renovations to residence hall. In addition, the project includes constructing a new soccer field and a new 200- Meter running track, relocating an existing basketball court, and converting existing site lighting to LED lamps.

A **MANDATORY** Pre-Bid Meeting will be held on **March 11, 2026**, at **3:00 PM** at Christina School District: Delaware for the Deaf school building for the purpose of establishing the listing of subcontractors and to answer questions. The area of the building affected by the Project will be available to walk-thru. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Please contact BSA+A, Jaclyn Moak, jmoak@simpers.com and Kelly Lucas klucas@simpers.com, with any questions related to this bid. All questions should be submitted by e-mail only to Jaclyn Moak and Kelly Lucas with the following reference: **CSD DELAWARE SCHOOL FOR THE DEAF - DSD RENOVATIONS - CHR-26013-DSDRENO.** All questions must received before **12:00 PM on March 18, 2026.** The final addendum will be issued March 20, 2026 at 12:00 PM**.**

Sealed bids shall be addressed to Christina School District, Attn: **Mr. George Wicks, IV**. The outer envelope should clearly indicate**: "CSD DELAWARE SCHOOL FOR THE DEAF - CONTRACT NO. DSD Renovations CHR-26013-DSDRENO - DO NOT OPEN."**

Construction documents will be available for purchase at the following location:
RCI Printing & Graphics
298 Churchman's Rd, Newcastle, DE 19720
(302) 328-5019

Checks are to be made payable to "Reprographic Center, Inc." at the cost established by RCI.

Bidders will not be subject to discrimination on the basis of race, creed, color, sex, sexual orientation, gender identity or national origin in consideration of this award, and Minority Business Enterprises, Disadvantaged Business Enterprises, Women-Owned Business Enterprises and Veteran-Owned Business Enterprises will be afforded full opportunity to submit bids on this contract. 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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ARTICLE 1: GENERAL

1.1 DEFINITIONS

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

1.2 STATE: The State of Delaware.

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

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

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

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

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

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

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

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

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

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

1.13 BID: A complete and properly executed proposal to do the Work for the sums stipulated therein, submitted in accordance with the Bidding Documents.

1.14 BASE BID: The sum stated in the Bid for which the Bidder offers to perform the Work described in the Bidding Documents as the base, to which Work may be added or from which Work may be deleted for sums stated in Alternate Bids (if any are required to be stated in the bid).

1.15 ALTERNATE BID (or ALTERNATE): An amount stated in the Bid, where applicable, to be added to or deducted from the amount of the Base Bid if the corresponding change in the Work, as described in the Bidding Documents is accepted.

1.16 UNIT PRICE: An amount stated in the Bid, where applicable, as a price per unit of measurement for materials, equipment or services or a portion of the Work as described in the Bidding Documents.

1.17 SURETY: The corporate body which is bound with and for the Contract, or which is liable, and which engages to be responsible for the Contractor's payments of all debts pertaining to and for his acceptable performance of the Work for which he has contracted.

1.18 BIDDER'S DEPOSIT: The security designated in the Bid to be furnished by the Bidder as a guaranty of good faith to enter into a contract with the Agency if the Work to be performed or the material or equipment to be furnished is awarded to him.

1.19 CONTRACT: The written agreement covering the furnishing and delivery of material or work to be performed.

1.20 CONTRACTOR: Any individual, firm or corporation with whom a contract is made by the Agency.

1.21 SUBCONTRACTOR: An individual, partnership or corporation which has a direct contract with a contractor to furnish labor and materials at the job site, or to perform construction labor and furnish material in connection with such labor at the job site.

1.22 CONTRACT BOND: The approved form of security furnished by the contractor and his surety as a guaranty of good faith on the part of the contractor to execute the work in accordance with the terms of the contract.

1.23 CUSTOM FABRICATION: As defined in 29 Del. C. § 6902, the term “custom fabrication” means the offsite fabrication, assembly, or other production of non-standard goods or materials, including components, fixtures or parts thereof, specifically for a public works project. Such goods and materials shall include those used in the following trades or systems: (1) Plumbing or pipe fitting systems, including heating, ventilating, air-conditioning, refrigeration systems, sheet metal or other duct systems; (2) Electrical systems; (3) Mechanical insulation work; (4) Ornamental iron work; and (5) Commercial signage that does not attempt or appear to direct the movement of traffic on highways or roadways or interfere with, imitate, or resemble any official traffic sign, signal or device.

ARTICLE 2: BIDDER'S REPRESENTATION

2.1 PRE-BID MEETING

2.1.1 A pre-bid meeting for this project will be held at the time and place designated. Attendance at this meeting is a pre-requisite for submitting a Bid, unless this requirement is specifically waived elsewhere in the Bid Documents.

2.2 By submitting a Bid, the Bidder represents that:

2.2.1 The Bidder has read and understands the Bidding Documents and that the Bid is made in accordance therewith.

2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder’s 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.

2.2.4 Bidder has accounted for the possibility of price increases due to the direct and indirect effect of tariffs, other international events, inflation, and supply chain interruptions. Change Orders will be denied if they are based upon any of these events. Bidder is expected to account for these possibilities and include them in the bid.

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.

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

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

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

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

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

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

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

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

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

3.3 SUBSTITUTIONS

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

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

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

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

3.4 ADDENDA

3.4.1 Addenda will be mailed or delivered to all who are known by the Architect to have received a complete set of the Bidding Documents.

3.4.2 Copies of Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.

3.4.3 No Addenda will be issued later than 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.

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 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.

4.1.6 Make no additional stipulations on the Bid Form and do not qualify the Bid in any other manner.

4.1.7 Each copy of the Bid shall include the legal name of the Bidder and a statement whether the Bidder is a sole proprietor, a partnership, a corporation, or any legal entity, and each copy shall be signed by the person or persons legally authorized to bind the Bidder to a contract. A Bid by a corporation shall further give the state of incorporation and have the corporate seal affixed. A Bid submitted by an agent shall have a current Power of Attorney attached, certifying agent's authority to bind the Bidder.

4.1.8 Bidder shall complete the Non-Collusion Statement form included with the Bid Forms and include it with their Bid.

4.1.9 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.

4.1.10 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). The bid bond may be an electronic bond and need not be transmitted as a paper document.

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 (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. 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, or engaged in custom fabrication work, as that term is defined in Article 1.23 herein and as also as defined in 29 Del. C § 6902 and described in 29 Del. C. § 6960(b), regardless of where the work is performed, 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 As per 29 Del. C. § 6960(b), the scale of the wages to be paid must be posted by the employer in a prominent and easily accessible place at the site of the work. There may be withheld from the employer so much of accrued payments as may be considered necessary by the Department of Labor to pay laborers and mechanics employed by the employer the difference between the rates of wages required by the contract to be paid laborers and mechanics on the work and rates of wages received by

such laborers and mechanics to be remitted to the Department of Labor for distribution upon resolution of any claims.

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.

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, paper or telegraphic bids are invalid and will not receive consideration.

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.

4.8.6 Compliance with Federal Bureau of Investigation rules mandates training for Contractors, Subcontractors, their employees, and custodial workers with access to locations that have access to Criminal Justice Information Services (CJIS). The contract awardee must have fingerprinting and background checks done for all Subcontractors and employees.

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 days of the Bid opening.

5.2 COMPARISON OF BIDS

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

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

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

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

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

5.2.6 Bidder must account for the possibility of price increases due to the direct and indirect effect of tariffs or other international events, inflation, and supply chain interruptions. Change Orders will be denied if they are based upon any of these events. Bidder is expected to account for these possibilities and include them in the bid.

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.

G. Any Bidder who is debarred in another State and/or by the United States Government is also debarred in Delaware.

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

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

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

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

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

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

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

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

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

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

5.4.2 Per Section 6962(d)(13)a., Title 29, Delaware Code, "The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid. Any public school district and its board shall award public works contracts in accordance with this section's requirements except it shall award the contract within 60 days of the bid opening."

5.4.3 Each Bid on any Public Works Contract must be deemed responsive by the Agency to be considered for award. A responsive Bid shall conform in all material respects to the requirements and criteria set forth in the Contract Documents and specifications.

5.4.4 The Agency shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid, plus accepted Alternates.

5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. 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 two (2) years after the date of the Certificate of Final Payment.

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

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.

7.2.3 The Performance Bond and/or the Payment Bond may be electronic bonds and need not be transmitted as paper documents.

ARTICLE 8: FORM OF AGREEMENT BETWEEN OWNER 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 SECTION

CSD Delaware School for the Deaf: Renovation
630 E. Chestnut Hill Road, Newark, DE 19713
BSA+A Project No. 24.007
CHR-26013-DSDRENO

BID FORM

For Bids Due: Wednesday March 25, 2026 **To:** Christina School District
925 Bear Corbitt Road
Bear, DE 19701

Name of Bidder: _____

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

(Other License Nos.): _____

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

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

$_____
($)

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.

ALTERNATE No. 1: Existing lighting replacement with LED lighting in Classrooms, Admin, & Media Center
Add/Deduct: _____
($)

ALTERNATE No. 2: Existing lighting replacement with LED lighting in Gym, Kitchen, Cafeteria, & Auditorium

Add/Deduct: _____
($)

ALTERNATE No. 3: School Building lightning protection system replacement

Add/Deduct: _____
($)

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BID FORM

ALTERNATE No. 4: Residence Hall lightning protection system replacement

Add/Deduct: _____
($)

UNIT PRICES

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

UNIT PRICE No. 1: Patching Brickwork at PTAC Openings at Residence Hall $ _____ per square foot

UNIT PRICE No. 2: Patching and Painting Drywall $ _____ per square foot

This Unit price is to be included as a line item in the Contract Sum.

ALLOWANCES

Allowances conform to applicable project specification section. Refer to the specifications for a complete description of the following Allowance:

Allowance No. 1: PROVIDE A CONTINGENCY ALLOWANCE OF $75,000 FOR UNFORSEEN CONDITIONS.

1. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under this contingency allowance are included in the allowance. These costs include but are not limited to delivery, installation, taxes, insurance, equipment rental, cost of engaging testing agencies, actual tests and inspections, and reporting results. This Contingency Allowance is to be included in the total value of the Contract Sum.

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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 thirty (30) days from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

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

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

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____ 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: _____

ATTACHMENTS

Sub-Contractor List
Non-Collusion Statement
Affidavit of Employee Drug Testing Program
Affidavit of Contractor Qualifications
Bid Security
(Others as Required by Project Manuals)

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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. Electrical			
A.			
B.			
C.			
2. Mechanical			
A.			
B.			
C.			

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BID FORM (Continued)

3. Plumbing			
A.			
B.			
C.			
4. Carpentry			
A.			
B.			
C.			
5. Sitework			
A.			
B.			
C.			

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BID FORM (Continued)

6.			
A.			
B.			
C.			
7.			
A.			
B.			
C.			
8.			
A.			
B.			
C.			
9.			
A.			
B.			
C.			

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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 *(*CHR-26013-DSDRENO*)* have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

_____

_____

E-MAIL: _____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____day of _____ 20_____.

My Commission expires _____. NOTARY PUBLIC _____.

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

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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, including subcontractors, 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 _____

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

CSD Delaware School for the Deaf: Renovation
630 E. Chestnut Hill Road, Newark, DE 19713
BSA+A Project No. 24.007
CHR-26013-DSDRENO

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.

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.

CSD Delaware School for the Deaf: Renovation
630 E. Chestnut Hill Road, Newark, DE 19713
BSA+A Project No. 24.007
CHR-26013-DSDRENO

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 the **Christina School District** 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 **Christina School District** a certain proposal to enter into this contract for the furnishing of certain material and/or services within the **State**, shall be awarded this Contract, and if said **Principal** shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the **Delaware Christina School District** this Contract to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

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

SEALED, AND DELIVERED IN THE
Presence of

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness:_____ By: _____

_____
Title

SECTION 00 52 13 - STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

The contract to be utilized on this project shall be the "Standard Form of Agreement Between Owner and Contractor" AIA Document A101-2017, including AIA Document A101 – 2017 Exhibit A, the Owner's Amendment to the A101-2017, as well as Supplements to A101-2017 and Exhibit A and the State of Delaware's General Requirements.

SECTION 00 54 13 - SUPPLEMENT TO AGREEMENT BETWEEN OWNER AND CONTRACTOR A101-2017

The following supplements modify the "Standard Form of Agreement Between Owner and Contractor," AIA Document A101-2017. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE 3: DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

3.1 Delete paragraph 3.1 in its entirety and replace with the following:

"The date of Commencement of the Work shall be a date set forth in a notice to proceed issued by the Owner."

ARTICLE 5: PAYMENTS

5.1 PROGRESS PAYMENTS

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

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

5.3 Insert the interest rate of "1% per month not to exceed 12% per annum."

ARTICLE 6: DISPUTE RESOLUTION

6.2 BINDING DISPUTE RESOLUTION

Check the box "Other" – and add the following sentence:

"Any remedies available in law or in equity."

ARTICLE 7: TERMINATION or SUSPENSION

7.1.1.1 Delete paragraph 7.1.1.1 in its entirety.

ARTICLE 8: MISCELLANEOUS PROVISIONS

8.4 Delete paragraph 8.4 in its entirety and replace with the following:

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

END OF SECTION

SECTION 00 54 14 - SUPPLEMENT TO A101-2017 – EXHIBIT A - INSURANCE & BONDS

The following supplements modify the "Standard Form of Agreement Between Owner and Contractor," AIA Document A101-2017 Exhibit A Insurance and Bonds. Where a portion of the Standard Form of Agreement is modified or deleted by the following, the unaltered portions of the Standard Form of Agreement shall remain in effect.

ARTICLE A.2 OWNER'S INSURANCE

A.2.1 General

Delete paragraph A.2.1 in its entirety.

A.2.2 Liability Insurance

Delete paragraph A.2.2 in its entirety, except in the case of school projects this paragraph shall remain.

A.2.3 Required Property Insurance

Delete paragraph A.2.3 in its entirety.

A.2.4 Optional Extended Property Insurance

Delete paragraph A.2.4 in its entirety.

A.2.5 Other Optional Insurance

Delete paragraph A.2.5 in its entirety.

ARTICLE A.3 CONTRACTORS INSURANCE AND BONDS

A.3.1.1 Strike the last sentence of the paragraph.

A.3.1.3 Additional Insured Obligations

In the first sentence after "coverage to include (1)" delete "(1) the Owner,".

Strike the remainder of the first sentence beginning at the semicolon "; and (2) the Owner" through the end of the sentence.

Delete the second sentence in its entirety.

A.3.2.2.1 Insert "$1,000,000.00" in the blank for each occurrence.
Insert "$3,000,000.00" in the blank for general aggregate.
Insert "$3,000,000.00" in the blank for aggregate for products-completed operations hazard.

A.3.2.3 Insert "$1,000,000.00" in the blank for per accident.

A.3.2.6 Insert "$500,000.00" in the blank for each accident.
Insert "$500,000.00" in the blank for each employee.
Insert "$500,000.00" in the blank for policy limit.

A.3.2.8 Insert "$1,000,000.00" in the blank for per claim.
Insert "$3,000,000.00" in the blank for in the aggregate.

A.3.2.9 Insert "$1,000,000.00" in the blank for per claim.
Insert "$3,000,000.00" in the blank for in the aggregate.

A.3.2.10 Insert "$2,000,000.00" in the blank for per claim.
Insert "$4,000,000.00" in the blank for in the aggregate.

A.3.2.11 Strike in its entirety.

A.3.2.12 Strike in its entirety.

A.3.3.2.1 Delete paragraph 3.3.2.1 in its entirety

A.3.3.2.2 Strike in its entirety.

A.3.3.2.3 Insert "$1,000,000.00" in the blanks for per claim.
Insert "$3,000,000.00" in the blanks for in the aggregate.

A.3.4 Insert the actual contract price in both the Payment Bond and the Performance Bond Penal Sum blanks. It must be 100% of the contract price.

Strike the last sentence in this section and replace with "Payment and Performance Bonds shall be in the standard form issued by the Delaware Office of Management and Budget."

END OF SECTION

CSD Delaware School for the Deaf: Renovation
630 E. Chestnut Hill Road, Newark, DE 19713
BSA+A Project No. 24.007
CHR-26013-DSDRENO

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 Christina School District ("**Owner**"), in the amount of _____ ($_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole, firmly by these presents.

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

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____ dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly provide and furnish all materials, appliances and tools and perform all the work required under and pursuant to the terms and conditions of the Contract and the Contract Documents (as defined in the Contract) or any changes or modifications thereto made as therein provided, shall make good and reimburse **Owner** sufficient funds to pay the costs of completing the Contract that **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

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

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

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

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

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

CSD Delaware School for the Deaf: Renovation
630 E. Chestnut Hill Road, Newark, DE 19713
BSA+A Project No. 24.007
CHR-26013-DSDRENO

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 Christina School District ("**Owner**"), in the amount of _____ ($_____), to be paid to **Owner**, for which payment well and truly to be made, we do bind ourselves, our and each and every of our heirs, executors, administrations, successors and assigns, jointly and severally, for and in the whole firmly by these presents.

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

NOW THE CONDITION OF THIS OBLIGATION IS SUCH, that if **Principal**, who has been awarded by **Owner** that certain contract known as Contract No. _____dated the _____ day of _____, 20__ (the "Contract"), which Contract is incorporated herein by reference, shall well and truly pay all and every person furnishing materials or performing labor or service in and about the performance of the work under the Contract, all and every sums of money due him, her, them or any of them, for all such materials, labor and service for which **Principal** is liable, shall make good and reimburse **Owner** sufficient funds to pay such costs in the completion of the Contract as **Owner** may sustain by reason of any failure or default on the part of **Principal**, and shall also indemnify and save harmless **Owner** from all costs, damages and expenses arising out of or by reason of the performance of the Contract and for as long as provided by the Contract; then this obligation shall be void, otherwise to be and remain in full force and effect.

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

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

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

SECTION 00 72 13 - GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION A201 - 2017

The General Conditions of this Contract are as stated in the American Institute of Architects Document AIA A201 (2017 Edition) entitled General Conditions of the Contract for Construction as revised by the Supplementary General Conditions and is part of this project manual as if herein written in full.

SECTION 00 73 13 - SUPPLEMENTARY GENERAL CONDITIONS A201-2017

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A201-2017. 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. CLAIMS AND DISPUTES

ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

Strike the last sentence of Section 1.1.1 in its entirety and replace with the following:

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

Add the following Section:

"1.1.1.1 In the event of conflict or discrepancies among the Contract Documents, the Documents prepared by the State of Delaware, Delaware Technical and Community College shall take precedence over all other documents."

1.1.8 INITIAL DECISION MAKER

Strike the last sentence of Section 1.1.8 in its entirety and add the following to the end of the remaining sentence:

" and certify termination of the Agreement under Section14.2.2."

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

1.2.1.1 Insert "if possible" at the end of the second sentence.

Add the following Sections:

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

"1.2.5The 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."

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

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

Strike Section 1.5.1 in its entirety and replace with the following:

"All pre-design studies, drawings, specifications and other documents, including those in electronic form, prepared by the Architect under this Agreement are, and shall remain, the property of the Owner whether the Project for which they are made is executed or not. Such documents may be used by the Owner to construct one or more like Projects without the approval of, or additional compensation to, the Architect. The Contractor, Subcontractors, Sub-

subcontractors, and Material or Equipment Suppliers are authorized to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by the Architect and the Architect's consultants appropriate to and for use in the execution of their Work under the Contract Documents. They are not to be used by the Contractor or any Subcontractor, Sub-subcontractor or Material and Equipment Supplier on other Projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and Architect's consultants.

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

Strike Section 1.5.2 in its entirety.

1.7 DIGITAL DATA USE AND TRANSMISSION

Strike Section 1.7 in its entirety and replace with the following:

"The parties shall agree upon protocols governing transmission and use of Instruments of Service or any other information or documentation in digital form."

1.8 BUILDING INFORMATION MODELS USE AND RELIANCE

Strike Section 1.8 in its entirety.

ARTICLE 2: OWNER

2.2 EVIDENCE OF THE OWNERS FINANCIAL ARRANGEMENTS

Strike Section 2.2 in its entirety.

2.3 INFORMATION AND SERVICES REQUIRED OF THE OWNER

2.3.3 Strike 2.3.3 in its entirety.

2.3.4 Add the following sentence at the end of the paragraph:

"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."

Strike Section 2.3.6 in its entirety and replace with the following:

"2.3.6The Contractor shall be furnished free of charge (1) electronic set of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling."

2.5 OWNER'S RIGHT TO CARRY OUT THE WORK

Add ", except as outlined in Section 3.15" after the reference to "Article 15" at the end of the last sentence of the Section.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

3.2.2 Add "and Owner" after "report to the Architect" in the second sentence.

3.2.4 Strike "subject to Section 15.1.7" in the second sentence.

3.2.4 Strike the third sentence.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Sections:

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

"3.3.4 The Contractor must provide suitable storage facilities at the Site for the proper protection and safe storage of their materials, or as otherwise identified by the specifications. Consult the Owner and the Architect before storing any materials."

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

3.4 LABOR AND MATERIALS

Add the Following Sections:

"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 Architect & Owner of any defects or imperfections in preparatory Work which will in any way affect satisfactory completion of its Work. Absence of such notification will be construed as an acceptance of preparatory Work and later claims of defects will not be recognized."

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

3.5 WARRANTY

Add the following Sections:

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

"3.5.4 Defects appearing during the period of warranty 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 warranty will have elapsed."

"3.5.5 Upon notification by the Owner of a defect covered by the Contractor's warranty, the Contractor shall respond within 4 hours of the notification."

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

"3.5.7 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."

3.8 ALLOWANCES

Add the following Section:

"3.8.1.1 For costs to be covered under a project allowance, (included in the schedule of values) the Contractor shall submit a summary of those costs anticipated and an Allowance Access Authorization Form to the Architect and Owner, reflecting the projected costs. The Allowance Access Authorization Form must be signed by the Owner prior to initiating any work associated with the allowance."

3.10 CONTRACTOR'S CONSTRUCTION AND SUBMITTAL SCHEDULES

3.10.1 Add "estimated" after "and the" and before "date of" in the second sentence.

3.10.2 Strike "and thereafter as necessary to maintain a current submittal schedule" in the first sentence.

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Sections:

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

"3.11.2 At the completion of the project, the Contractor shall obtain a set of the conformed contract 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 Upon completion of the work noted in 3.11.2 the contractor shall schedule a meeting with the Architect/Engineer and Owner to review the final record drawings and closeout documents prior to submission. After this meeting the Contractor shall make adjustments per the review, and submit one (1) original markup and (2) copies of the red line drawings (as-built conditions, to the Owner and one (1) print to the Architect. In addition, attach one complete set of the as-built documents to each of the Operating and Maintenance Instructions/Manuals. The Contractor will include (2) USB drives, each containing all "red line drawings (as-built) and Closeout Documents properly tabbed in accordance with closeout requirements as defined elsewhere in the contract documents."

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.10.2 Strike "If the Contract Documents require" from the beginning of the sentence.

3.12.10.2 Strike "to" between "professional" and certify" and replace with "shall".

3.17 Insert "indemnify and" between "shall" and "hold" in the second sentence.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2 ADMINISTRATION OF THE CONTRACT

4.2.7 Strike the first sentence and replace with the following:

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

4.2.7 Strike the second sentence and replace with the following:

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

Add the following Section:

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

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

ARTICLE 5: SUBCONTRACTORS

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

5.2.3 Strike Section 5.2.3 in its entirety and replace with the following:

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

5.2.4 Strike Section 5.2.4 in its entirety and replace with the following:

"The Contractor may not substitute any Subcontractor listed in its Bid unless the Contractor complies with the requirements of 29 Delaware Code § 6962(d)(10)b.3 and 4. Failure to comply with this requirement shall subject the Contractor to a penalty as outlined in Section 5.2 of the Owner's General Requirements."

Add the following Section:

"5.2.5 The Contractor shall comply and shall ensure all Subcontractors comply with all requirements for drug testing as set forth in TITLE 19 LABOR DELAWARE ADMINISTRATIVE CODE 4000 Office of Management and Budget 4100 Division of Facilities Management 4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects."

ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

6.1.1 Strike "and waiver of subrogation" from the end of the second sentence.

6.1.4 Strike Section 6.1.4 in its entirety.

6.2 MUTUAL RESPONSIBILITY

6.2.3 Strike "shall" and replace with "may" in the second sentence.

ARTICLE 7: CHANGES IN THE WORK

(SEE ARTICLE 7: CHANGES IN WORK IN THE STATE OF DELAWARE DIVISION OF FACILITIES MANAGEMENT GENERAL REQUIREMENTS)

7.3.4.1 Strike "and other employee costs approved by the Architect" after "worker's compensation insurance,"

7.3.4.4 Add "work attributable to the" before "change" at the end of the sentence.

7.4 MINOR CHANGES IN WORK
Add "unless such changes are approved" at the end of the third sentence.

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

8.2.1 Add the following Section:

"8.2.1.1 Refer to Project Specifications Section SUMMARY OF WORK for Contract time requirements."

8.2.2 After "by the Contractor" strike "and" and insert "to".

8.2.4 Add the following Section:

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

8.3 DELAYS AND EXTENSION OF TIME

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

Add the following Section:

"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."

Strike Section 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 Section 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 Section:

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

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Sections:

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

"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 1.5% of the initial contract amount."

9.3 APPLICATIONS FOR PAYMENT

9.3.1 Strike Section 9.3.1 in its entirety and replace with the following:

"At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values for completed portions of the Work. The application shall be notarized, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage."

Add the following Sections:

"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."

"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 Subsections 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

9.6.1 Strike Section 9.6.1 in its entirety and replace with the following:

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

9.6.8 Strike "Provided the Owner has fulfilled its payment obligations under the Contract Documents," in the first sentence.

9.7 FAILURE OF PAYMENT

Strike Section 9.7 in its entirety and replace with the following:

"If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within fourteen days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within thirty days after the date established in the Contract Documents, the amount certified by the Architect, then the Contractor may, upon thirty additional days' notice to the Owner 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

9.8.3 At the end of Section 9.8.3, add the following sentence:

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

9.8.5 Strike "shall" and insert "may" in the second sentence.

9.8.5 Insert "1/2 of the" after "make payment of" in the second sentence.

9.9 PARTIAL OCCUPANCY OR USE

9.9.1 Strike the first sentence and replace with the following (the remainder of the Section remains as written):
"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 authorized by public authorities having jurisdiction over the Project."

9.10.2 Strike "to remain in force after final payment is currently in effect" after "required by the Contract Documents" and replace with "shall remain in force until final payment is completed" in the first sentence.

9.10.4.4 Strike "if permitted by the Contract Documents,"

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Sections:

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

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

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Section:

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

10.2.5 Strike the second sentence in its entirety.

10.3 HAZARDOUS MATERIALS AND SUBSTANCES

10.3.3 Strike Section 10.3.3 in its entirety.

10.3.4 Insert "hazardous" in the last sentence after "handling of such" .

10.3.6 Strike Section 10.3.6 in its entirety.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S INSURANCE AND BONDS

11.1.1 Strike "Owner" from the third sentence.

11.2 OWNER'S LIABILITY INSURANCE

Strike 11.2 in its entirety, except that in the case of school projects in which case Section 11.2 shall remain.

11.3 WAIVERS OF SUBROGATION

Delete Section 11.3 in its entirety

11.4 LOSS OF USE, BUSINESS INTERRUPTION, AND DELAY IN COMPLETION INSURANCE

Delete Section 11.4 in its entirety

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Section:

"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 non-conforming work and that required under contract including any damage to the structure."

12.2.2.1 Strike all references to "one year" or "one-year" and replace with "two years".

12.2.2.2 Strike "one-year" and replace with "two years".

12.2.2.3 Strike "one-year" and replace with "two years".

12.2.5 Strike "one-year" and replaced with "two years".

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 GOVERNING LAW

Strike the last sentence.

13.4 TESTS AND INSPECTIONS

13.4.1 Strike the last sentence and replace with the following:

"The Owner shall pay for tests, inspections, or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor."

13.5 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" and replace with "30 days of presentment of the authorized Certificate of Payment at the annual rate of 12% or 1% per month."

Insert the following Section:

"13.6 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

13.6.1 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

14.1 TERMINATION BY THE CONTRACTOR

14.1.1.4 Insert ", upon the Contractors' request," after "furnish to the Contractor".

14.1.3 Strike "and profit on Work not executed, and" after "as well as reasonable overhead" and replace with ", profit, and reasonable"

14.3 SUSPENSION BY OWNER FOR CONVENIENCE

14.3.2 Strike "Adjustment of the Contract Sum shall include profit".

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

14.4.3 Strike Section 14.4.3 in its entirety and replace with the following:

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

ARTICLE 15: CLAIMS AND DISPUTES

15.1 CLAIMS

15.1.2 TIME LIMITS ON CLAIMS

Strike the last sentence.

15.1.3 NOTICE OF CLAIM

Strike all references to "21" and replace with "45".

15.1.5 CLAIMS FOR ADDITIONAL COSTS

Strike the first sentence and replace with the following:

"Contractor shall not proceed to execute any portion of the Work that is subject to the Claim without prior approval of the costs or method of payment for the costs associated with the Claim as determined by the Architect and approved by the Owner."

15.1.7 WAIVER OF CLAIMS FOR CONSEQUENTIAL DAMAGES

Strike Section 15.1.7 in its entirety.

15.2 INITIAL DECISION

15.2.1 Strike "and binding dispute resolution" in the fourth sentence and replace with "or any and all remedies at law or in equity".

15.2.5 Strike Section 15.2.5 in its entirety and replace with the following:

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

15.2.6 Strike Section 15.2.6 and its sub-Sections in their entirety.

15.3 MEDIATION

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

15.3.2 Strike ", shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedure in effect on the date of the Agreement," in the first sentence.

15.3.2 Strike all references to "binding dispute resolution" and replace with "any or all remedies at law and in equity".

15.3.3 Strike Section 15.3.3 in its entirety.

15.4 ARBITRATION

Strike Section 15.4 and its Subsections in their entirety.

END OF SECTION

DIVISION 00 73 43 – WAGE RATE REQUIREMENTS

1.01 GENERAL CONDITIONS

A. Prevailing wages are applicable to this project per the requirements noted in Delaware's Prevailing Wage Law, 29 Del.C.§6960 and Regulations as noted.

B. Prevailing Wage Rates, as directed by Delaware Law, must be adhered to where applicable. Davis-Bacon Act wages, in accordance with Subchapter IV of Chapter 31 of Title 40USC, must be adhered to. Contractors must pay the higher of the two rates.

C. A copy of the Prevailing Wages letter from the Delaware Department of Labor, and Davis-Bacon Act wage rates, for the project is attached here to.

STATE OF DELAWARE
DEPARTMENT OF LABOR
OFFICE OF CONSTRUCTION INDUSTRY ENFORCEMENT
252 CHAPMAN ROAD, STE 210
NEWARK, DELAWARE 19702

Via Electronic and Regular Mail

October 3, 2025

Ms. Maureen Rozanski
Buck Simpers Architect & Associates, Inc.
954 Justison Street
Wilmington, DE 19801

Re: CHR-25013-DSDSITE CSD Delaware School for the Deaf Renovation Bid Pack A
New Castle County, DE

Dear Ms. Rozanski:

I am responding to your request for a category determination for CHR-25013-DSDSITE CSD Delaware School for the Deaf Renovation Bid Pack A, which is a state funded construction project located in New Castle County, DE. The work consists of the construction of a new soccer field and a new 200- meter running track, relocate an existing basketball court, and convert existing site lighting to LED lamps. You estimate the total cost of construction for this project to be $997,237.

Based on the information you provided, the Department of Labor has determined that this project is a Multiple Category project consisting of a Heavy Construction portion and a Highway Construction portion, each of which is substantial i.e., more than twenty percent (20%) of the overall cost of the project. The Heavy Construction portion, with an estimated cost of $498,371.00, represents approximately 50% of the total cost, consists of the construction of a new soccer field and the conversion of existing site lighting to LED lamps. The Highway Construction portion, with estimated costs of $498,902.00, represents approximately 50% of the total cost, consists of the construction of a new 200- meter running track and the relocation of an existing basketball court.

Delaware's Prevailing Wage Regulations provide that the rates applicable to a project are the rates in effect on the date of publication of the specifications for that project. I have enclosed a certified copy of the March 14, 2025, prevailing wage rates for Highway Construction and Heavy Construction to be included in your bid specification. However, please be advised that, in the event that a contract for a project is not executed within one hundred and twenty (120) days from the earliest date the specifications were published, the rates in effect at the time of the execution of the contract shall be the applicable rates for the project.

This determination is directed solely to the parties identified herein. It is based on the unique facts relevant to this matter. It does not constitute precedent and should not be cited as such by future parties.

Pursuant to 19 Del. Chapter 36, All contractors must obtain their Contractor Registration Certificate prior to performing construction services or maintenance work throughout Delaware. Contractors can submit an application by visiting the Delaware One Stop https://onestop.delaware.gov/Operate_Contractors.

Additionally, effective January 1, 2025, SSI for SB307 amends Delaware's Prevailing Law 29 Del.C.6960(b) now requires these applicable prevailing wage rates to be paid to all workers who perform custom fabrication work regardless of where the work is performed. For further information regarding custom fabrication see 29 Del.C.6902(8).

Lastly, please see the enclosed debarment list. Entities/individuals listed shall not be permitted to bid on, be awarded or work on Delaware State funded construction projects, in the timeframe specified, as provided for under 29 Del.C.6960 or other applicable State statutes.

If you have any questions or I can provide any additional assistance, please do not hesitate to contact me at 302-451-3403.

Sincerely,

Laran GreggBilly
Labor Law Enforcement Officer
laran.greggbilly@delaware.gov

Enclosures

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 **HIGHWAY CONSTRUCTION** EFFECTIVE MARCH 14, 2025

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
BRICKLAYERS	66.79	66.79	71.09
CARPENTERS	67.79	62.56	50.80
CEMENT FINISHERS	72.72	44.60	45.46
ELECTRICAL LINE WORKERS	36.72	59.33	29.04
ELECTRICIANS	83.92	83.92	83.92
IRON WORKERS	89.37	32.59	34.62
LABORERS	56.58	52.08	51.11
MILLWRIGHTS	22.01	21.36	18.46
PAINTERS	83.14	83.14	83.14
PILEDRIVERS	98.33	32.46	91.23
POWER EQUIPMENT OPERATORS	84.74	54.11	49.57
SHEET METAL WORKERS	31.09	27.76	25.12
TRUCK DRIVERS	53.26	38.59	46.99

CERTIFIED: 10-3-2025

BY: Salina Crosdale / for Francis Chey
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: CHR-25013-DSDSITE CSD Delaware School for the Deaf Renovation Bid Pack A 200-Meter Running Track and Basketball Court, New Castle County

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 **HEAVY CONSTRUCTION** EFFECTIVE MARCH 14, 2025

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	28.89	25.41	55.24
BOILERMAKERS	90.82	41.97	77.00
BRICKLAYERS	90.12	77.39	32.55
CARPENTERS	62.56	62.56	50.80
CEMENT FINISHERS	56.98	31.82	23.71
DIVER	103.26	CONTACT DDOL	CONTACT DDOL
DIVER TENDER	116.61	CONTACT DDOL	CONTACT DDOL
ELECTRICAL LINE WORKERS	96.29	96.29	96.29
ELECTRICIANS	83.92	83.92	83.92
GLAZIERS	26.67	23.17	15.70
INSULATORS	69.12	69.12	69.12
IRON WORKERS	78.58	79.67	78.58
LABORERS	57.65	57.65	57.65
MILLWRIGHTS	88.35	88.35	70.97
PAINTERS	95.76	95.76	95.76
PILEDRIVERS	91.12	51.44	40.03
PLASTERERS	25.12	21.85	15.00
PLUMBERS/PIPEFITTERS/STEAMFITTERS	99.88	101.73	25.47
POWER EQUIPMENT OPERATORS	83.29	89.93	83.29
SHEET METAL WORKERS	40.16	24.92	23.41
SPRINKLER FITTERS	43.29	16.39	15.00
TRUCK DRIVERS	44.73	26.88	29.10

CERTIFIED: 10-3-2025

BY: Salina Crossland / Fu Franchuckyk
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

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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: CHR-25013-DSDSITE CSD Delaware School for the Deaf Renovation Bid Pack A New Soccer Field and Site Lighting, New Castle County

PREVAILING WAGE DEBARMENT LIST

The following contractors have been debarred for violations of the prevailing wage law 29Del.C. §6960 or other applicable State statutes.

Therefore, no public construction contract in this State shall be bid on, awarded to, or received by contractors and individuals on this list for a period of (3) three years from the date of the judgment or as deemed by a court of competent jurisdiction.

Contractor	Address	Date of Debarment
Mullen Brothers, Inc. and Daniel Mullen, individually	3375 Garnett Road, Boothwyn, PA 19060	Indefinite/ Civil Contempt
State Contractors Corporation, and Jose Oscar Rivera, individually	13004 Hathaway Drive Silver Spring, MD 20906	Indefinite/ 19 Del.C. 2374(f)
Green Granite and Jason Green, individually	604 Heatherbrooke Court Avondale, PA 19311	Indefinite/ Civil Contempt
Pro Image Landscaping, Inc. and Owner(s) individually	23 Commerce Street Wilmington, DE 19801 and/or 2 Cameo Road Claymont, DE 19703	Indefinite/19 Del.C. §108 & 10 Del.C. 542(c)
Liberty Mechanical, LLC and Owner(s), individually	2032 Duncan Road Wilmington, DE 19801	Indefinite/ 19 Del.C. 2374(f)
Integrated Mechanical and Fire Systems Inc. and Allison Sheldon, individually	4601 Governor Printz Boulevard Wilmington, DE 19809	Indefinite/19 Del.C. §108 & 10 Del.C. 542(c)
ACH 1, INC.	873 Salem Church Road Newark, DE 19702	Indefinite/19 Del.C.6960

Updated: July 6, 2022

STATE OF DELAWARE
DEPARTMENT OF LABOR
OFFICE OF CONSTRUCTION INDUSTRY ENFORCEMENT
655 SOUTH BAY ROAD
SUITE 2H
DOVER, DELAWARE 19901

October 7, 2025

Via Electronic and Standard Mail

Maureen Q. Rozanski, NCIDQ, Principle
Buck Simpers Architect + Associates, Inc. (BSA+A)
954 Justison Street
Wilmington, DE 19801

RE: CSD Delaware School for the Deaf: Renovation Bid Pack B

Dear Ms. Rozanski-

I am responding to your request for a category determination for the CSO Delaware School for the Deaf: Renovation Bid Pack B, which is a state funded construction project located in New Castle County, Delaware. The project is proposing to provide window film (tinted) at café/cafeteria windows, ballistic resistant film at exit. School building main entry glazing, cane detection system and new hi-lo drinking fountains with bottle fillers. Partial replacement of lights to LED in school building. Full replacement, residence hall lighting to LED, HVAC and water heater replacement. You estimate the total cost of construction for this project to be $2,027,090.

Based upon the information you provided; the Department of Labor has determined that this project is a Building Construction project.

Delaware's Prevailing Wage Regulations provide that the rates applicable to a project are the rates in effect on the date of publication of the specifications for that project. I have enclosed a certified copy of the prevailing wage rates effective March 14, 2025, for Building Construction, to be included in your bid specification. However, please be advised that, if a contract for a project is not executed within one hundred and twenty (120) days from the earliest date the specifications were published, the rates in effect at the time of the execution of the contract shall be the applicable rates for the project.

This determination is directed solely to the parties identified herein. It is based on the unique facts relevant to this matter. It does not constitute precedent and should not be cited as such by future parties.

Pursuant to 19 Del. Chapter 36, all contractors must obtain their Contractor Registration Certificate prior to performing construction services or maintenance work throughout Delaware. Contractors can submit an application by visiting the Delaware One Stop: https://onestop.delaware.gov/Operate_Contractors

Additionally, effective January 1, 2025, SSI for SB307 amended Delaware's Prevailing Law 29 Del.C.6960(b) now requires these applicable prevailing wage rates to be paid to all workers who perform custom fabrication work regardless of where the work is performed. For further information regarding custom fabrication see 29 Del.C.6902(8).

Lastly, please see the enclosed debarment list. Entities/individuals listed shall not be permitted to bid on, be awarded or work on Delaware State funded construction projects, in the timeframe specified, as provided for under 29 Del.C. §6960 or other applicable State statutes.

If you have any questions or I can provide any additional assistance, please do not hesitate to contact me at (302) 430-7722.

Sincerely,

Lisa Swayze-Thomas
Labor Law Enforcement Officer II
Lisa.Swayze@delaware.gov

Enclosures

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 14, 2025

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	29.89	36.79	53.56
BOILERMAKERS	89.46	45.39	66.72
BRICKLAYERS	66.79	66.79	66.79
CARPENTERS	62.56	62.56	50.80
CEMENT FINISHERS	94.36	67.11	52.04
ELECTRICAL LINE WORKERS	59.42	50.96	38.85
ELECTRICIANS	83.92	83.92	83.92
ELEVATOR CONSTRUCTORS	117.63	84.30	100.06
GLAZIERS	85.50	85.50	74.04
INSULATORS	69.12	69.12	69.12
IRON WORKERS	77.73	77.73	77.73
LABORERS	57.65	57.65	57.65
MILLWRIGHTS	88.35	88.35	70.97
PAINTERS	59.63	59.63	59.63
PILEDRIVERS	91.12	51.44	41.60
PLASTERERS	39.01	39.01	28.91
PLUMBERS/PIPEFITTERS/STEAMFITTERS	79.55	82.95	73.71
POWER EQUIPMENT OPERATORS	83.29	83.29	83.29
ROOFERS-COMPOSITION	32.40	30.53	32.76
ROOFERS-SHINGLE/SLATE/TILE	24.03	28.59	22.47
SHEET METAL WORKERS	86.84	86.84	86.84
SOFT FLOOR LAYERS	61.68	61.68	47.74
SPRINKLER FITTERS	73.13	73.13	73.13
TERRAZZO/MARBLE/TILE FNRS	70.79	70.79	81.89
TERRAZZO/MARBLE/TILE STRS	78.73	78.73	90.82
TRUCK DRIVERS	56.88	35.86	27.91

CERTIFIED: 10-7-25

BY: TDzwonkor-/for Francis Chudzik
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCE

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REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LA
ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIO
CLASSIFICATIONS, PHONE (302) 318-2769.

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

**PROJECT: CHR-25014_DSDBLD CSD DELAWARE SCHOOL FOR THE DEAF RENOVATION BID PACK B, Ne
Castle County**

PREVAILING WAGE DEBARMENT LIST

The following contractors have been debarred for violations of the prevailing wage law 29Del.C. §6960 or other applicable State statutes.

Therefore, no public construction contract in this State shall be bid on, awarded to, or received by contractors and individuals on this list for a period of (3) three years from the date of the judgment or as deemed by a court of competent jurisdiction.

Contractor	Address	Date of Debarment
Mullen Brothers, Inc. and Daniel Mullen, individually	3375 Garnett Road. Boothwyn, PA 19060	Indefinite/ Civil Contempt
State Contractors Corporation, and Jose Oscar Rivera, individually	13004 Hathaway Drive Silver Spring, MD 20906	Indefinite/ 19 Del.C. 2374(f)
Green Granite and Jason Green, individually	604 Heatherbrooke Court Avondale, PA 19311	Indefinite/ Civil Contempt
Pro Image Landscaping, Inc. and Owner(s) individually	23 Commerce Street Wilmington, DE 19801 and/or 2 Cameo Road Claymont, DE 19703	Indefinite/19 Del.C. §108 & 10 Del.C. 542(c)
Liberty Mechanical, LLC and Owner(s), individually	2032 Duncan Road Wilmington, DE 19801	Indefinite/ 19 Del.C. 2374(f)
Integrated Mechanical and Fire Systems Inc. and Allison Sheldon, individually	4601 Governor Printz Boulevard Wilmington, DE 19809	Indefinite/19 Del.C. §108 & 10 Del.C. 542(c)
ACH 1, INC.	873 Salem Church Road Newark, DE 19702	Indefinite/19 Del.C.6960

Updated: July 6, 2022

B S A + A

Planning

Architecture

Interior Design

Graphic Design

Project Management

00 73 44 - RELEASE FORM FOR ELECTRONIC FILES

OWNER: Christina School District
PROJECT: Delaware School for the Deaf: Renovation
LIST OF DRAWINGS:
USAGE FEE: $0.00 DATE:

Definitions:
All electronic information and other instruments of service provided by BSA+A and its consultants, 954 Justison Street, Wilmington, DE 19801, which include everything transmitted on electronic storage media, from a website, or via the Internet, is known as the Data. The Recipient is the undersigned firm or individual requesting the Data.

Terms:

In accepting and utilizing the Data, the Recipient agrees with the following Terms:

1. The General Contractor/Construction Manager, and every subcontractor using the Data shall each return one signed copy of this Release Form to BSA+A.
2. DISTRIBUTION AND COORDINATION: The Recipient will not distribute the Data to any other firm or individual, except for the Recipient's consultants or subcontractors. If BSA+A issues an update or change in the Data during the course of the project, the General Contractor/Construction Manager is responsible for distribution and coordination. Transfer of electronic data does not include subsequent updates and revisions
2. USE: The Data will be used only for the specific project and owner listed above. None of the Data will be used for any other project or purpose, at this or any other site. Indicia/Title Block may be removed at the discretion of the design professional. The
3. OWNERSHIP: Copyright and ownership of the Data are not transferred to the Recipient, or to any other party. BSA+A and/or Owner retain all rights to the Data.
4. ACCURACY: Design data is never perfect. The information is not guaranteed to be accurate. The method of data transfer cannot be guaranteed to be error-free, durable, or compatible with the Recipient's hardware, software or output systems. Any defects discovered by the Recipient shall be reported to BSA+A. **Contractors and subcontractors are not relieved of their normal responsibilities to independently check, coordinate & verify information and dimensions, and to familiarize themselves thoroughly with the project. The electronic data received should not be relied upon for existing building conditions, which must be verified as required.**
5. Electronic data **(REVIT 2021 Model and AutoCAD 2021 Files)** shall be provided for use as background plans only. Contractor shall be responsible for verification of all dimensions and revisions. Contractor shall not have, copy or reproduce details, elevations, sections, schedules or other similar data.
6. Neither BSA+A nor its consultants are not to be held liable for any damages attributable to the use of the Data, or changes and additions made to the Data by you or your consultants or subcontractors. The Undersigned agrees, to the fullest extent permitted by law, to indemnify and hold BSA+A and its consultants harmless from any damage, liability or cost, including reasonable attorney's fees and costs of defense, arising from any changes made by anyone other than the Firm or from any reuse of the drawings and data without the prior written consent of BSA+A and its consultants.
7. This agreement shall be governed by the laws of Delaware.
8. The Undersigned agrees to make payment of _____ processing fee for each consultant's electronic files to BSA+A prior to release of any electronic media release.

Buck Simpers
Architect
+ Associates, Inc.

954 Justison Street
Wilmington, DE 19801

302.658.9300
fax 658.1125

www.simpers.com

GENERAL CONTRACTOR, CONSTRUCTION MANAGER, OR SUBCONTRACTOR:

Print Clearly:

Company:_____

Name:_____

Address:_____

_____

Phone:_____**Email:**_____

Signed_____**Date:**_____

SECTION 00 81 13 - GENERAL REQUIREMENTS

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ARTICLE 1: GENERAL

1.1 CONTRACT DOCUMENTS

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

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

1.2 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

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

1. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, sex, color, sexual orientation, gender identity 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, sex, color, sexual orientation, gender identity 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, sex, color, sexual orientation, gender identity or national origin."

ARTICLE 2: OWNER

(NO ADDITIONAL GENERAL REQUIREMENTS – SEE SUPPLEMENTARY GENERAL CONDITIONS)

ARTICLE 3: CONTRACTOR

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

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

3.3 Before commencing any work or construction, the General Contractor is to consult with the Owner as to matters in connection with access to the site and the allocation of Ground Areas for the various features of hauling, storage, etc.

3.4 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions.

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

3.6 The Contractor warrants to the Owner that materials and equipment furnished will be new and of good quality, unless otherwise permitted, and that the work will be free from defects and in conformance with the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved, may be considered defective. If required by the Owner, the Contractor shall furnish evidence as to the kind and quality of materials and equipment provided.

3.7 Unless otherwise provided, the Contractor shall pay all sales, consumer, use and other similar taxes, and shall secure and pay for required permits, fees, licenses, and inspections necessary for proper execution of the Work.

3.8 The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities bearing on performance of the Work. The Contractor shall promptly notify the Owner if the Drawings and Specifications are observed to be at variance therewith.

3.9 The Contractor shall be responsible to the Owner for the acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons performing portions of the Work under contract with the Contractor.

3.10 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work the Contractor shall remove from and about the Project all waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials. The Contractor shall be responsible for returning all damaged areas to their original conditions.

3.11 STATE LICENSE AND TAX REQUIREMENTS

3.11.1 Each Contractor and Subcontractor shall be licensed to do business in the State of Delaware and shall pay all fees and taxes due under State laws. In conformance with Section 2503, Chapter 25, Title 30, Delaware Code, "the Contractor shall furnish the Delaware Department of Finance within ten (10) days after entering into any contract with a contractor or subcontractor not a resident of this State, a statement of total value of such contract or contracts together with the names and addresses of the contracting parties."

3.12 The Contractor shall comply with all requirements set forth in Section 6962, Chapter 69, Title 29 of the Delaware Code.

3.13 During the contract Work, the Contractor and each 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.

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.1 CONTRACT SURETY

4.1.1 PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

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

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

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

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

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

4.2 FAILURE TO COMPLY WITH CONTRACT

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

4.3 CONTRACT INSURANCE AND CONTRACT LIABILITY

4.3.1 In addition to the bond requirements stated in the Bid Documents, each successful Bidder shall purchase adequate insurance for the performance of the Contract and, by submission of a Bid, agrees to indemnify and save harmless and to defend all legal or equitable actions brought against the State, any Agency, officer and/or employee of the State, for and from all claims of liability which is or may be the result of the successful Bidder's actions during the performance of the Contract.

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

4.4 RIGHT TO AUDIT RECORDS

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

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

ARTICLE 5: SUBCONTRACTORS

5.1 SUBCONTRACTING REQUIREMENTS

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

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

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

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

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

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

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

5.1.3 After such a Contract has been awarded, the successful Bidder shall not substitute another Subcontractor for any Subcontractor whose name was set forth in the statement which accompanied the Bid without the written consent of the awarding Agency.

5.1.4 No Agency shall consent to any substitution of Subcontractors unless the Agency is satisfied that the Subcontractor whose name is on the Bidders accompanying statement:

A. Is unqualified to perform the work required;

B. Has failed to execute a timely reasonable Subcontract;

C. Has defaulted in the performance on the portion of the work covered by the Subcontract; or

D. Is no longer engaged in such business.

5.1.5 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.

5.1.6 The Contractor may employ additional Subcontractors on the jobsite only after submitting a copy of the Subcontractor's Employee Drug Testing Program to the Owner for approval. A Contractor or Subcontractor shall not commence work until the Owner has concluded its review and determined that the submitted Employee Drug Testing Program complies with OMB Regulation 4104.

5.2 PENALTY FOR SUBSTITUTION OF SUBCONTRACTORS

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

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

5.3 ASBESTOS ABATEMENT

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

5.4 STANDARDS OF CONSTRUCTION FOR THE PROTECTION OF THE PHYSICALLY HANDICAPPED

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

5.5 CONTRACT PERFORMANCE

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

ARTICLE 6: CONSTRUCTION BY OWNER OR SEPARATE CONTRACTORS

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

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

ARTICLE 7: CHANGES IN THE WORK

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

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

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

7.3.1 "DPE" shall be defined to mean "direct personnel expense". Direct payroll expense includes prevailing wage rates plus a maximum multiplier of 1.35 times DPE. For example, if the prevailing wage rate is $50/hour, the DPE would be $67.50/hour (50 x 1.35).

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

7.3.3 In addition to the above, the General Contractor is allowed a fifteen percent (15%) markup for overhead and profit for additional work performed by the General Contractor's own forces. For additional subcontractor work, the Subcontractor is allowed a fifteen (15) percent overhead and profit on change order work above and beyond the direct costs stated previously. To this amount, the General Contractor will be allowed a mark-up not exceeding seven and one half percent (7.5%) on the subcontractors work.

These mark-ups shall include all costs including, but not limited to: overhead, profit, bonds, insurance, supervision, etc. No markup is permitted on the work of the subcontractors subcontractor. No additional costs shall be allowed for changes related to the Contractor's onsite superintendent/staff, or project manager, unless a change in the work changes the project duration and is identified by the CPM schedule. There will be no other costs associated with the change order.

ARTICLE 8: TIME

8.1 Time limits, if any, are as stated in the Project Manual. By executing the Agreement, the Contractor confirms that the stipulated limits are reasonable, and that the Work will be completed within the anticipated time frame.

8.2 If progress of the Work is delayed at any time by changes ordered by the Owner, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions, unavoidable casualties or other causes beyond the Contractor's control, the Contract Time shall be extended for such reasonable time as the Owner may determine.

8.3 Any extension of time beyond the date fixed for completion of the construction and acceptance of any part of the Work called for by the Contract, or the occupancy of the building by the Owner, in whole or in part, previous to the completion shall not be deemed a waiver by the Owner of his right to annul or terminate the Contract for abandonment or delay in the matter provided for, nor relieve the Contractor of full responsibility

8.4 SUSPENSION AND DEBARMENT

8.4.1 Per Section 6962(d)(14), Title 29, Delaware Code, "Any Contractor who fails to perform a public works contract or complete a public works project within the time schedule established by the Agency in the Invitation To Bid, may be subject to Suspension or Debarment for one or more of the following reasons: a) failure to supply the adequate labor supply ratio for the project; b) inadequate financial resources; or, c) poor performance on the Project."

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

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

8.5 RETAINAGE

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

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

ARTICLE 9: PAYMENTS AND COMPLETION

9.1 APPLICATION FOR PAYMENT

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

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

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

9.2 PARTIAL PAYMENTS

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

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

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

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

9.3 SUBSTANTIAL COMPLETION

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

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

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

9.4 FINAL PAYMENT

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

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

9.4.1.2 An acceptable RELEASE OF LIENS,

9.4.1.3 Copies of all applicable warranties,

9.4.1.4 As-built drawings,

9.4.1.5 Operations and Maintenance Manuals,

9.4.1.6 Instruction Manuals,

9.4.1.7 Consent of Surety to final payment.

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

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

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

10.2 The Contractor shall notify the Owner in the event any existing hazardous material such as lead, PCBs, asbestos, etc. is encountered on the project. The Owner will arrange with a qualified specialist for the identification, testing, removal, handling and protection against exposure or environmental pollution, to comply with applicable regulation laws and ordinances. The Contractor and Architect will not be required to participate in or to perform this operation. Upon completion of this work, the Owner will notify the Contractor and Architect in writing the area has been cleared and approved by the authorities in order for the work to proceed. The Contractor shall attach documentation from the authorities of said approval.

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

10.4 The Contractor shall certify to the Owner that materials incorporated into the Work are free of all asbestos. This certification may be in the form of Material Safety Data Sheet (MSDS) provided by the product manufacturer for the materials used in construction, as specified or as provided by the Contractor.

ARTICLE 11: INSURANCE AND BONDS

11.1 The Contractor shall carry all insurance required by law, such as Unemployment Insurance, etc. The Contractor shall carry such insurance coverage as they desire on their own property such as a field office, storage sheds or other structures erected upon the project site that belong to them and for their own use. The Subcontractors involved with this project shall carry whatever insurance protection they consider necessary to cover the loss of any of their personal property, etc.

11.2 Upon being awarded the Contract, the Contractor shall obtain a minimum of two (2) copies of all required insurance certificates called for herein, and submit one (1) copy of each certificate, to the Owner, within 20 days of contract award.

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

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

11.5 Builders Risk (including Standard Extended Coverage Insurance) on the existing building during the entire construction period, may be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

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

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

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury		
	$1,000,000	for each occurrence
	$3,000,000	aggregate
Property Damage	$1,000,000	for each occurrence
	$3,000,000	aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury		
	$1,000,000	for each occurrence
	$3,000,000	aggregate

Property Damage	$1,000,000	for each occurrence
	$3,000,000	aggregate

11.7.3 Automobile Liability Insurance

Minimum coverage to be:

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

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

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

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

11.7.5.2 Minimum Limit for all employees working at one site.

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

11.7.7 Social Security Liability

11.7.7.1 With respect to all persons at any time employed by or on the payroll of the Contractor or performing any work for or on their behalf, or in connection with or arising out of the Contractor's business, the Contractor shall accept full and exclusive liability for the payment of any and all contributions or taxes or unemployment insurance, or old age retirement benefits, pensions or annuities now or hereafter imposed by the Government of the United States and the State or political subdivision thereof, whether the same be measured by wages, salaries or other remuneration paid to such persons or otherwise.

11.7.7.2 Upon request, the Contractor shall furnish Owner such information on payrolls or employment records as may be necessary to enable it to fully comply with the law imposing the aforesaid contributions or taxes.

11.7.7.3 If the Owner is required by law to and does pay any and/or all of the aforesaid contributions or taxes, the Contractor shall forthwith reimburse the Owner for the entire amount so paid by the Owner.

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.1 The Contractor shall promptly correct Work rejected by the Owner or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be not in accordance with the requirements of the Contract Documents within a period of two years from the date of Substantial Completion, or by terms of an applicable

special warranty required by the Contract Documents. The provisions of this Article apply to work done by Subcontractors as well as to Work done by direct employees of the Contractor.

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

ARTICLE 13: MISCELLANEOUS PROVISIONS

13.1 CUTTING AND PATCHING

13.1.1 The Contractor shall be responsible for all cutting and patching. The Contractor shall coordinate the work of the various trades involved.

13.2 DIMENSIONS

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

13.3 LABORATORY TESTS

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

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

13.4 ARCHAEOLOGICAL EVIDENCE

13.4.1 Whenever, in the course of construction, any archaeological evidence is encountered on the surface or below the surface of the ground, the Contractor shall notify the authorities of the State Historic Preservation Office 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 by the Division of Historical and Cultural Affairs.

13.5 GLASS REPLACEMENT AND CLEANING

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

13.6 WARRANTY

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

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

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

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

END OF SECTION

SECTION 00 81 14 – DRUG TESTING

1. DRUG TESTING

1.1 Drug Testing must be in the following forms:

1. Employee Drug Testing Report Form
2. Report of Positive Results

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 maintain testing data that includes but is not limited to the data elements below.

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:
_____
_____
_____

Date: _____

This form is not required to be submitted to the Owner. Included as a reference to show information required to be maintained by the Contractor. The Owner shall have the right to periodically audit all Contractor and Subcontractor test results at the Contractor's or Subcontractor's offices (or by other means to make the data available for inspection by the Owner).

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:
_____
_____
_____

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.

CSD Delaware School for the Deaf: Renovation
630 E. Chestnut Hill Road, Newark, DE 19713
BSA+A Project No. 24.007
CHR-26013-DSDRENO

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 or, if the contractor and/or subcontractor meets the requirements under Title 29, Chapter 69, Section 6960A.(b)(1)c.1.-3., payment may be made in accordance with Title 29, Chapter 69, Section 6960A.(b)(1)d. 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 all questions in writing to the Delaware Department of Labor at: apprenticeship@delaware.gov. ***This Affidavit of Craft Training Compliance 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).

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)
) ss:
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.

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Coordination with occupants.
5. Work restrictions.
6. Specification and drawing conventions.
7. Miscellaneous provisions.
8. Related Requirements:
9. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

A. Project Identification: CSD Delaware School for the Deaf: Renovation.

1. Project Location: 630 E Chestnut Hill Rd
Newark, Delaware 19713

B. Owner: Christina School District

C. Civil Engineer: McKin and Creed Engineering

D. Architect: Buck Simpers Architect and Associates (BSA+A)

E. MEP Engineer: Gipe Associates, Inc.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following: Project consists of adding an exterior wall to enclose existing service shed, interior renovations are limited to replacement of all drinking fountains, replacement of all light fixtures with LED, HVAC renovations to residence hall. In addition, the project includes constructing a new soccer field and a new 200- Meter running track, relocating an existing basketball court, and converting existing site lighting to LED lamps.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 CONSTRUCTION SCHEDULE

A. The contractor is required to submit a detailed project schedule seven (7) days after receipt of Notice to Proceed and to begin its submittal process. The Project Schedule is an integral part of this contract. This schedule is to include a contingency of 10 days lost to delays during construction for any reason (weather, owner delay)

1. Unless otherwise specifically authorized, the Contractor shall absorb, without additional compensation, all costs of working beyond normal hours to maintain job progress in accordance with the current construction schedule.
2. **Anticipated Award on 04/14/2026**
Mobilization on 04/15/2026
Substantial Completion on 12/01/2026
Final Project Completion by 10/06/2026 (Exterior)
Final Project Completion by 12/29/2026 (Main Building and Residence Hall)

1.6 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits: Confine construction operations, storage, laydown, and construction staging areas to site areas identified on the drawings
2. Keep driveways, loading areas, walkways 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.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. You are to generally contain your work to the limit of disturbance identified on the drawings. Provide necessary protection and clear paths around the construction area for public accessibility and to meet the requirements of the Delaware State Fire Marshal for emergency access to exits. Contractor will be responsible to keep all areas of the project, including, but not limited to public roadways, parking areas, interior corridors, existing rooms soiled by construction traffic on a daily basis.

B. Owner Occupancy: The owner will occupy the building and the parking area during entire construction period. Contractor is to cooperate with concurrent users during construction operations to minimize conflicts. Perform the Work so as not to interfere with user operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

1.8 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. Preceding Work: Owner has performed limited demolition work. Any items left are to become the responsibility of the contractor to protect or remove and properly dispose of.

C. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.

1. Furniture purchase and Installation.

a. To be installed at completion of project

1.9 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Work hours are defined as follows:

1. Weekday Hours (M-F):

a. 4/15/2026- 6/14/2026: 3:30 pm - 10:30 pm

b. 6/15/2026-8/31/2026: 6:00 am - 6:00 pm
   1) Extended work hours with owner approval: before 6:00 am and after 6:00 pm
c. Spring Break: 6:00 am – 6:00 pm
   1) Extended work hours with owner approval: before 6:00 am and after 6:00 pm
d. 9/1/2023-12/1/2026: 3:30 pm – 10:30 pm
e. Both 9/80 work schedule and 10/80 work schedule style are acceptable. Notify owner of intended work schedule.

2. Weekend Hours: As arranged with owner prior approval (min. 24 hour notice)
3. Holiday Hours: As arranged with owner prior approval (min. 24 hour notice)

C. Contractor is responsible for having a competent project superintendent/foreman on-site during all work performed under its contract. In the event the Contractor has non-English speaking employees or subcontractors on the project, they shall have a superintendent or foreman on site, at all times, who speaks English and can communicate with Contractor's employees. Should the Contractor fail to meet this requirement, at any time, The Owner may direct all Work to stop until the proper supervision is on site. The Contractor will be responsible for maintaining the project work schedule and make up at its own expense, any delay to the Schedule resulting from the work stoppage.

D. Nonsmoking site: Smoking, use of tobacco products and e-cigarettes is not permitted anywhere on the job site and school property. Violators of this policy are to be placed on notice for the first offense and removed from the job site with a second offense

E. Firearms, ammunition, explosives, etc. are prohibited from anywhere on the property. Contractor employees, subcontractors or contract workers violating this policy are to be immediately removed from the site. Law enforcement official may be notified.

F. Controlled Substances: Use or possession of controlled substances or illegal drugs is prohibited on the property. Contractor employees, subcontractors or contract workers violating this policy are to be immediately removed from the site. Law enforcement official may be notified.

1. All public works contracts (paid) with public funds must include provisions requiring the contractor, its agents and employees to implement (a) mandatory drug testing program(s) for all employees or agents working on the job site in non-clerical positions. Provisions governing mandatory drug testing shall be incorporated into all public works contracts…" "The rules governing the administration of such tests by the contractor shall be promulgated by the Director of the Office of Management and Budget." [in accordance with 29Del.C.§6908(a)(b)

G. Interaction or Photography of employees, staff, students, or guests are prohibited. Violators are to be immediately removed from the construction site for the duration of the project

H. Radios or other devices that could affect the adjacent users are prohibited.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.11 MISCELLANEOUS PROVISIONS

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

1. Provide properly sized containers and schedule pick up schedule to not allow waster materials to accumulate on-site
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Burying, or disposing of waste material on site is not permitted

B. Hazardous Materials

1. Owner is to be notified before disposing of any hazardous materials
2. Hazardous materials are to be properly disposed of following Federal, State, and local requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SUMMARY

SECTION 01 21 00 – ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

1. DEFINITION
   a) Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:
   1. Contingency allowance.

1.3 COORDINATION

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

1.4 CONTINGENCY ALLOWANCES

A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance. Submit costs for approval before proceeding with contingency allowance work

B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance. These costs include delivery, installation, taxes, insurance, equipment rental, cost of engaging testing agencies, actual tests and inspections, and reporting results. Contingency Allowance is to be included as a line item in the Contract Sum.

C. At Project closeout, unused amounts remaining in the contingency allowance are to be returned to the Owner with a credit Change Order to the Contractor.

1.5 ADJUSTMENT OF ALLOWANCES

A. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

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: PROVIDE A CONTINGENCY ALLOWANCE OF $75,000 FOR UNFORSEEN CONDITIONS.
1. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under this contingency allowance are included in the allowance. These costs include but are not limited to delivery, installation, taxes, insurance, equipment rental, cost of engaging testing agencies, actual tests and inspections, and reporting results. This Contingency Allowance is to be included in the total value of the Contract Sum.

END OF SECTION

ALLOWANCE AUTHORIZATION

Project:

Architect: **Project No.**

Contractor:

AAA No.: **Initiation Date:**

The Allowance is allocated as follows:

Total original Contract Allowance was:	$
Amount of Contract Allowance Access previously authorized:	$
Adjusted Contract Allowance prior to this authorization is:	$
The amount of available Allowance will Decrease by this Access Authorization:	$
The remaining Contract Allowance, after this Access Authorization will be:	$

Recommended by:
Architect

By (Signature): _____
Date: _____

Accepted by:
Contractor

By (Signature): _____
Date: _____

Approved by:
Owner

By (Signature): _____
Date: _____

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 014000 "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See 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 schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Patching Brickwork at Residence Hall

1. Description: provide unit price for patching brickwork at PTAC openings. B.O.D. is to match existing brickwork and mortar.
    a. Existing brick:
        1) Manufacturer: Bowerston Shale Company, Bowerston Ohio
        2) Colors:
            a) (main field):#110 red
            b) (accent bands):445 orange buff
        3) Style: smooth face (wire cut) brick
        4) Size: 3-5/8” deep x 2 ¼” high x 11 5/8” long
2. Unit of Measurement: per square foot

B. Unit Price No. 2: Patching and painting Drywall

END OF SECTION

SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

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

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

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

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Existing lighting replacement with LED lighting in Classrooms, Admin, & Media Center

1. Base Bid: _____.
2. Alternate: _____.

B. Alternate No. 2: Existing lighting replacement with LED lighting in Gym, Kitchen, Cafeteria, & Auditorium

1. Base Bid: _____.
2. Alternate: _____.

C. Alternate No. 3: School Building lightning protection system replacement

1. Base Bid: _____.
2. Alternate: _____.

D. Alternate No. 4: Residence Hall lightning protection system replacement

1. Base Bid: _____.
2. Alternate: _____.

END OF SECTION

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
   2. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

   1. Substitution Request Form: Use facsimile of form provided in Project Manual.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

      a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.

b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

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

B. Substitutions for Convenience: Not allowed unless otherwise indicated.

C. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include

compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

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

PART 3 - EXECUTION (Not Used)

END OF SECTION

SUBSTITUTION REQUEST

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: [] New product [] 2-5 years old [] 5-10 yrs old [] More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

[] Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: [] No [] Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: [] No [] Yes [Add] [Deduct] _____ days.

Supporting Data Attached: [] Drawings [] Product Data [] Samples [] Tests [] Reports [] _____

SUBSTITUTION REQUEST

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: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

A/E's REVIEW AND ACTION

[] Substitution approved - Make submittals in accordance with Specification Section 01330.
[] Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
[] Substitution rejected - Use specified materials.
[] Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: [] Contractor [] Subcontractor [] Supplier [] Manufacturer [] A/E [] _____

_____

_____

_____

_____

_____

_____

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Division 01 Section "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 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. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.

d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail." or forms acceptable to owner and / or Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail" or form acceptable to Owner and / or Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Division 01 Section "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

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

1.7 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

SECTION 01 29 00 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:
1. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Division 01 Section "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with continuation sheets.
b. Submittal schedule.
c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

3. Sub-schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values coordinated with each phase of payment.
4. Sub-schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub-schedules showing values coordinated with each element.
5. Sub-schedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide sub-schedules showing values coordinated with the scope of each design services contract as described in Division 01 Section "Summary."

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

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Contractor's name and address.
    e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

        1) Labor.
        2) Materials.
        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

    a. Include separate line items under Contractor and principal subcontracts for LEED documentation and other Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

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

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and 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 Times: Submit Application for Payment to Architect by the 30th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

    1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.

D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in Project Manual.

F. Application for Payment Forms: Use forms acceptable to Architect and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.

G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

I. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

K. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

L. 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. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.
16. Data needed to acquire Owner's insurance.

M. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

N. Final Payment Application: After completing Project closeout requirements, 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. Evidence that claims have been settled.
7. 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.
8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

AIA® Document G703™ – 1992

Continuation Sheet

AIA Document G702, APPLICATION AND CERTIFICATION FOR PAYMENT, containing Contractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
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	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED FROM PREVIOUS APPLICATION (D + E)	WORK COMPLETED THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
		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

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SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Project Web site.
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.

2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

4. Division 01 Section "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

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

1.4 SCHEDULE

1. Bidding and Negotiation (B&N)
   a. Advertise for Bid / Posted to GSS: 03/04/2026
   b. Pre-Bid Meeting: 03/11/2026

c. Bidding Period (3 Weeks): 03/11/2026 – 03/25/2026
d. Bids Due: 03/25/2026
e. Bids Awarded / Approved: 04/14/2026

2. Construction – Main Building and Residence Hall
   a. Contractor Mobilization: 04/15/2026
   b. Substantial Completion: 12/01/2026
   c. Punch Listing / Closeout: 12/29/2026
   d. Final Building Occupation: 12/29/2026
3. Construction – Sitework
   a. Contractor Mobilization: 04/15/2026
   b. Substantial Completion: 09/09/2026
   c. Punch Listing / Closeout: 09/23/2026
   d. Final Completion: 10/06/2026
4.

1.5 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.7 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.

c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.

f. Indicate required installation sequences.

g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.

2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Division 01 Section "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Preparation Format: DWG, Version Autocad (Release 2010), operating in Microsoft Windows operating system
3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.

4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    b. Digital Data Software Program: Drawings are available in PDF and / or Autocad.

c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.8 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

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

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.

10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

12. Contractor's signature.

13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

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

1. The following Contractor-generated RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log bi-weekly. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's[action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.9 PROJECT WEB SITE

A. Use Owner's Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:

1. Project directory.
2. Project correspondence.
3. Meeting minutes.
4. Contract modifications forms and logs.

5. RFI forms and logs.
6. Task and issue management.
7. Photo documentation.
8. Schedule and calendar management.
9. Submittals forms and logs.
10. Payment application forms.
11. Drawing and specification document hosting, viewing, and updating.
12. Online document collaboration.
13. Reminder and tracking functions.
14. Archiving functions.

B. Provide up to seven Project Web site user licenses for use of the Owner,, Architect, and Architect's consultants. Provide two hours of software training at Architect's office for Project Web site users.

C. On completion of Project, provide one complete archive copy(ies) of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.

D. Provide one of the following Project Web site software packages under their current published licensing agreements:

1. Procore
2. Plan Grid
3. Bluebeam
4. Or Equal.

E. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of AIA Document C106.

1.10 PROJECT MEETINGS

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

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: The entity responsible for conducting the meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.

2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect progress, including the following:

   a. Tentative construction schedule.
   b. Critical work sequencing and long-lead items.
   c. Designation of key personnel and their duties.
   d. Lines of communications.
   e. Procedures for processing field decisions and Change Orders.
   f. Procedures for RFIs.
   g. Procedures for testing and inspecting.
   h. Procedures for processing Applications for Payment.
   i. Distribution of the Contract Documents.
   j. Submittal procedures.
   k. Preparation of record documents.
   l. Use of the premises and existing buildings.
   m. Work restrictions.
   n. Working hours.
   o. Owner's occupancy requirements.
   p. Responsibility for temporary facilities and controls.
   q. Procedures for moisture and mold control.
   r. Procedures for disruptions and shutdowns.
   s. Construction waste management and recycling.
   t. Parking availability.
   u. Office, work, and storage areas.
   v. Equipment deliveries and priorities.
   w. First aid.
   x. Security.
   y. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

   a. Contract Documents.
   b. Options.

c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.

4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.

5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

E. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than **9** days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.

2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.

b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Coordination of separate contracts.
k. Owner's partial occupancy requirements.
l. Installation of Owner's furniture, fixtures, and equipment.
m. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

F. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Progress cleaning.

10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of proposal requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

G. Coordination Meetings: Conduct Project coordination meetings at biweekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:
1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Deliveries.

6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 32 00 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's construction schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Special reports.

B. Related Requirements:

1. Division 01 Section "Multiple Contract Summary" for preparing a combined Contractor's construction schedule.
2. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
3. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

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 Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Startup construction schedule.

1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures**,** including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 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, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

    a. HVAC / Mechanical Equipment.

3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than **15** days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.

i. Tests and inspections.
j. Adjusting.
k. Curing.
l. Building flush-out.
m. Startup and placement into final use and operation.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.
b. Temporary enclosure and space conditioning.
c. Permanent space enclosure.
d. Completion of mechanical installation.
e. Completion of electrical installation.
f. Substantial Completion.

C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion**.**

D. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Division 01 Section "Payment Procedures" for cost reporting and payment procedures.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's construction schedule within 30 days of date established for commencement of the Work. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

20. Material stored prior to previous report and remaining in storage.
21. Material stored prior to previous report and since removed from storage and installed.
22. Material stored following previous report and remaining in storage.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

C. Distribution: Distribute copies of approved schedule to Architect**,** 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

SECTION 01 33 00 – SUBMITTAL PROCEDURES

1. GENERAL PROVISIONS

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate, apply to the Work specified in this Section.

2. ITEMS TO BE SUBMITTED AT START OF WORK

2.1 Performance/Labor and Material Payment Bond(s): One (1) copy of each bond simultaneously with the signed Agreement. See General Conditions Article 11.4 and Supplementary Conditions.

2.2 Policies or Certificates of Insurance: Two (2) copies simultaneously with the signed Agreement. See General Conditions Article 11 and Supplementary Conditions.

2.3 Contractor's License: Submit a copy of all business licenses required by local and state agencies.

2.4 Contractor's Schedule of Values: Two (2) copies for approval within 21 days after the Agreement is signed. See General Conditions Article 9.2 and provisions in this Section.

2.5 Contractor's Progress Schedule: Two (2) copies for review and reference within 21 days after the Agreement is signed. See General Conditions Article 3.10 and provisions in this Section.

2.6 Submittal Schedule: In Excel electronic format within 21 days after the Agreement is signed. See provisions in this Section.

2.7 Products List: In Excel format for approval within 30 days after the Agreement is signed. See provisions in Section 016200 - MATERIAL AND EQUIPMENT.

3. NON-RESIDENT CONTRACTOR & SUBCONTRACTORS BONDS

3.1 Refer to requirements in Section 011100 - INSTRUCTIONS TO BIDDERS for filing of Surety Bonds with the Division of Revenue.

3.2 If such bonds are required on this project, it will be the responsibility of the Contractor to produce evidence to the Construction Manager that they have been filed, or if not required, to supply a notarized statement that they are not required. This must be done within seven (7) days after award of Contract and in any event before construction starts.

4. RELATED REQUIREMENTS

4.1 See Section 017700 - CONTRACT CLOSE OUT: for submittal requirements for Contract Close out.

5. SUBMITTALS

5.2 Prepare a Submittal's Schedule in Excel electronic format for Shop Drawings, Product Data and Samples. Show:

1. The dates for Contractor's submittals.

2. The dates submittals will be required for Owner-furnished products.

3. The date approved submittals will be required from the Architect.

5.3 Should the Architect or Construction Manager elect to omit any items from the list of items to be reviewed, it shall not relieve the Contractor from compliance with the Contract Documents with regard to that item. In such instance, the Contractor may still elect to have submittals prepared for his own use without review by the Architect or Construction Manager.

6. SHOP DRAWINGS

6.1 Conform to provisions in General Conditions applying to Shop Drawings.

6.2 Present in a clear and thorough manner.

1. Identify details by reference to sheet and details, schedule or room numbers shown on Contract Drawings.

7. PRODUCT DATA

7.1 Conform to provisions in General Conditions applying to Product Data.

7.2 Preparation:

1. Clearly mark each copy to specifically identify products or models pertinent to project.

2. Show performance characteristics and capacities.

2. Show dimensions and clearances required.

4. Show wiring or piping diagrams and controls.

7.3 Manufacturer's standard schematic drawings and diagrams:

1. Modify drawings and diagrams to delete information which is not applicable to the Work.

2. Supplement standard information to provide information specifically applicable to the Work.

8. SAMPLES

8.1 Conform to provisions in General Conditions applying to Samples.

8.2 Provide samples of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of the project, with integrally related parts and attachment devices.

2. Full range of color, texture and pattern.

8.3 Samples must be clearly labelled with project number, submittal number, color, type, model number, and any other identifying items, in order to be properly reviewed and approved.

8.4 Field samples and mock-ups; See requirements, if any, in other specification Sections.

9. SUBMITTAL REQUIREMENTS

9.1 Number of submittals required.

1. Shop drawings and Product Data: shop drawings for temporary steel, steel and miscellaneous steel, MEP shop drawings shall also provide one (1) paper copy for approval and ultimate use by the Construction manager for field verification. Any additional copies required by the Contractor shall be made by him.

2. Samples: Submit four (4) each. Submit all data and pictures of samples through the Building Blok Management System. Physical samples to be noted on Building Blok submittal and supplied to Construction manager for processing. When approved it will be returned to the Construction Manager to be retained at the site for reference use.

9.2 Submittals shall contain:

1. The date of submission and the dates of any previous submissions.

2. The Project title and number.

3. Contract identification.

4. The names of the Contractor, Supplier and Manufacturer.

5. Identification of the product, with the specification section number.

6. Field dimensions, clearly identified as such.

7. Relation to adjacent or critical features of the Work or materials.

8. Applicable standards, such as ASTM or Federal Specification numbers.

9. Identification of deviations from Contract Documents.

10. Identification of revisions on resubmittals.

11. An 8 inch x 3 inch blank space for Contractor and Architect's stamps.

12. Contractor's stamp, initialed or signed, certifying review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents. Submittals which have not been stamped with this stamp or its approved equivalent will be returned without being reviewed.

9.3 Shop Drawing coordination and interface with work of other Contracts and adjacent work is the responsibility of each individual Contractor.

10. RESUBMISSION REQUIREMENTS

10.1 Make any corrections or changes in the submittals required by the Architect and resubmit until approved.

10.2 Shop drawings and Product Data:

1. Revise initial drawings or data, and resubmit as specified for the initial submittal.

2. Indicate any changes which have been made other than those requested by the Architect.

10.3 Samples: Submit new samples as required for initial submittal.

11. FINAL DISTRIBUTION OF APPROVED SUBMITTALS

11.1 The Construction Manager will distribute copies of Shop Drawings and Product Data which carry the Architect's stamp through Building Blok to:

1. Contractor that made submittal.

2. Jobsite File.

3. Record Document File.

4. Other Contractors, as required for coordination.

11.2 The Construction Manager will distribute samples as required.

11.3 The Contractor will distribute copies of Shop Drawings and Product Data which carry the Architect's stamp to:

1. Subcontractors.

2. Suppliers.

3. Fabricators.

12. SCHEDULE OF VALUES

12.1 Use AIA Document G703, Continuation Sheet to G702.

13. PROGRESS SCHEDULE

13.1 Prepare schedules in the form of a horizontal bar chart.

1. Provide separate horizontal bar chart for each trade or operation.
2. Horizontal time scale: Identify the first work day of each week.
3. Scale and spacing: To allow space for notations and future revisions.
4. Minimum sheet size 11 inches by 17 inches.

13.2 Format of listings: The chronological order of the start of each item of work.

13.3 Show the complete sequence of construction by activity.

13.4 Show the dates for the beginning, and completion of, each major element of construction such as:

1. Site clearing.
2. Site utilities.
3. Foundation work.
4. Structural framing.
5. Subcontractor work.
6. Equipment installation.

13.5 Show projected percentage of completion for each item as of the first day of each month.

13.6 Update Progress Schedule monthly and submit with Application for Payment and Schedule of values.

13.7 Indicate progress of each activity to date of submission.

13.8 Show changes occurring since previous submission of schedule:

1. Major changes in scope.
2. Activities modified since previous submission.
3. Revised projections of progress and completion.
4. Other identifiable changes.

13.9 Provide a narrative report as needed to define:

1. Problem areas, anticipated delays and the impact of the schedule.
2. Corrective action recommended, and its effect.
3. The effect of changes on schedules of other prime contractors.

13.10 Submit one reproducible transparency.

13.11 After review, distribute copies of the schedule to:

1. Jobsite File.
2. Subcontractors.
3. Architect.
4. Owner.

13.12 Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

14. CLOSE OUT DOCUMENTS, GUARANTEES, WARRANTIES, OPERATION MANUALS:
Contractors shall include the cost to provide (2) copies of the following close-out documentations to Owner with-in 30 Calendar days of the completion of the contract work.
1. CLOSE OUT DOCUMENTS, GUARANTEES, WARRANTIES, OPERATION MANUALS

(2) Each Contractor shall be prepared for the Owner's Design Professionals to make a final inspection of the construction (accompanied by Owner Representative) and certify the completion of construction in writing. The inspection will be scheduled at least 15 days prior to the scheduled completion date.

(3) All Guarantees and Warranties shall be in writing and be delivered to Owner at the time of the final inspection. In conjunction with this delivery, Contractor shall prepare and deliver to Owner a listing (company, and name, address, day and night phone numbers) of contacts for service calls.
(a) Note that no final invoice will be processed until all close-out documentation is received.

(4) The following is a list of O&M items to delivered to Owner at the above stated time.
(a) Note that this is to be a rider to the O&M information required by the specification and not to be an all inclusive list.
(b) Contractor shall furnish Contract specific items. If an item is not applicable to a Contractor agreement then it may be disregarded

(c) Contractor shall provide two (2) sets of the manufacturer's operation and service manuals of all equipment.
(d) All warranties and guarantees shall be issued in the name of the Owner

(e) Contractor shall provide all relevant documents on the following "CLOSE OUT DOCUMENT LIST".

(i) Paving warranty (1 year).
(ii) Roofing and watertight warranty from manufacturer (20 years)
(iii) Contractor Blanket Warranty (1 year)
(iv) Roof installer warranty (3 years)
(v) HVAC units (1 year general / 5 year compressor)
(vi) Caulking and Sealants (5 years)
(vii) Store front Aluminum Warranty (3 years)
(viii) *Soil treatment of termites (5 year certificate)
(ix) Masonry waterproofing (5 year)
(x) Foundation Inspection and Certification.
(xi) Structural Steel Inspection and Certification.
(xii) Fire Sprinkler Material and Test certificate (above and below grade)
(xiii) Water line pressure test.
(xiv) Gas Line pressure test
(xv) Sanitary sewer flow test
(xvi) Domestic Water Sterilization Certification
(xvii) Electrical Panel Balance and Phase Test
(xviii) HVAC Test and Balance report
(xix) HVAC and Control Panel start-up report and certification that systems perform according to specifications.
(xx) Fire protection systems Warranty (1 year) and Certification letter that states all corrections have been completed according to Fire Marshall.
(xxi) As-Built drawings and Specifications two (2) complete and one (1) reproducible.
(xxii) Final Contractor's List and Phone Numbers.
(xxiii) Final Lien Releases from Contractor
(xxiv) Punch list Completion Statement from Contractor that all items related to the associated contract have been completed
(xxv) 11-Month Warranty Inspection and Punch list.
(xxvi) Waste manifests for the transportation of environmental waste.

END OF SECTION

SECTION 01 35 23 - SAFETY PROGRAM

1. GENERAL

1.1 The Contractor shall be responsible for initiating, maintaining and supervising all safety activities and programs in connection with the Work.

1.2 Contractor shall be responsible for the safety of its personnel.

1.3 Hard hats and safety glasses must be worn by all personnel on the jobsite, except in contractor's administrative office/trailer. All equipment must comply with OSHA standards. All job site personnel shall wear long pants, shirts (no tank tops) and work boots.

2. SAFETY PROGRAM

2.1 Prior to commencing the Work, the Contractor shall submit to the (1) electronic copy and (1) bound copy of its safety program and one (1) copy of MSDS information in a 2" ringed notebook. One paper copy of the safety program and MSDS will be retained by the Construction Manager in the field office.

2.2 The safety program shall outline those hazards peculiar to the Contractor's Work, and the steps to be taken to eliminate or reduce the risk of injury or loss due to those hazards**. The program shall be site specific.** Contractor shall implement and enforce its safety program, which is in accordance with all OSHA, Federal, State and local laws.

2.3 Contractor shall designate a qualified Safety Supervisor to implement the safety program. Unless otherwise approved by the Owner, the Safety Supervisor shall be the Contractor's field Superintendent/Foremen.

2.4 Contractor shall hold weekly safety toolbox talks with all of its employees. The Contractor shall designate a responsible, capable person to conduct these meetings.

3. SUBSTANCE ABUSE POLICY STATEMENT

The Owner is committed to providing a safe work site environment for its employees and Contractors' employees. The Owner does not condone or permit employees and Contractors' employees to use or be under the influence of drugs or alcohol while they are on the work site. The Policy is as follows:

3.1 It is a violation Contractors' employees to use, possess, sell, trade, or otherwise engage in the use of illegal drugs and alcohol.

3.2 It is a violation for Contractors' employees to report to work while influenced by illegal drugs or alcohol.

3.3. It is a violation for Contractors' employees to use prescription drugs illegally (i.e. to use prescription drugs that have not been legally obtained) and to use prescription drugs in a manner other than the prescribed intentions.

3.4 Contractors' employees who are taking medication, which is prescribed by their physician, are expected to discuss potential side effects with their prescribing physician, as it relates to the

work requirements.

Violations of this policy will require disciplinary action. If any Contractors' employees are observed or suspected of being influenced by drugs or alcohol, they will be instructed to stop work and may be required to leave the work site.

4. EXECUTION

4.1 Contractor shall comply with all applicable federal, state and local laws, regulations and orders relating to occupational safety and health, and related procedures, and shall, to the extent permitted by law, indemnify and hold Owner and Architect, and their respective directors, officers, or agents and employees, harmless from any and all liability, public or private, penalties, contractual or otherwise, losses, damages, costs, attorney's fees, expenses, causes of action, claims or judgments resulting from a claim filed by anyone in connection with the aforementioned acts, or any rule, regulation or order promulgated thereunder, arising out of the Contractor's Work, this Agreement or any subcontract executed in prosecution of the Work. Contractor further agrees in the event of a claim of violation of any such laws, regulations, orders or procedures arising out of or in any way connected with the performance of this agreement, Owner may immediately take whatever action is deemed necessary by Owner and/or Architect to remedy the claim or violation. Any and all costs or expenses paid or incurred by Owner and/or Architect in taking such action shall be borne by Contractor, and may be deducted from any payments due Contractor.

4.2 The Contractor agrees to (1) take all necessary steps to promote safety and health on the job site; (2) cooperate with Owner and/or Architect in preventing and eliminating safety and health hazards: (3) train, instruct and provide adequate supervision to ensure that its employees are aware of, and comply with, applicable Federal and State safety and health laws, standards, regulations and rules, safe healthful work practices and all applicable safety rules, regulations and work practices and procedures (4) not create any hazards or expose any of its employees, employees of the Owner and/or Architect or employees of Contractors to any hazards; and (5) where the Contractor is aware of the existence of a hazard not within its control, notify the Owner/ Architect of the hazard as well as warn exposed persons to avoid the hazard.

4.3 The Contractor's Superintendent or Safety Supervisor shall immediately, verbally report, and promptly thereafter confirm in writing to the Owner and Architect any unsafe conditions or practices that are observed, or violations of job safety which are not within the Contractor's control.

4.4 Contractors shall immediately, verbally report, and promptly thereafter confirm in writing, to the Owner and Architect any unsafe practices or conditions that are observed which are not under the Contractor's control.

4.5 The Contractor's Superintendent or Safety Supervisor shall insure that adequate first aid supplies are available, and that personnel are qualified to administer first aid/CPR, as required by State and/or Federal regulations.

4.6 Contractor shall promptly notify Owner and Architect of any personal injury requiring medical treatment of any of the Contractor's employees at the Project site; or of significant damage to property arising in connection with Contractor's performance, as promptly as possible after the occurrence of such injury or damage. Within forty-eight hours of such

occurrence, Contractor shall furnish to Owner and Architect a complete written report of such injury or damage.

4.7 Contractor certifies that the forgoing terms shall be made applicable to all Contractors' suppliers, materialmen or anyone furnishing labor and/or materials to the site.

4.8 The Contractor shall continue to educate his job Safety Supervisor or Superintendent of their responsibilities, which shall include:

1. Instructing workers and subcontractors under its supervision in safe work practices and work methods at the time they are given work assignments.

2. Ensuring that its workers and subcontractors have and use the proper protective equipment and suitable tools for the job.

3. Continuously checking to see that no unsafe practices or conditions are allowed to exist on any part of his job.

4. Acquainting its workers and subcontractors with all applicable safety requirements and seeing that they are enforced.

5. Setting a good example for his workers.

6. Making a complete investigation of accidents to determine facts necessary to take corrective action.

7. Holding weekly "tool box" safety meetings with his men to:

   a. Discuss observed unsafe work practices or conditions including a review of current safety report.

   b. Review the accident experience of his crew and discuss correction of accident causes.

   c. Encourage safety suggestions from his men.

8. Seeing that prompt medical treatment is administered to an injured employee.

9. Correcting or reporting immediately to job superintendent any observed unsafe conditions, practices or violations of job security.

10. Making all reports required by these Contract Documents in a full and timely fashion.

5. SAFETY MEETINGS

5.1 The Contractor's Project Manager or Superintendent shall attend weekly or biweekly supervisory job meetings. The first topic of these meetings will be job site safety. The weekly safety reports will be reviewed and violations must be corrected immediately. Contractors will be encouraged to participate in the on-going jobsite safety.

6. TOOL BOX SAFETY MEETINGS

6.1 The Contractor shall schedule weekly "tool box" safety sessions to be held by his job safety supervisor or superintendent for all of his employees.

6.2 A member of the Contractor's management staff shall periodically attend "tool box" safety sessions to evaluate their effectiveness and offer any appropriate suggestions for improvement.

7. REPORTS

7.1 Contractors shall report all accidents or injuries on a timely basis in accordance with all applicable regulations.

7.2 Contractors shall promptly complete an accident investigation report of all accidents.

7.3 A record of all "tool box" safety sessions shall be made.

8. FALL PROTECTION PROCEDURES

8.1 Contractor is responsible, in accordance with federal, state, local laws and regulations including OSHA. to provide and enforce their own site specific fall protection program and equipment. The following fall protection procedures shall be enforced by all Contractors as a minimum standard.

All workers on walking/working surfaces with unprotected sides or edges six feet (6') or higher above the next lower level must be protected from falls by the use of guardrail systems, net systems, fall arrest systems or control access zone programs. It is intended that when fall protection is required, it is required 100% of the time. All contractors are reminded that relevant industry regulations require that contractors comply with the following standards.

1. Workers constructing or working near leading edges must be protected.

2. Workers on the face of formwork or reinforcing steel must be protected at a height of 6 feet (6') or greater.

3. Scaffolds shall be guarded at 6 feet (6') above next lower level.

4. Brick layers performing overhand bricklaying and related work six feet (6') or higher above lower levels must be protected from falls.

5. Roofers must comply with OSHA standards for roof work.

6. The Contractor's controlled access zone plan shall be included in their site-specific safety program and shall be submitted prior to the start of work. Contractors are responsible for assuring programs are OSHA compliant.

7. Guidelines for Residential Construction or any interpretations will not be accepted in lieu of 1926 Standards.

8.2 Contractor shall provide its own fall protection. Fall protection may be provided by guardrail systems, net systems, or personal fall arrest systems. All fall protection systems must comply

with OSHA standards.

8.3 Stepladders, exposed to shafts or edges of the building, greater than six feet (6') above the next lower level, must be tied off or otherwise secured. Employee must wear fall protection, i.e. harness/lanyard.

8.4 The Safety Cable System shall not be altered or removed without a written request submitted to the Project Manager with a copy to the Field Manager. It shall be the responsibility of each and every Contractor that is removing or altering the Safety Cable System to maintain the fall protection safety provided by the safety cable and not leave the area unprotected. Each and every Contractor shall be responsible to re-install the Safety Cable System immediately after work is completed. Each and every Contractor shall be responsible to re-install the Safety Cable System in accordance to OSHA standards.

8.5 Fall protection will be enforced for Structural Steel Erectors.

1. As for a Contractor engaged in structural steel erection, the Contractor is specifically advised that structural steel erectors shall comply with all protection requirements for all work at a height of six feet (6') or greater above the next lower level, 100 percent of the time, by any of the following means.

   a. Standard guardrail system.

   b. Personal Fall Arrest System (PFAS) – full body harness with shock absorbing lanyard. Maximum free fall distance permitted, with lanyard and lanyard attachment shall not exceed six feet (6'). Anchor point must be capable of supporting five thousand pounds. Perimeter guard cables or alignment cables may not be used for anchor points.

   c. Access to work area shall be provided by ladders. There shall be sufficient number of ladders available to reduce the amount of "beam walking." When it is absolutely necessary to traverse a beam, 100% fall protection must be utilized.

   d. Steel erection Contractors must, at all times, be able to certify in writing that each of his employees has been properly trained in both OSHA fall protection standards and the Contractor's site specific project fall protection procedures.

   e. Prior to the erection of the steel, the Contractor shall meet with the Project Manager and Safety Representatives to review and document site specific procedures.

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:
1. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to

show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data : For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections in Divisions 02 through 33.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.

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

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify

agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and re-inspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

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

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

PRIVATE tbl1

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AAADM	American Association of Automatic Door Manufacturers www.aaadm.com	(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
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists www.aatcc.org	(919) 549-8141
ABAA	Air Barrier Association of America www.airbarrier.org	(866) 956-5888
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 367-1155

ACI	American Concrete Institute www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association (Now part of CPA)	
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150

ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
AOSA	Association of Official Seed Analysts, Inc. www.aosaseed.com	(405) 780-7372
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA EWS	APA - The Engineered Wood Association; Engineered Wood Systems (See APA - The Engineered Wood Association)	
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500
AWCI	Association of the Wall and Ceiling Industry www.awci.org	(703) 534-8300

AWCMA	American Window Covering Manufacturers Association (Now WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	(571) 323-3636
AWPA	American Wood Protection Association (Formerly: American Wood Preservers' Association) www.awpa.com	(205) 733-4077
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BICSI	BICSI, Inc. www.bicsi.org	(800) 242-7405 (813) 979-1991
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
BISSC	Baking Industry Sanitation Standards Committee www.bissc.org	(866) 342-4772
BWF	Badminton World Federation (Formerly: IBF - International Badminton Federation) www.internationalbadminton.org	6-03-9283 7155
CCC	Carpet Cushion Council www.carpetcushion.org	(610) 527-3880
CDA	Copper Development Association www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(613) 230-9263
CEA	Consumer Electronics Association www.ce.org	(866) 858-1555 (703) 907-7600

CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CRRC	Cool Roof Rating Council www.coolroofs.org	(866) 465-2523 (510) 485-7175
CPA	Composite Panel Association www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
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
CSA	Canadian Standards Association	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Cast Stone Institute www.caststone.org	(717) 272-3744
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700

CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eima.com	(800) 294-3462 (770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association (Electrostatic Discharge Association) www.esda.org	(315) 339-6937
ETL SEMCO	Intertek ETL SEMCO (Formerly: ITS - Intertek Testing Service NA) www.intertek.com	(800) 967-5352
FIBA	Federation Internationale de Basketball (The International Basketball Federation) www.fiba.com	41 22 545 00 00
FIVB	Federation Internationale de Volleyball (The International Volleyball Federation) www.fivb.ch	41 21 345 35 35
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000
FMRC	Factory Mutual Research (Now FM Global)	
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772

FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fsc.org	49 228 367 66 0
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America www.glasswebsite.com	(785) 271-0208
GRI	(Part of GSI)	
GS	Green Seal www.greenseal.org	(202) 872-6400
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (Part of NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (Now CSA International)	
IBF	International Badminton Federation (Now BWF)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission	41 22 919 02 11

	www.iec.ch	
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IEST	Institute of Environmental Sciences and Technology www.iest.org	(847) 255-1561
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(877) 464-7732 (702) 567-8150
ITS	Intertek Testing Service NA (Now ETL SEMCO)	
ITU	International Telecommunication Union www.itu.int/home	41 22 730 51 11
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association (Now part of CPA)	
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association, Inc. www.maplefloor.org	(888) 480-9138

MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(630) 942-6591
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAGWS	National Association for Girls and Women in Sport www.aahperd.org/nagws/	(800) 213-7193, ext. 453
NAIMA	North American Insulation Manufacturers Association www.naima.org	(703) 684-0084
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCAA	National Collegiate Athletic Association (The) www.ncaa.org	(317) 917-6222
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094

NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-2300
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.netaworld.org	(888) 300-6382 (269) 488-6382
NFHS	National Federation of State High School Associations www.nfhs.org	(317) 972-6900
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(866) 342-5642 (703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association) www.nofma.com	(901) 526-5016
NOMMA	National Ornamental & Miscellaneous Metals Association www.nomma.org	(888) 516-8585
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400

NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo & Mosaic Association, Inc. (The) www.ntma.com	(800) 323-9736 (540) 751-0930
NTRMA	National Tile Roofing Manufacturers Association (Now TRI)	
NWWDA	National Wood Window and Door Association (Now WDMA)	
OPL	Omega Point Laboratories, Inc. (Now ITS)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting & Decorating Contractors of America www.pdca.com	(800) 332-7322 (314) 514-7322
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.ce.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network (Formerly: ACLA - Associated Landscape Contractors of America) www.landcarenetwork.org	(800) 395-2522 (703) 736-9666
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute www.rfci.com	(301) 340-8580
RIS	Redwood Inspection Service www.redwoodinspection.com	(888) 225-7339 (415) 382-0662

SAE	SAE International www.sae.org	(877) 606-7323 (724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabs.com	(877) 294-5424 (516) 294-5424
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234
SIA	Security Industry Association www.siaonline.org	(866) 817-8888 (703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (Now IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association www.smacentral.org	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers www.smpte.org	(914) 761-1100
SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPRI	Single Ply Roofing Industry www.spri.org	(781) 647-7026

SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (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. (Now TCNA)	
TCNA	Tile Council of North America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(703) 683-1010
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 649-5555
TRI	Tile Roofing Institute www.tileroofing.org	(312) 670-4177
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USAV	USA Volleyball www.usavolleyball.org	(888) 786-5539 (719) 228-6800
USGBC	U.S. Green Building Council www.usgbc.org	(800) 795-1747

USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
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 www.wcmanet.org	(212) 297-2122
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 297-2109
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WI	Woodwork Institute (Formerly: WIC - Woodwork Institute of California) www.wicnet.org	(916) 372-9943
WIC	Woodwork Institute of California (Now WI)	
WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 570-5441
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

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

IAPMO	International Association of Plumbing and Mechanical Officials www.iapmo.org	(909) 472-4100
ICC	International Code Council www.iccsafe.org	(888) 422-7233

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

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

CE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-7923
DOC	Department of Commerce www.commerce.gov	(202) 482-2000
DOD	Department of Defense http://.dodssp.daps.dla.mil	(215) 697-6257
DOE	Department of Energy www.energy.gov	(202) 586-9220
EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
FAA	Federal Aviation Administration www.faa.gov	(866) 835-5322
FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(800) 488-3111
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-4000
NCHRP	National Cooperative Highway Research Program (See TRB)	

NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Buildings Service (See GSA)	
PHS	Office of Public Health and Science www.osophs.dhhs.gov/ophs	(202) 690-7694
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board http://gulliver.trb.org	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

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

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
DSCC	Defense Supply Center Columbus (See FS)	

FED-STD	Federal Standard (See FS)	
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
	Available from Defense Standardization Program www.dps.dla.mil	
	Available from General Services Administration www.gsa.gov	(202) 619-8925
	Available from National Institute of Building Sciences www.wbdg.org/ccb	(202) 289-7800
FTMS	Federal Test Method Standard (See FS)	
MIL	(See MILSPEC)	
MIL-STD	(See MILSPEC)	
MILSPEC	Military Specification and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

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

CBHF	State of California, Department of Consumer Affairs Bureau of Home Furnishings and Thermal Insulation www.dca.ca.gov/bhfti	(800) 952-5210 (916) 574-2041
CCR	California Code of Regulations www.calregs.com	(916) 323-6815
CPUC	California Public Utilities Commission www.cpuc.ca.gov	(415) 703-2782
TFS	Texas Forest Service Forest Resource Development	(979) 458-6650

http://txforestservice.tamu.edu

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations. Contractor is responsible for dislocating hoses and verifying water is turned off at water source locations. Where hose bibbs and valves are secured, contractor to verify they are secured at the end of the work day

C. Electric Power Service from Existing System: Power will be available on site for contractor use. Contractor will be responsible for all power usage charges.
1. The contractor is responsible for providing any additional power, or higher voltages not available from on site power. This can be provided by metered temporary power, or on-site generator.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Field office is not required. Contractor will be responsible for providing on site location for access to drawings and submittals

B. Storage and Fabrication areas or structures: Provide secure storage areas or structures to accommodate materials and equipment for construction operations.
   1. Coordinate location of storage areas with owner.
      a. Do not affect fire lane access
      b. Do not affect general access to site
   2. Obtain approval and coordinate location of long term storage with owner

C. Provide temporary toilets for use until permanent facilities are installed.
   1. Coordinate location with current tenant to not affect fire lane access, or general access to site, or access/egress from occupied space
   2. Contractor is responsible for securing and maintenance of temporary facilities.
      a. Arrange for regular emptying and cleaning of facility
      b. Ensure security of toilet at the end of the work day

D. Provide temporary drinking water and wash facilities for use of construction personnel

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Provide land line or reliable cellular service phone on site for communication with architect, owner and others associated with the project in a timely manner

PART 3 - EXECUTION

3.1 PARKING AND LAYDOWN SPACE

A. Parking: Parking for contractors, subcontractors and suppliers shall only be in identified areas

B. Staging, Storage, and construction lay down space shall be only in areas identified, or coordinated with tenant and client

C. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

D. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.2 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. The contractor is responsible for the providing locks and security of the job site and equipment during the construction. The owner is to be provided with keys to the lock.

B. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

C. Barricades, Warning Signs, covered walkways etc. to protect persons and property
1. Contractor is responsible for repair of any vehicles or equipment owned and not owned by the school caused by work associated with this project including damage during deliveries

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:
   1. Division 01 Section "Substitution Procedures" for requests for substitutions.
   2. Division 01 Section "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

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

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

1.5 QUALITY ASSURANCE

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

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See Divisions 02 through 33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    b. Non-restricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    b. Non-restricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers.

Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

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

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 62 00 - MATERIAL AND EQUIPMENT

1. GENERAL CONDITIONS

1.1 The general provisions of the Contract, including the Conditions of the Contract (General, Supplementary and other Conditions, if any) and Division 1 as appropriate apply to the Work specified in this Section.

1.2 Where work is to be executed under Separate Prime Contracts, the provisions of this Section apply to each Contract.

2. REQUIREMENTS INCLUDED

2.1 All materials and equipment incorporated into the Work shall:

1. Be new;
2. Conform to applicable specifications and standards; and
3. Comply with size, make, type and quality specified, or as specifically approved in writing by the Architect / Engineer.

2.2 Manufactured and Fabricated Products shall conform to the following requirements:

1. Designed, fabricated and assembled in accord with the best engineering and shop practices.

2. Manufactured like parts of duplicate units to standard sizes and gauges, to be interchangeable.

3. Two or more items of the same kind shall be identical, by the same manufacturer.

4. Products shall be suitable for service conditions.

5. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

2.3 Contractor shall not use materials or equipment for any purpose other than that for which it is designated or is specified.

2.4 Materials removed form existing structures shall not be reused in the completed work unless specifically indicated or specified.

2.5 For materials and equipment specifically indicated or specified to be reused in the Work:

1. Contractor shall use special care on removal, handling storage and reinstallation, to assure proper function in the completed Work.

2. Arrange for transportation, storage and handling of products which require off-site storage, restoration or renovation. Pay all costs for such work.

3. MANUFACTURER'S INSTRUCTIONS

3.1 When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, Contractor shall obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Construction Manager.

1. Maintain one set of complete instructions at the job site during installation and until completion.

3.2 Contractor shall handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, Contractor shall consult with Construction Manager for further instructions.

2. Contractor shall perform work in accord with manufacturer's instructions. Contractor shall not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

4. TRANSPORTATION AND HANDLING

4.1 Contractor shall arrange deliveries of Products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.

1. Deliver Products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

2. Contractor shall immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.

4.2 Contractor shall provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

5. STORAGE AND PROTECTION

5.1 Contractor shall store Products in accord with manufacturer's instructions, with seals and labels intact and legible.

1. Contractor shall store Products subject to damage by the elements in weathertight enclosures.

2. Contractor shall maintain temperature and humidity within the ranges required by manufacture's instructions.

5.2 Exterior Storage

1. Contractor shall store fabricated Products above the ground, on blocking or skids, to prevent soiling or staining. Cover Products which are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
2. Contractor shall store loose granular materials in a well-drained area on soiled surfaces to prevent mixing with foreign matter.

5.3 Contractor shall arrange storage in a manner to provide easy access for inspection. Contractor shall make periodic inspections of stored Products to assure that Products are maintained under specified conditions, and free from damage or deterioration.

5.4 Contractor shall store flammable materials so as to prevent contact with flames and fire. Conform with manufacturer's recommendations and local laws. Pay particular attention to storage of:

1. Roof insulation.
2. Roofing materials, including solvents.
3. Cleaning and other solvents.
4. Fuels.

5.5 Protection after Installation:

1. Contractor shall provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove when no longer needed.

6. SUBSTITUTIONS AND PRODUCT OPTIONS

6.1 Product List.

1. Within 30 days after Contract Date, Contractor shall submit to Construction Manager a complete list of major products proposed to be used, with the name of the manufacturer and the installing Contractor.

6.2 Contractor's Options.

1. For Products specified only by reference standard, Contractor shall select any Product meeting that standard.

2. For Products specified by naming several Products or manufacturers, Contractor shall select any one of the Products or manufacturers named which complies with the specifications.

3. For Products specified by naming one or more Products or manufacturers and "or equal", Bidders must, during the bidding period, submit a request for substitutions for any Product or manufacturer not specifically named. See provisions in Paragraph 1.6.3.

4. For Products specified by naming only one Product and manufacturer, there is no option; and Contractor shall provide the precise Product specified.

6.3 Substitutions.

1. Until a date no later than ten (10) days before the date Bids are due, Architect will consider written requests from bidders for substitution of Products. Architect will review requests and will notify Bidders in an Addendum if the requested substitution is acceptable.

2. Should the Bidder desire a substitution, it shall submit a separate request for each Product, supported with complete data, with drawings and samples as appropriate, including:

    1. Comparison of the qualities of the proposed substitution with that specified.

    2. Changes required in other elements of the Work because of the substitution.

    3. Effect on the construction schedule.

    4. Cost data comparing the proposed substitution with the Product specified.

    5. Any required license fees or royalties.

    6. Availability of maintenance service, and source of replacement materials.

3. Architect, in its sole discretion, shall be the judge of the acceptability of the proposed substitution.

4. A request for a substitution constitutes a representation that Bidder:

    1. Has investigated the proposed Product and determined that it is equal to or superior in all respects to that specified;

    2. Will provide the same warranties or bonds for the substitution as for the Product specified;

    3. Will coordinate the installation of an accepted substitution into the Work, and make such other changes as may be required to make the Work complete in all respects; and

    4. Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.

6.4 Architect will review requests for substitutions with reasonable promptness, and notify Bidders, in writing, through the Construction Manager, of the decision to accept or reject the requested substitution. Any decision to accept a substitution must be confirmed in an Addendum issued during the bidding period in order to be valid. Oral approvals will not be binding.

6.5 MATERIAL LOADING LOGISTICS: Any and all costs associated with stocking the job with labor and material and other site logistical issues such as parking, off hours stocking shall be INCLUDED in the BASE BID for this project.

END OF SECTION

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Coordination of Owner-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of the Work.

B. Related Requirements:

1. Division 01 Section "Summary" for limits on use of Project site.
2. Division 01 Section "Submittal Procedures" for submitting surveys.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Certified Surveys: Submit two copies signed by professional engineer.

E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 sustainable design requirements Section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

3.2 PREPARATION

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

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

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Pre-installation Conferences: Include Owner's construction personnel at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Division 01 Section "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

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.

H. Universal waste components (UWC) are as follows: electric motors, PCB ballasts, non PCB ballasts, capacitors, contactors, circuit breakers, elemental and liquid mercury containing articles, transformers, lead acid batteries, fluorescent light bulbs, and all HID light bulbs.

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.

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.

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

C. 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.

D. 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
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.

1.6 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;
    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

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.

3.4 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.

3.5 UNIVERSAL WASTE DIVERSION

A. Remove all universal waste from fixtures, panels, and related devices for proper diversion and reclamation.

B. Store all universal waste in containers provided by contact person within facilities operations.

C. Store all universal waste in a secured location and request periodic removal from assigned contact person.

D. Exemption: electric motors, circuit breakers, transformers and lighting contactors are exempt from this provision provided the contractor chooses to salvage or reuse the components.

E. No identified universal waste will be discarded into the waste stream.

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)	

END OF SECTION

SECTION 01 77 00 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
2. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
   3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number where applicable.

      a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

   5. Submit test/adjust/balance records.
   6. Submit sustainable design submittals required in Division 01 sustainable design requirements Section and in individual Division 02 through 33 Sections.
   7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

   1. Advise Owner of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   3. Complete startup and testing of systems and equipment.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.
   5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
   6. Advise Owner of changeover in heat and other utilities.
   7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
   8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   9. Complete final cleaning requirements, including touchup painting.
   10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection 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.

1.7 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.

B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Submit list of incomplete items in the following format:

a. PDF electronic file. Architect will return annotated copy.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
B. 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, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
    2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
    3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
    4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

    1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

    1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
        a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
        b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
        c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

    1.) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.

p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.

3.2 REPAIR OF THE WORK

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

    1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
    2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF CLOSEOUT PROCEDURES

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Requirements:
   1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   2. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set(s) of marked-up record prints.
   2. Number of Copies: Submit copies of record Drawings as follows:
      a. Final Submittal:
         1) Submit PDF electronic files of scanned record prints and three set(s) of prints.
         2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCT

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised Drawings as modifications are issued.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Record data as soon as possible after obtaining it.
c. Record and check the markup before enclosing concealed installations.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file **with comment function enabled**.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Note related Change Orders and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

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

B. Format: Submit record Product Data as annotated PDF electronic file

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

B. Related Requirements:

1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project record documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.

c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

DIVISION 01 SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS
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SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Dra wings 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:

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.
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 compliance with the Contract Documents. Operation and maintenance documentation requirements are specified in Division 01 Section "Operation and Maintenance Data."

L. Assemble the final commissioning documentation, including the commissioning report and Project Record Documents.

1.8 COMMISSIONING DOCUMENTATION

A. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.
2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
3. Identification of systems and equipment to be commissioned.
4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
5. Identification of items that must be completed before the next operation can

proceed.

6. Description of responsibilities of commissioning team members.
7. Description of observations to be made.
8. Description of requirements for operation and maintenance training, including required training materials.
9. Description of expected performance for systems, subsystems, equipment, and controls.
10. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.
11. Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase.
12. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.
13. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.
14. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

B. Test Checklists: CxA, with assistance of Contractor and Subcontractors, shall develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Specific checklist content requirements are specified in Division 01 Section "HVAC Commissioning Requirements", "Electrical Commissioning Requirements" and "Plumbing System Commissioning Requirements". Test checklists will be jointly developed as the project progresses. Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested item.
2. Test number.
3. Time and date of test.
4. Indication of whether the record is for a first test or retest following correction of a problem or issue.
5. Dated signatures of the person performing test and of the witness, if applicable.
6. Individuals present for test.
7. Deficiencies.
8. Issue number, if any, generated as the result of test.

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

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

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

F. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

1. Creating an Issues Log Entry:

   a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.
   b. Assign a descriptive title of the issue.
   c. Identify date and time of the issue.
   d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
   e. Identify system, subsystem, and equipment to which the issue applies.
   f. Identify location of system, subsystem, and equipment.
   g. Include information that may be helpful in diagnosing or evaluating the issue.
   h. Note recommended corrective action.
   i. Identify commissioning team member responsible for corrective action.
   j. Identify expected date of correction.
   k. Identify person documenting the issue.

2. Documenting Issue Resolution:

   a. Log date correction is completed, or the issue is resolved.
   b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
   c. Identify changes to the Contract Documents that may require action.
   d. State that correction was completed and system, subsystem, and equipment is ready for retest, if applicable.
   e. Identify person(s) who corrected or resolved the issue.
   f. Identify person(s) documenting the issue resolution.

3. Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, CxA shall prepare a written narrative for review of outstanding issues and a status update of the issues log. As a minimum, CxA shall include the following information in the issues log and expand it in the narrative:

   a. Issue number and title.
   b. Date of the identification of the issue.
   c. Name of the commissioning team member assigned responsibility for resolution.
   d. Expected date of correction.

G. Commissioning Report: CxA shall document results of the commissioning process

including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the Contract Documents. The commissioning report shall include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances in the Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.
2. Commissioning plan.
3. Testing plans and reports.
4. Corrective modification documentation.
5. Issues log.
6. Completed test checklists.
7. 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."

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.

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 GENERAL COMMISSIONING REQUIREMENTS

DIVISION 01 SECTION 01 91 14
PLUMBING COMMISSIONING REQUIREMENTS
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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. Bottle filling Stations.
3. Condensate neutralizers.
4. Domestic hot water expansion tank.
5. Domestic hot water heater.
6. Domestic hot water re-circulating system.
7. Electric water coolers.
8. Gas pressure regulators.
9. High/low mixing valves.
10. Plumbing fixtures.
11. Plumbing pumps.

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.

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. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
iii. 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.
iv. 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.

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.

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. Discharge temperatures of water heaters.
    c. Flow rates for domestic re-circulating systems.
    d. High/low and thermostatic mixing valve temperatures and water flow rates.
    e. Re-circ. pump pressures and flow rates.
    f. Water heater temperatures and set points.
    g. Temperature and flow rate of electric water coolers and bottle filling stations.

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 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 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 temperature of high/low mixing valves.
6. Test discharge of water at all trap priming stations.
7. Verify that all backflow preventers have been tested. Document in writing.
8. Test domestic water heater.
9. Test operation, set points, and safeties of water heater.
10. Test all electric water coolers and bottle filling stations.

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 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, domestic re-circulating systems, backflow preventers, plumbing fixtures, and high/low 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 PLUMBING COMMISSIONING REQUIREMENTS

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HVAC COMMISSIONING REQUIREMENTS
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SECTION 01 91 15 - 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. Automatic Temperature Control System.
2. Carbon Monoxide Detector.
3. Condensate overflow alarms.
4. Condensate pumps.
5. Condensing Units.
6. Motor Operated Dampers.
7. Duct smoke detectors.
8. Ductless heat pump units.
9. Electric Heaters.
10. Exhaust Fans.
11. HVAC controls and sequences of operation.
12. Packaged terminal heat pumps.
13. Relative Humidity Sensors.
14. Refrigerant Leak Detectors Sensors/Refrigerant Mitigation Controls.
15. Split System Heat Pump Units.
16. Thermostats/Humidistats.
17. Unit Heaters.

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 and water flow rates have been specified and compared to central equipment output capacities.

b. Identify discontinuities and omissions in the Contract Documents.

c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

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 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. Duct Smoke detectors operation and interlocks with fire alarm system.
    c. Ductless heat pump units with air flow rates, and temperatures.
    d. Electric heating equipment volts, amps, and temperature rise.
    e. Head pressure controls for air cooled heat pump units.
    f. Minimum outdoor-air intake in each operational mode.
    g. Operation of heat pump units in both heating and cooling cycles.
    h. Sequences of operation of all HVAC equipment.
    i. Split system heat pump units.
    j. Supply and return air flow rates for all HVAC equipment.
    k. Total exhaust airflow and total outdoor-air intake.
    l. Unit heaters operation and control.
    m. Refrigerant mitigation controls, refrigerant leak detection sensor operation and fan speed increase/refrigerant system shutdown controls.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load. Operational modes include the following:

1. Heating/Cooling Mode.
2. Occupied and unoccupied.
3. Warm up and cool down.
4. Emergency power supply.
5. Life-safety and safety systems.
6. Duct detectors.
7. Fire safety.
8. Temporary upset of system operation.
9. Partial occupancy conditions.
10. Special cycles.
11. All alarms.
12. Condensate overflow safety switch shut-down and alarm.
13. Condensate pump operation.

3.2 TAB VERIFICATION

A. TAB Subcontractor shall coordinate with CxA for work required in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing." TAB Subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Contractor, HVAC Contractor, and CxA shall witness TAB Work.

C. TAB Preparation:

1. TAB Subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

    a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.
2. CxA shall notify TAB Subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item is defined as follows:

    a. For all readings a deviation of more than 10 percent.

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

E. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

F. CxA shall certify that TAB Work has been successfully completed.

3.3 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. 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.

H. Heat-Generation System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air handling units, heat pumps, unit heaters, ductless heat pumps. 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 ductless units, refrigerant mitigation controls, heat pump units, unit heaters, 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 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 HVAC COMMISSIONING REQUIREMENTS

DIVISION 01 SECTION 01 91 16
ELECTRICAL SYSTEMS COMMISSIONING REQUIREMENTS
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SECTION 01 91 16 - ELECTRICAL SYSTEMS COMMISSIONING REQUIREMENTS

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. Fire Alarm System.

2. Interior lighting and associated controls.

3. Exterior lighting and associated controls.

4. Electrical distribution system.

a. Main switchboard.
b. Distribution panelboards.
c. Motor starters.
d. Lighting contactors.

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.

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.

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 the system being tested.

7. Check safety cutouts, alarms, and interlocks and 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.
    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 emergency generator, electrical distribution systems, fire alarm system, exterior lighting control systems. 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 system to verify proper operation of the electrical 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 ELECTRICAL SYSTEMS COMMISSIONING REQUIREMENTS

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SECTION 02 41 19 - SELECTIVE DEMOLITION

TIPS:

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

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

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on the use of the premises, Christina School District-occupancy requirements, and phasing requirements.
2. Section 013591 "Historic Treatment Procedures" for historic removal and dismantling.
3. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
4. Section 017300 "Execution" for cutting and patching procedures.
5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Christina School District[**ready for reuse**].

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS CHRISTINA SCHOOL DISTRICTSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Christina School District that may be uncovered during demolition remain the property of Christina School District.

1. Carefully salvage in a manner to prevent damage and promptly return to Christina School District.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at [**Delaware School for the Deaf**] <**Insert location**>.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.
6. <**Insert agenda items**>.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property [**, for environmental protection**] [**, for dust control**] [**and**] [**, for noise control**]. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Christina School District's [**building manager's**] [**and**] [**other tenants'**] on-site operations are uninterrupted.

2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Christina School District's continuing occupancy of portions of existing building and of Christina School District's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Christina School District prior to start of demolition.

E. Predemolition Photographs or Video: Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

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

1.8 QUALITY ASSURANCE

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

1.9 FIELD CONDITIONS

A. Christina School District will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Christina School District's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Christina School District as far as practical.

1. Before selective demolition, Christina School District will remove the following items:

a. <**Insert items to be removed by Christina School District**>.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Christina School District before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Christina School District. Hazardous materials will be removed by Christina School District under a separate contract.

E. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Christina School District will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.

F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by [**12 inches (300 mm)**] <**Insert dimension**> or more.

G. Storage or sale of removed items or materials on-site is not permitted.

H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.10 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

1. <**Insert warranted system**>.

B. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

C. LEED Requirements for Building Reuse:

1. Credit MR 1.1[**and Credit MR 1.2**]: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
3. Credit MR 1.2[**and Credit MR 1.3**]: Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Christina School District. Christina School District does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. [**Perform**] [**Engage a professional engineer to perform**] an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
2. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

F. Survey of Existing Conditions: Record existing conditions by use of [**measured drawings**] [**preconstruction photographs**] [**preconstruction videotapes**] [**and**] [**templates**].

1. Comply with requirements specified in Section 013233 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide [**photographs**] [**or**] [**video**] of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. [**Christina School District**] [**Building manager**] will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Christina School District.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

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

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and

chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain[**fire watch and**] portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.[**Comply with requirements in Section 017419 "Construction Waste Management and Disposal."**]

B. Work in Historic Areas: Selective demolition may be performed only in areas of the Project that are not designated as historic. In historic spaces, areas, and rooms or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 013591 "Historic Treatment Procedures."

C. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

1. Building Structure and Shell: [**75**] [**100**] percent.
2. Nonshell Elements: 50 percent.
3. Nonshell Elements: [**40**] [**60**] percent.

D. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Christina School District.
4. Transport items to Christina School District's storage area [**on-site**] [**off-site**] [**designated by Christina School District**] [**indicated on Drawings**].
5. Protect items from damage during transport and storage.

E. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition[**and cleaned**] and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."[**Do not use methods requiring solvent-based adhesive strippers.**]

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section <**Insert Section number**> "<**Insert Section title**>" for new roofing requirements.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be[**recycled,**] reused, salvaged, reinstalled, or otherwise indicated to remain Christina School District's property, remove demolished materials from Delaware School for the Deaf[**and legally dispose of them in an EPA-approved landfill**].

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Burning: Burning of demolished materials will be permitted **only at designated areas on Christina School District's property,** provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

D. Disposal: Transport demolished materials and dispose of at designated spoil areas on Christina School District's property.

E. Disposal: Transport demolished materials off Christina School District's property and legally dispose of them.

3.7 CLEANING

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

3.8 SELECTIVE DEMOLITION SCHEDULE

A. Existing [**Items**] [**Construction**] to Be Removed: <**Insert description of items and construction to be removed**>.

B. Existing Items to Be Removed and Salvaged: <**Insert description of items to be removed and salvaged**>.

C. Existing Items to Be Removed and Reinstalled: <**Insert description of items to be removed and reinstalled**>.

D. Existing Items to Remain: <**Insert description of items to remain**>.

END OF SECTION 024119

SECTION 03 01 30- MAINTENANCE OF 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:

1. Polymer-modified, self-leveling, cementitious wear topping.

2. Manufactured bonding agent

3. Formwork

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at **Project site, 630 E. chestnut Hill Road Newark, DE 19713**

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

B. Samples: Cured samples for each exposed product and for each color and texture specified, **in manufacturer's standard size appropriate for type of work**.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **installers and manufacturers**.

B. Material Certificates: For each type of **aggregate** supplied for mixing or adding to products at Project site.

C. Product Test Reports: For each **manufactured bonding agent** and **polymer-modified cementitious wear topping**, for tests performed by manufacturer and witnessed by a qualified testing agency

D. Field quality-control reports.

E. Maintenance Program: Submit before work begins.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Each **manufactured bonding-agent** and **polymer-modified cementitious wear topping** manufacturer shall employ factory-trained technical representatives who are available for consultation and Project-site inspection and assistance at no additional cost.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer to apply **manufactured bonding-agent** and **polymer-modified cementitious wear topping materials**

C. Maintenance Program: Prepare a written plan for maintenance of cast-in-place concrete, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

B. Store cementitious materials off the ground, under cover, and in a dry location.

C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.8 FIELD CONDITIONS

A. Cold-Weather Requirements for Cementitious Materials: Do not apply unless concrete-surface and air temperatures are above 40 deg F (5 deg C) and will remain so for at least 48 hours after completion of Work.

B. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F (32 deg C) and above.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain each color, grade, finish, type, and variety of product from single source with resources to provide products of consistent quality in appearance and physical properties.

B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

2.2 MANUFACTURED BONDING AGENTS

A. Epoxy Bonding Agent: ASTM C881/C881M, bonding system **Type II** and free of VOCs. Provide combined Part A and Part B components consisting of 25 percent or more of waste stream ingredients.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Kaufman Products, Inc.; **SurePoxy HM** or comparable product by one of the following:
   a. Euclid Chemical Company (The); an RPM company.
   b. Dayton Superior Corporation.

2.3 **POLYMER-MODIFIED CEMENTITIOUS WEAR TOPPING**

A. **polymer-modified cementitious wear topping**, General:

1. Only use **polymer-modified cementitious wear topping** mortars that are recommended by manufacturer for each applicable horizontal orientation.
2. Coarse Aggregate for Patching Mortar: ASTM C 33, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. **polymer-modified cementitious wear topping mortar**: Packaged, dry mix, for resurfacing and leveling concrete.

1. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**:

2. Basis-of-Design Product: Subject to compliance with requirements, provide Kaufman; SureFlow 042 or comparable product by one of the following:

   a. Dayton Superior Corporation.
   b. Euclid Chemical Company (The); an RPM company.

3. Compressive Strength: Not less than **5000 psi (34.5 MPa)** at **28 days** when tested according to ASTM C 109/C 109M.

2.4 MIXES

A. General: Mix products, in clean containers, according to manufacturer's written instructions.

1. Do not add water, thinners, or additives unless recommended by manufacturer.
2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.

C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.

D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.2 PREPARATION

A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.

B. Preparation for Removal of Deteriorated Concrete: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.

1. Verify that affected utilities have been disconnected and capped.
2. Inventory and record the condition of items to be removed for reinstallation or salvage.

C. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.

1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
2. Use only proven protection methods appropriate to each area and surface being protected.
3. Provide barricades, barriers, and temporary directional signage to exclude public from areas where concrete maintenance work is being performed.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.
5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.
7. Protect floors and other surfaces along haul routes from damage, wear, and staining.
8. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
9. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape **or a liquid strippable masking agent**. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
10. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
11. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

D. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.

1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

E. Surface Preparation for Overlays:

1. Remove delaminated material and deteriorated concrete surface material.
2. Roughen surface of concrete to produce a surface profile matching CSP range recommended by manufacturer according to ICRI 310.2.
3. Use **manufacturer approved methods to achieve CSP range according to ICRI 310.2**.
4. Sweep and vacuum roughened surface to remove debris **followed by low-pressure water cleaning**.

3.3 APPLICATION

A. General: Comply with manufacturer's written instructions and recommendations for application of products, including surface preparation.

B. Epoxy Bonding Agent, Type II: Apply to **concrete** by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas. Place **polymer-modified cementitious wear topping** mortar or while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar or concrete.

C. Placing Patching Mortar: Place as follows unless otherwise recommended in writing by manufacturer:

1. Provide forms where necessary to confine patch to required shape according to ACI 301.
2. Wet substrate and forms thoroughly and then remove standing water only if required by premanufactured bonding agent.
3. Pretreatment: Apply specified **bonding agent**
4. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
5. Consolidation: After each lift is placed, consolidate material and screed surface.
6. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
7. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a **smooth surface with a wood or sponge float**.
8. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. ASTM C1583/C1583M-20 Standard Test Method for Tensile strength of concrete surfaces and the bond strength or tensile strength of concrete repair and overlay materials by direct tension (Pull-off Method)

C. Product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 05 40 00 - 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.

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.

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).

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).

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:

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.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon- steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of

sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire- resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 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.

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

SECTION 06 10 00 – ROUGH - CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Preservative treated wood materials.
- B. Fire retardant treated wood materials.
- C. Communications and electrical room mounting boards.
- D. Concealed wood blocking, nailers, and supports.

1.2 RELATED REQUIREMENTS
- A. Section 06 20 00 - Finish Carpentry
- B. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- C. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.3 REFERENCE STANDARDS
- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2023.
- F. PS 1 - Structural Plywood; 2023.
- G. PS 2 - Performance Standard for Wood Structural Panels; 2018.
- H. PS 20 - American Softwood Lumber Standard; 2021.

1.4 SUBMITTALS
- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and all items listed under products.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING
- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.6 WARRANTY
- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

A. Wall Sheathing: PS-1 type.
   1. Bond Classification: Exterior.
   2. Grade: Structural I Sheathing.
   3. Span Rating: 24.
   4. Performance Category: 3/4 PERF CAT.
   5. Edge Profile: Square edge.

B. Gypsum Wall Sheathing: See Section 09 21 16.

C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

D. Other Applications:
   1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
   2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
   3. Other Locations: PS 1, C-D Plugged or better.

2.4 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Anchors: Expansion shield and lag bolt type for anchorage to solid masonry or concrete.

2.5 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating

compliance with specified requirements.

2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Fire Retardant Treatment:
   1. Products:
      a. Arxada: www.arxada.com.
      b. Hoover Treated Wood Products, Inc: www.frtw.com/#sle.
      c. Koppers, Inc: www.koppersperformancechemicals.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat exterior rough carpentry items where indicated.
      c. Do not use treated wood in direct contact with the ground.
   3. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated .
      c. Treat communications and electrical room mounting boards.
      d. Do not use treated wood in applications exposed to weather or where the wood may become wet.

C. Preservative Treatment:
   1. Products:
      a. Arxada; _____ ; Wolman AG: www.arxada.com.
      b. Koppers Performance Chemicals, Inc; MicroPro: www.koppersperformancechemicals.com/#sle.
      c. Viance, LLC; Ecolife: www.treatedwood.com/#sle.
      d. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber exposed to weather.
      c. Treat lumber in contact with flashing or waterproofing.
      d. Treat lumber in contact with masonry or concrete.
      e. Treat lumber less than 18 inches above grade.
      f. Treat lumber in other locations as indicated.
   3. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
      a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.

b. Treat plywood in contact with flashing or waterproofing.
c. Treat plywood in contact with masonry or concrete.
d. Treat plywood less than 18 inches above grade.
e. Treat plywood in other locations as indicated.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.
B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
F. Separate preservative-treated wood from metal framing and aluminum with felt paper, 10-mil polyethylene sheet, or self-adhered transition membrane products (See Section 072500).
G. Provide the following specific nonstructural framing and blocking:
    1. Cabinets and shelf supports.
    2. Wall brackets.
    3. Handrails.
    4. Grab bars.
    5. Towel and bath accessories.
    6. Wall-mounted door stops.
    7. Chalkboards and marker boards.
    8. Wall paneling and trim.
    9. Joints of rigid wall coverings that occur between studs.
    10. TV and monitor mounts..

3.3 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.4 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.

1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.

3.5 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.6 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.7 CLEANING

A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.

1. Comply with applicable regulations.
2. Do not burn scrap on project site.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

END OF SECTION

SECTION 06 06 60 - TRANSLUCENT RESIN PANEL SYSTEM

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 the Plastic Fabrication as shown and specified in the described system(s):

1. engineered acrylic resin panel
2. Double ear wall mounting bracket

B. The extent of Solid Polymer Fabrication is shown on the drawings.

1. Additional fabrication and installation details from manufacturer's technical department, if applicable

1.3 ADMINISTRATIVE REQUIREMENTS

A. Project Pre-installation Meeting

1. Owner, Architect, Contractor, Installer to meet at project site within one week of scheduled installation.
2. Review mounting conditions, installation and storage instructions, fabrication requirements, seaming and protection measures.

1.4 SUBMITTALS

A. General: Submit the following in accordance with conditions of contact and Division 1 specification section 01 33 00 "Submittal Procedures".

B. Product Data: Submit manufacturer's product data; include product description, fabrication information, and compliance with specified performance requirements.

C. Submit product test reports from a qualified independent 3rd party testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Test reports required are:
   a. Flame Spread (ASTM D 635)
   b. Self-Ignition Temperature (ASTM D 1929)
   c. Smoke Density (ASTM D 2843)
   d. Steiner Tunnel (ASTM E84)
   e. Dynamic environmental testing (ASTM standards D 5116 or D 6670)
   f. Coefficient of Friction (ASTM 2047)

D. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.

E. Samples for Initial Selection:

1. Submit minimum 2-inch by 2-inch samples. Indicate full color, texture and pattern variation.

F. Samples for Verification:

1. Submit minimum 4-inch by 4-inch sample for each type, texture, pattern and color of solid plastic fabrication.

G. Mockups:

1. Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects.
2. Build mockup of engineered acrylic resin panel and attachment brackets.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications

1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least three (3) consecutive years and which can show evidence of those materials being satisfactorily used on at least three (3) projects of similar size, scope and location. At least one (1) of the projects shall have been successful for use one year or longer.
2. Manufactured panels must be produced from a minimum of 38% pre-consumer recycle content and 9% post-consumer recycled content or a minimum total recycled content factor of 0.20. This recycle content must be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).
3. Completely PVC – Free product
4. Manufacturer must offer a documented reclaim process that will take back, at the manufacturers cost, panels that are at their end-of life cycle.
5. Manufacturer must have an Environmental Product Declaration (EPD).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver engineered acrylic resin panel, and specified items in manufacturer's standard protective packaging.

B. Do not deliver engineered acrylic resin panel, components and accessories to Project site until areas are ready for installation.

C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements. Materials are to be protected against damage from moisture and direct sunlight.

D. Store engineered acrylic resin panel in area of installation minimum of 24 hours prior to installation.

E. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.

F. Before installing Plastic Fabrications, permit them to reach room temperature.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install Solid Polymer Fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTY

A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.

B. Warranty Period: 1 year after ship date.

PART 2 - PRODUCTS

2.1 MANUFACTURER

1. Manufacturers: Subject to compliance with requirements **provide products by one of the following:**

2. Basis-of-Design Product: Subject to compliance with requirements, provide 3Form; Chroma or comparable product by one of the following:

   a. Lumicor, Inc.
   b. Reynolds Polymer Technology, Inc.

2.2 MATERIALS

A. MATERIALS

3. Sheet Size: Maximum 4' x 10'
4. Panel size: as indicated on drawings for panel width, height, and mounting height.
5. Thickness: Minimum 1"
6. Mounting holes in panel: locate 2" minimum from edge of hole to edge of panel.

B. Resin Panel minimum performance attributes:

1. Rate of Burning (ASTM D 635): CC2 Rating for a nominal thickness of 1.5 mm (0.060 in.) and greater.
2. Self-Ignition Temperature (ASTM D 1929). Self-ignition temperature 850°F.
3. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 10%.
4. Coefficient of Friction (ASTM 2047) 0.73 Dry, 0.79 Wet

5. Dynamic environmental testing (ASTM standards D 5116 or D 6670). Panels must not have detectable VOC off-gassing agents and must be have Greenguard™ Indoor Air Quality Children and Schools certified.
6. Product must be fused using heat and pressure, not laminated with adhesives.
7. Color must be PVC-Free and be an acrylic resin made with pigments, not dyes. Must be UV stable colors
8. Vellum surface should be completely renewable onsite.

2.2 FABRICATION

A. General: Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings, additional fabrication and installation details can be found on the 3form Fabrication Drawings.

B. Comply with manufacturer's written recommendations for fabrication.

C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.

1. Sawing: Select equipment and blades suitable for type of cut required.
2. Drilling: Drills compatible with plastic products.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Fasteners: use screws designed specifically for Resins.

C. Use Gaskets, washers and tubing produced out of non-plasticized material (neoprene, Teflon, nylon, &silicone) to prevent direct contact between resin panel and metal fasteners, where required by manufacturer.

D. Wall mounting bracket: Stamped SS Two Ear Bracket For 1" Panel, 1-1/2" X 2-1/2" with thru hole at minimum 2 -1/8" from base.

E. Cleaner: Type recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for the installation of Plastic Fabrications. Sizes, profiles and other characteristics are indicated on the

drawings, additional installation details can be found on the 3form Certified Installer, if applicable.

B. Manufacturer's shop to fabricate items to the greatest degree possible.

C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.

D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.3 CLEANING AND PROTECTION

A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at cavity wall construction and cavity wall construction.
B. Batt insulation in exterior wall and wall construction.
C. Acoustical insulation in interior partitions.
D. Batt insulation for filling fire-rated assemblies.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers : Separate air barrier materials.
B. Section 07 21 29 - Sprayed Acoustical Insulation: Sprayed-on, adhered fibrous insulation.
C. Section 07 53 00 - Elastomeric Membrane Roofing: Insulation specified as part of roofing system.
D. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

1.03 DEFINITIONS

A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
    1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
    2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
    3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.04 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation;

2014 (Reapproved 2019).

F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
G. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
I. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015 (Reapproved 2020).
NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, product limitations, and other relevant data.
C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.06 QUALITY ASSURANCE

A. Thermal Resistivity: Where thermal resistivity properties of insulation materials are designated by r-values, they represent the rate of heat flow through a homogenous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperature indicated.
B. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
    1. Surface Burning Characteristics: ASTM E 84.
    2. Fire Resistance Ratings: ASTM E 119.
    3. Combustion Characteristics: ASTM E 136.
C. Protect plastic insulation as follows:
    1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
    2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
    3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction

1.07 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 INSULATION TYPES

A. General
   1. The categorizations of thermal barriers by location, form, and application in this Article are general descriptions only. Refer to the Drawings and other Sections for specific requirements.

B. Type 1: Mineral fiber batt insulation with no vapor retarder.
   1. Application: Thermal insulation.
   2. Location: Stud cavities of exterior metal-framed walls.

C. Type 2: (NOT USED)

D. Type 3: Extruded polystyrene (XPS)
   1. Application: Thermal insulation.
   2. Location: Perimeter of Foundation, Under Concrete Slabs.

E. Type 4: Mineral fiber board.
   1. Application: Thermal insulation.
   2. Location: Exterior cavity walls, other locations as indicated.

F. Type 5: Mineral fiber batt insulation with no vapor retarder.
   1. Application: Acoustical insulation.
   2. Location: Stud cavities of sound-rated partitions.

G. Type 6: Mineral fiber batts.
   1. Application: Fire safing insulation.
   2. Location:
      a. In voids and penetrations of fire separations and smoke walls.
      b. At terminations of rated CMU partitions to deck above.
      c. At perimeter firestopping systems.
   3. Form: Batts or blankets.

2.02 FOAM BOARD INSULATION MATERIALS

A. Type 3: Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Type and Thermal Resistance, R-value: Type VI, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
   4. Board Edges: Square.
   5. Type and Water Absorption: Type VI, 0.3 percent by volume, maximum, by total immersion.
   6. Products:
      a. DuPont de Nemours, Inc; Styrofoam Brand Highload 40: building.dupont.com/#sle.
      b. Dow Chemical Company; Highload 40: www.dow.com.
      c. Owens Corning Corporation; FOAMULAR Type 400 Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.

d. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MINERAL FIBER BOARD INSULATION MATERIALS

A. Type 4: Mineral Wool Block or Board Thermal Insulation: Complying with ASTM C612, Type IVB.
   1. Flame Spread Index: 0 (zero), when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Board Size: 16 by 48 inches.
   4. Board Thickness: 3 inches, unless otherwise noted.
   5. Thermal Resistance: R-value of 4.3 per inch at 75 degrees F, minimum, when tested in accordance with ASTM C518.
   6. Density: 6.2 pcf, nominal, outer layer; 3.8 pcf, nominal, inner layer;.
   7. Water vapor permeance: 27.2 perm per ASTM E 96.
   8. Products:
      a. ROCKWOOL; CAVITYROCK: www.rockwool.com/#sle.
      b. Thermafiber, Inc; RainBarrier HD: www.thermafiber.com/#sle.
   9. Substitutions: See Section 01 60 00 - Product Requirements See Section 01 60 00 - Product Requirements.
B. Type 6: Mineral Wool Block, Board, or Blanket Fire Safing Insulation: Complying with ASTM C612 or ASTM C553.
   1. Flame Spread Index: 0 (zero), when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Products:
      a. Johns Manville; MinWool Safing: www.jm.com/#sle.
      b. Johns Manville; MinWool ___Curtainwall ; MinWool 40 Curtainwall: www.jm.com/#sle.
      c. ROCKWOOL; CURTAINROCK 40: www.rockwool.com/#sle.
      d. ROCKWOOL; ROXUL SAFE: www.rockwool.com/#sle.
      e. Thermafiber, Inc; FireSpan 40: www.thermafiber.com/#sle.
      f. Thermafiber, Inc; Safing: www.thermafiber.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Type 1: Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
   1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
   3. Thermal Resistance: R-value of 4.0 per inch.
   4. Products:
      a. Johns Manville; Mineral Wool TempControl Batts: www.jm.com/#sle.
      b. ROCKWOOL; COMFORTBATT: www.rockwool.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.
B. Type 5: Mineral Wool Blanket Acoustical Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.

1. Flame Spread Index: 0 (zero), when tested in accordance with ASTM E84.
2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Board Size: 16 by 48 inches.
4. Thickness: As shown.
5. Density: 6.2 pcf, nominal.
6. Products:
   a. Johns Manville; MinWool Sound Attenuation Fire Batts ; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
   b. ROCKWOOL; AFB: www.rockwool.com/#sle.
   c. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements See Section 01 60 00 - Product Requirements.

2.05 ACCESSORIES

A. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.
B. Mineral Wool Insulation Attachment: 3" diameter, high-density polypropylene washer for attaching mineral wool and rigid insulation to various substrates in high wind-load areas.
   1. Products:
      a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Grip-Lok Hurricane Washer : www.trufastwalls.com/#sle.
C. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips and clips, to be mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
D. Adhesive: Type recommended by insulation manufacturer for application. See Section 07 25 00 for insulation compatible with air barriers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
B. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and to protrusions.

C. Extend boards over expansion joints, unbonded to foundation on one side of joint.
D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT CAVITY WALLS

A. Secure impale fasteners to substrate at following frequency:
   1. Six (6) per insulation board.
B. Install boards to fit snugly between wall ties.
C. Install boards horizontally on walls.
   1. Butt edges and ends tightly to adjacent boards and protrusions.
   2. Place impale fastener locking discs.
D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 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.

3.05 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.
B. Install in exterior wall 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.

3.06 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 25 00 - WEATHER BARRIERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes
   1. Air Barrier.

B. Related Requirements
   1. Section 03 05 06 - Underslab Vapor Barrier.
   2. Section 04 20 00 - Unit Masonry: Air barrier substrates and compatibility with flashing components.
   3. Section 06 10 00 - Rough Carpentry: Air barrier substrates and joint treatments.
   4. Division 07 Sections: Roof assembly air barriers and interface coordination.
   5. Section 07 26 40 - Spray Polyurethane Foam Insulating Air Barrier.
   6. Section 07 62 00 - Sheet Metal Flashing and Trim: Flashings installed in conjunction with air barriers.
   7. Section 07 92 00 - Joint Sealants: Sealing building expansion joints.
   8. Division 08 Sections: Framing for aluminum-framed entrances and storefronts, glazed aluminum curtain walls, louvers, and vents receiving air barrier transition assemblies specified in this Section.

1.02 DEFINITIONS

A. Weather Barrier: A material or assembly that acts as an air barrier, a vapor retarder, or a water-resistive barrier.

B. Air Barrier: A material or assembly that is relatively air impermeable but water vapor permeable, both to the degree specified, seamless or with sealed seams, and with joints to adjacent surfaces sealed.
   1. For the purposes of this specification, air barriers that are relatively vapor impermeable are classified as vapor retarders.

C. Vapor Retarder: A material or assembly that is relatively water vapor impermeable, to the degree specified, seamless or with sealed seams, and with joints to adjacent surfaces sealed.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

D. Water-Resistive Barrier: A material or assembly that is intended to shed water and is moisture-resistant to the degree specified, seamless or with sealed seams.

1.03 REFERENCE STANDARDS

A. References, General: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section.

B. ASTM International (ASTM): www.astm.org:
   1. ASTM A 240/A 240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
   2. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
   3. ASTM C 1193 - Guide for Use of Joint Sealants
   4. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
   5. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
   6. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials
   7. ASTM E 162 - Standard Test Method for Surface Flammability of Materials Using a

Radiant Heat Energy Source
8. ASTM E 783 - Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors
9. ASTM E 1186 - Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
10. ASTM E 2178 - Standard Test Method for Air Permeance of Building Materials
11. ASTM E 2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

C. California Department of Public Health: www.cdph.ca.gov
1. Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.

D. National Fire Protection Association (NFPA): www.nfpa.org:
1. NFPA 285 - Standard Fire Test Method For Evaluation Of Fire Propagation Characteristics Of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

E. US Environmental Protection Agency (EPA): www.epa.gov:
1. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.

B. Preinstallation Conference: Conduct conference at Project Site.
1. Review requirements for air barrier products and installation, project and Manufacturer's details, mockups, testing and inspection requirements, and coordination and sequencing of air barrier work with work of other Sections.
2. Review Manufacturer's instructions for air barrier application meeting and project requirements for substrates specified.
3. If available from Manufacturer, review video materials demonstrating proper application of components at wall openings.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of air barrier product specified, including:
1. Technical data indicating compliance with requirements.
2. Substrate preparation instructions and recommendations.

B. Shop Drawings:
1. Show locations for air barrier.
2. Show typical penetration, transition, and termination details for each type of substrate, joint, and edge condition including but not limited to door and window rough and masonry openings, utility penetrations, and other exterior wall conditions.
3. Show locations of transition and accessory materials relative to adjacent materials by others as required to demonstrate connectivity throughout the assemblies, including but not limited to flashings, counterflashings, sealants, and extrusions.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Manufacturer, Installer, and Air Barrier Inspector.
1. Certification of Manufacturer's approval of Installer.

B. Manufacturer's Product Compatibility Certificate: Certify compatibility of air barrier products with adjacent materials.

C. Low-Emitting Product Certificate: For air barrier products specified to meet volatile organic

emissions standards, submit Greenguard Children and Schools Certification or comparable certification acceptable to Architect.

D. Fire Propagation Characteristics Certificate: From a qualified testing agency, documentation that air barrier system as a component of a wall assembly has been tested and passed NFPA 285. Include system classification number of testing agency on shop drawings.

E. Product Test Reports: Test data for air barrier products and air barrier assembly, by qualified testing agency, indicating proposed membrane air barrier meets performance requirements, when requested by Architect.

F. Warranty: Sample of unexecuted Manufacturer and Installer special warranties.

G. Field quality control reports.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Manufacturer has minimum five years' experience in the manufacture of air barriers as one of its principal products.
2. Manufacturer is accredited by the Air Barrier Association of America.
3. Manufacturer's product has been in satisfactory operation on five similar installations for at least five years.
4. Approval of Manufacturers and Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
   a. Completed and signed Substitution Request form.
      1) Include assessment of projected impact of Architect's potential acceptance on Project Cost and Time.
   b. Certificate of ABAA accreditation.
   c. Project references: Minimum of five installations of similar system not less than five years old, with Owner and Architect contact information.
   d. Proposed product data, including certified independent test data indicating compliance with requirements.
   e. Sample shop drawings from similar project.
   f. Sample warranty.

B. Installer Qualifications: A firm with minimum three years' experience in installation of specified products in successful use on similar projects, employing workers trained by Manufacturer, including a full-time on-site supervisor with a minimum of three years' experience installing similar work.

C. Air Barrier Inspector Qualifications: A technical representative of Manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified air barrier system, qualified to perform observation and inspection specified in Field Quality Control Article, to determine Installer’s compliance with the requirements of this Project, and approved by the Manufacturer to issue warranty certification. The Inspector shall be one of the following:

1. An authorized full-time technical employee of the Manufacturer.
2. A independent party certified as an air barrier inspector by the ABAA or other certifying organization acceptable to Architect, retained by the Contractor.

D. Mockups: Provide air barrier mockup application within mockups required in other sections, or if not specified, in an area of not less than 150 sq. ft. of wall surface where directed by Architect for each type of backup wall construction.

1. Include examples of surface preparation, crack and joint treatment, air barrier application,

and flashing, transition, and termination conditions, to set quality standards for execution.
2. Include intersection of wall air barrier with roof air barrier and with foundation wall intersection.

1.08 DELIVERY, STORAGE AND HANDLING

A. Accept materials on site in Manufacturer's unopened original packaging.
B. Store products in weather protected environment, clear of ground and moisture, within temperature ranges recommended by Manufacturer.
C. Construction Waste: Store and dispose of packaging materials and construction waste in accordance with requirements of Division 01 Section "Temporary Facilities and Controls."

1.09 ENVIRONMENTAL REQUIREMENTS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by Manufacturer.
1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.10 SCHEDULING

A. Coordinate installation of membrane air barrier with completion of roofing and other work requiring interface with air barrier.
B. Schedule work so air barrier applications may be inspected prior to concealment.
C. Ensure air barrier materials are cured before covering with other materials.

1.11 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which Manufacturer agrees to furnish and install air barrier material to repair or replace those materials installed according to Manufacturer's written instructions that exhibit material defects or otherwise fail to perform as specified under normal use within warranty period specified.
1. Access for Repair: Owner shall provide unimpeded access to the Project and the air barrier system for purposes of testing, leak investigation, and repair, and shall reinstall removed cladding materials upon completion of repair.
2. Cost Limitation: Manufacturer's obligation for repair or replacement shall be limited to the original installed cost of the work.
3. Warranty Period: Two years from date of Substantial Completion.
B. Special warranties specified in this article exclude deterioration or failure of air barrier materials from the following:
1. Movement of the structure caused by structural settlement or stresses on the air barrier exceeding Manufacturer's written specifications for elongation.
2. Mechanical damage caused by outside agents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Manufacturer: Tremco, Inc., Commercial Sealants and Waterproofing Division, Beachwood OH.
B. The products of other manufacturers, including but not limited to the following, are acceptable subject to conformance to the requirements of this Section.
1. E.P. Henry.
2. Prosoco.

3. W.R. Meadows.

2.02 MATERIALS, GENERAL

A. Source Limitations: Obtain air-barrier materials from single source from single manufacturer.

B. VOC Content: Maximum 50 g/L when tested in accordance with 40 CFR 59, Subpart D (EPA Method 24) and with the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Compatibility: Provide membrane air barrier materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by Manufacturer based on testing and field experience.

2.03 PERFORMANCE REQUIREMENTS

A. General: Membrane air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Membrane air barriers shall accommodate substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without moisture deterioration and air leakage exceeding performance requirements.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. when tested according to ASTM E 2357.

C. Fire Propagation Characteristics: Provide air barrier system qualified as a component of a comparable wall assembly that has been tested and passed NFPA 285.

2.04 MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, UV-resistant, synthetic membrane, formulated for application in a range of 48 - 70 mils wet, curing to 25 - 35 mils dry film thickness.

1. Basis of Design Product: Tremco, Inc., ExoAir 230.
2. Properties
    a. Air Permeance, ASTM E 2178: 0.004 cfm/sq. ft of surface area at 1.57-lbf/sq. ft. pressure difference, maximum.
    b. Vapor Permeance, ASTM E 96/E96M: Minimum 12 perms.
    c. Elongation, Ultimate, ASTM D 412, Die C: 600 percent, minimum.
    d. Combustion Characteristics: Class A, flame spread, not greater than 25; smoke developed, not greater than 450, per ASTM E 84.
    e. UV Resistance, QUV-B: Over 160 cycles of UV and water spray with no observable deterioration.
    f. VOC Content: Less than 50 g/L.

2.05 ACCESSORY MATERIALS

A. General: Accessory materials as described in Manufacturer's written installation instructions, recommended to produce complete air barrier system meeting performance requirements, and compatible with air barrier material and adjacent materials.

B. Transitions: Provide any or all the following in accordance with Manufacturer's recommendations and with approved shop drawings.

1. Counterflashing Strip: Modified bituminous, 40 mils thick self-adhering composite sheet consisting of 32 mils of SBS rubberized asphalt laminated to an 8 mils high-density, cross-laminated polyethylene film, for counterflashing of metal flashings and for substrate

transitions and for termination of air barrier to bituminous roof membranes and to air barrier terminations at openings.
   a. Basis of Design Product: Tremco, Inc., ExoAir TWF Thru-Wall Flashing.
2. High Temperature Flashing Strip and Underlayment: Butyl, 24 mil thick self-adhering composite sheet consisting of 20 mils of butyl laminated to 4 mil polyethylene film; thermally stable under intermittent, non-continuous exposure up to 240 deg F.
   a. Basis of Design Product: Tremco, Inc., ExoAir 110AT.
3. Flashing Strip: Butyl, 22 mil thick self-adhering composite sheet consisting of 16 mils of butyl laminated to 6 mil polypropylene film; thermally stable under intermittent, non-continuous exposure up to 240 deg F.
4. Liquid Flashing: ASTM C 920, single-component polyurethane, approved by Manufacturer for adhesion and compatibility with air barrier and accessories.
   a. Basis of Design Product: Tremco, Inc., Dymonic 100.
5. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with Manufacturer's recommended silicone sealant for bonding extrusions to substrates.
   a. Basis of Design Product: Tremco, Inc., Spectrem Simple Seal.

C. Reinforcing Fabric: High strength mesh fabric consisting of open-weave glass fiber saturated with synthetic resins formulated for high moisture resistance, for reinforcing of liquid applications; not less than 2.5 oz/sq. yd.
   1. Basis of Design Product: Tremco, Inc., Tremco 2011.
D. Liquid Joint Sealant: ASTM C 920, single-component, neutral-curing silicone, approved by Manufacturer for adhesion and compatibility with membrane air barrier and accessories after installation of the membrane.
   1. Basis of Design Product: Tremco, Inc., Spectrem 1.
E. Sprayed Polyurethane Foam Sealant: Sprayed Polyurethane Foam Sealant: Foamed-in-place, 1.5- to 2.0-lb/cu. ft. density, with flame-spread index of 25 or less per ASTM E 162, for filling of gaps at openings and penetrations.
   1. Basis of Design Product: Tremco Inc., Flexible Low Expanding Foam (LEF).

PART 3 EXECUTION

3.01 EXAMINATION

A. Pre-installation conditions: Before applying air barrier materials, examine substrate and conditions to ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles, and other deterrents to adhesion. Verify conditions comply with Manufacturer's written recommendations.
   1. Verify concrete and masonry surfaces are visibly dry, have cured for time period recommended by Manufacturer, and are free from release agents, curing agents, and other contaminants.
   2. Test for capillary moisture by method recommended in writing by Manufacturer.
   3. Verify masonry joints are filled with mortar and struck flush.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INTERFACE WITH OTHER WORK

A. Commencement of Work: Commence work after the following conditions are met.
   1. Air barrier substrates are adequately protected from weather and subsequent construction activities

2. Provisions are in place to keep installed work protected until covered by exterior finish systems.

B. Sequencing of Work: Coordinate sequencing of air barrier work with work of other sections that form portions of building envelope air barrier to ensure that flashings and transition materials can be properly installed and inspected. Roofing systems shall be capped and sealed, or top of walls protected, in such a way as to eliminate the ability of water to saturate the wall or interior space, both before and after, air barrier system installation. Coordinate installation of fluid-applied air barrier with the roofing trade to ensure compatibility and continuity with the roofing system.

C. Subsequent Work: Coordinate air barrier work with the work of other sections to be installed after air barrier to ensure complete inspection of installed air barrier and sealing of air barrier penetrations necessitated by subsequent work.

3.03 PREPARATION

A. Clean, prepare, and treat substrate in accordance with Manufacturer's written instructions.
1. Mask adjacent finished surfaces.
2. Remove contaminants and film-forming coatings from substrates.
3. Remove projections and excess materials and fill voids with substrate patching material.
4. Prepare and treat joints and cracks in substrate per ASTM C 1193 and Manufacturer's written instructions.

3.04 APPLICATION OF ACCESSORY MATERIALS

A. General: Install strips, transition strips, and accessory materials according to Manufacturer's written instructions. Install transition materials and other accessories to form, connect, and seal membrane air barrier material to adjacent components of building air barrier system, including, but not limited to, roofing system air barrier, exterior fenestration systems, door framing, and other openings.

B. Assembly Transitions: Connect and seal exterior wall air barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
a. Opening Transitions: Fill gaps at perimeter of openings with foam sealant and apply approved transition or accessory material.
b. Penetrations: Fill gaps at perimeter of penetrations with foam sealant and level with approved sealant, or seal openings around penetrating objects with transition strips and terminate with approved sealant.
c. Joints: Bridge and cover isolation joints, expansion joints, and discontinuous joints between separate assemblies utilizing approved transition or accessory materials.
d. Changes in Plane: Apply beads of approved sealant at corners and edges to form smooth transition.
e. Substrate Gaps: Cover gaps with stainless steel sheet mechanically attached to substrate as required to provide continuous support for air barrier.

C. Flashings: Seal top of through-wall flashings to membrane air barrier with a continuous bead of approved sealant recommended by Manufacturer.

D. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following Manufacturer’s recommendations and extend repair beyond repaired areas to maintain continuity.

3.05 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with transition materials and accessories to achieve a continuous air barrier according to Manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

B. Membrane Air Barrier: Apply fluid air barrier material in full contact with substrate to produce a continuous seal according to Manufacturers written instructions.
   1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, in a range of 25 – 35 mils dry film thickness depending on substrate, applied in one or more equal coats, roller- or spray-applied.

C. Connect and seal exterior wall air-barrier membrane continuously to subsequently-installed roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, wall openings, and other construction used in exterior wall openings, using approved transitions and accessory materials.

D. Wall Openings: Apply approved sealant to adhere silicone extrusion to perimeter of windows, curtain walls, storefronts, doors, and louvers. Apply [opening transition assembly] [preformed silicone sealant extrusion] according to air barrier transition manufacturer’s written instructions.

E. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following Manufacturer’s recommendations and extend repair beyond repaired areas to maintain continuity.

F. Do not cover air barrier until it has been tested and inspected by testing agency.

G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified Inspector to perform tests and inspections, including documenting of membrane air barrier prior to concealment.
   1. Inspections and testing shall be carried out at the following rate:
      a. Up to 10,000 sq. ft. (930 sq. m): One inspection.
      b. 10,001 to 35,000 sq. ft.: Two inspections.
      c. 35,001 to 75,000 sq. ft.: Three inspections.
      d. 75,001 to 125,000 sq. ft.: Four inspections.
      e. 125,001 to 200,000 sq. ft.: Five inspections.
      f. Over 200,000 sq. ft.: Six inspections.

B. Scope of Testing: Testing shall include the following:
   1. Qualitative air-leakage testing per ASTM E 1186.
   2. Quantitative air-leakage testing per ASTM E 783.
   3. Photo documentation of work to be subsequently concealed.

C. Coordination of Testing: Cooperate with testing agency. Allow access to work areas and staging. Notify testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection.
   1. Do not cover Work until testing and inspection is completed and accepted.

D. Reporting: Forward written inspection reports to the Architect within 10 working days of the inspection and test being performed.

E. Correction: Correct deficient applications not passing tests and inspections, make necessary

repairs, and retest as required to demonstrate compliance with requirements.

3.07 CLEANING AND PROTECTING

A. Clean spills, stains, and overspray resulting application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.

B. Protect membrane air barrier from damage from subsequent work. Protect membrane materials from exposure to UV light for period in excess of that acceptable to Manufacturer. Replace overexposed materials and retest.

END OF SECTION

SECTION 07 42 13 - METAL WALL PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes complete systems of metal panels in the following applications:
   1. Rain Screen System
   2. Suspended metal panel soffit system.

B. Related Requirements:
   1. Section 05 40 00: Cold-Formed Metal Framing.
   2. Section 07 21 00: Thermal Insulation.
   3. Section 07 26 00: Vapor Retarders.
   4. Section 07 92 00: Joint Sealants.
   5. Section 07 62 00 Sheet Metal Flashing and Trim

1.02 REFERENCES

A. Reference Standards
   1. ASCE 7: Minimum Design Loads for Buildings and Other Structures.
   2. ASTM A653: Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
   3. ASTM A792: Steel Sheet, 55% Aluminum Zinc Alloy Coated by the Hot Dip Process.
   4. ASTM A 1011: 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.
   5. ASTM C1371: Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
   6. ASTM C1549: Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
   7. ASTM D523: Specular Gloss.
   8. ASTM D 2244: Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
   9. ASTM E283: Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   10. ASTM E331: Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   11. ASTM E1592: Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
   12. ASTM E1918: Measuring Solar Reflectance of Horizontal and Low Sloped Surfaces in the Field.
   13. ASTM E1980: Calculating Solar Reflectance Index of Horizontal and Low Sloped Opaque Surfaces.
   14. ASTM D 4214: Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
   15. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
   16. CRRC-1 Method #1: Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer.
   17. SMACNA Architectural Sheet Metal Manual.

1.03 SUBMITTALS

A. Product Data.
B. Shop Drawings: Indicating thicknesses and dimensions of parts, fastenings and anchoring methods, details and locations of joints, transitions, and other provisions necessary for thermal expansion and contraction, and locations of field- and factory-applied sealant.
C. Samples:
    1. Submit two samples, 12 inches long by 12 inches wide, showing proposed metal thickness and seam profile.
    2. Submit standard color samples of metal for Architect’s selection.
D. Manufacturer Qualifications.
E. Installer Qualifications: Submit list of completed projects, with names and contact information for architects and contractors.
F. Test Reports: Indicating compliance of products with project requirements.
G. Warranty Documentation.
H. Insurance Documentation.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications
    1. Ten years' experience, minimum, in factory fabrication of metal panels.
    2. Manufacturer shall carry $2,000,000 liability insurance, minimum, for metal panel system.
B. Installer Qualifications:
    1. Three years' experience, minimum, in application of metal roof or wall panels.
    2. Five satisfactory projects with metal panel work of similar scope and complexity to Work of this Project.
C. Testing Agency Qualifications: Agency compliant with ISO/IEC Standard 17025, or an accredited independent agency recognized by the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement or ANSI.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
    1. Keep panels and accessory items dry.
    2. Protect against damage and discoloration.
    3. Handle panels with non-marring slings.
    4. Support panels to prevent permanent deformation.
    5. Store panels above ground, with one end elevated for drainage.
    6. Protect panels against standing water and condensation between adjacent surfaces.
    7. If panels become wet, immediately separate sheets, wipe dry with clean cloth, and keep sheets separate for air-drying.
    8. Painted panels shall be shipped with protective plastic sheeting or a strippable film coating between panels. Remove strippable film coating prior to installation. Do not allow strippable film coating to remain on panels in extreme heat, cold, or direct sunlight or other UV source.

1.06 WARRANTY

A. Special Exposed Panel Finish Warranty: Manufacturer's standard form PVDF Fluorocarbon System Warranty for film integrity, chalk rating and fade rating in which manufacturer agrees to repair or replace panels that show evidence of deterioration within specified warranty period.
   1. Deterioration shall include but is not limited to:
      a. Color fading of more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling or failure of paint to adhere to bare metal.
   2. Warranty Period: Film integrity for 45 years and chalk and fade rating for 35 years from date of Substantial Completion.
   3. Manufacturer’s warranty may exclude surface deterioration due to physical damage and exposure to salt air environments.

B. Installer's Warranty: Warrant panels, flashings, sealants, fasteners and accessories against failure due to defective materials, poor workmanship, or faulty installation. Warranty shall provide for repairs required to maintain wall panels watertight and weatherproof with normal usage.
   1. Term: Two (2) years following date of Project's Substantial Completion.
   2. Furnish written warranty, signed by installer.

PART 2 PRODUCTS

2.01 RAIN SCREEN METAL WALL PANELS

A. Manufacturer
   1. Basis of Design: Exposed Fastener Series, Econolap-¾” Panel CENTRIA Architectural Systems; Moon Township, PA 15108-2994.
   2. The products of other manufacturers, including the following, are acceptable subject to compliance with requirements of this section.
      a. ATAS.
      b. MBCI.
      c. Petersen Aluminum.

B. Performance Criteria
   1. Wind Uplift: As required by ASCE 7 and applicable codes.
      a. Panel system shall be ASTM E1592 tested under the supervision of an ANSI or ISO/IEC accredited laboratory and the laboratory shall issue the test report.
         1) Test data based on ASTM E330 is not acceptable.
      b. Deflection Limits: Withstand wind loads with deflections no greater than 1/180 of the span.
   2. Thermal Movements: Accommodate thermal movement without buckling, joint opening, failure of connections, or other detrimental effects, through the following temperature changes:
      a. 120 degrees F, ambient.
      b. 180 degrees F, surface.

C. Properties
   1. Material: Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Class Z275), structural steel.
      a. Structural quality, Grade 50.
      b. Thickness: 0.036 inch/20 gage (0.91 mm) nominal thickness.
      c. Z275 coating designation.
   2. Finish:

a. Exposed coil-coated: JF Coating (fluorofinish-Fluoropolymer Two-Coat System: 0.2 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA [620] [621].)
b. Concealed finish apply pre treatment and manufacturer's standard white or light colored acrylic or polyester backed finish consisting of prime coat and wash coat with a minimum dry film thickness of 0.5 mil.

3. Color: silversmith.
4. Panel Coverage: 34.66 inches (880 mm).
5. Panel Height: 0.75 inches (19 mm).
6. Corrugation Spacing: 2.66 inches (68 mm) o.c.Attachment: Exposed, direct fastened panel.

2.02 RAIN SCREEN MOUNTING SYSTEM

A. Manufacturers
1. Basis of Design
a. Z-Framing: Z-Girt for Rainscreen Framing by ClarkDietrich, Baltimore, MD.
2. The products of other manufacturers are acceptable subject to compliance with requirements of this section.

B. Z-Framing Properties
1. Material: G90 galvanized steel.
a. Thickness: 18 gauge (43mils).
b. Yield strength: Minimum 33 ksi.
2. Features
a. Flange width: 1 1/2 inches.
b. Depth to match metal wall panel depth.
c. Toed-in legs along flange edges.
d. Prepunched holes in flanges at four inches (4") on center for attachment.
e. Slotted holes in webs for moisture weeping.

C. Fasteners and anchors
1. Material: 304 series stainless steel.
2. Of type, size and spacing required for type of substrate and project conditions, to meet performance requirements specified and as indicated in design calculations and shop drawings.
3. Application-specific requirements
a. Attach metal wall panels to supporting components with blind rivets color-matched to panel colors as provided or recommended by Manufacturer.
b. Attach brackets with grommet fasteners to ensure face seal of brackets.

2.03 FABRICATION

A. Fabrication, General
1. Unless otherwise shown on Drawings or specified herein, fabricate panels in continuous lengths and fabricate flashings and accessories in longest practical lengths.
2. Panels shall be correctively leveled in factory.

B. Fabrication Tolerances
1. Flat metal surfaces will display waviness commonly referred to as "oil canning." This is caused by steel mill tolerances and is a characteristic, not a defect, of panels manufactured from light gauge metal.
2. Panels are correctively leveled in factory to minimize the occurrence of "oil canning."

3. As such, “oil canning” will not be accepted as cause for rejection.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions: With Installer present.
   1. Examine conditions and substrates on which metal panels are to be installed. Structural support or substrate shall be flat and plumb to avoid panel stresses and distortion.
   2. Verify that weather barrier work is complete and inspected.
   3. Prior to starting work, correct defects.

B. Field Measurements:
   1. Coordinate field measurements and fabrication schedule with construction progress.
   2. Field measure prior to fabrication. Show recorded dimensions on shop drawings, including locations of shop-fabricated openings.
   3. If field measurements differ from drawing dimensions, notify Architect prior to fabrication.

C. Framing Tolerances: Deviations from flat plane shall not exceed the following.
   1. 1/4 inch in 20 feet vertically or horizontally.
   2. 1/2 inch across building elevation.
   3. 1/8 inch in 5 feet.

3.02 PREPARATION

A. Protection
   1. Treat contacting surfaces of dissimilar materials to prevent electrolytic corrosion.
   2. Where panels or trim may contact dissimilar materials or treated lumber, fabricate transitions to facilitate drainage and minimize possibility of galvanic corrosion.
   3. At points of contact with dissimilar metal or treated lumber, coat panel or trim with protective paint or separate materials with a weatherproof underlayment.
   4. Avoid contact with wood materials treated with preservatives, including but not limited to CCA, ACQ, AC, or other treated or fire-retardant-impregnated wood materials.

3.03 INSTALLATION

A. Substrate, secondary framing, and weather barrier: Install according to approved shop drawings and metal panel manufacturer's recommendations.

B. Panels and Flashing
   1. Install according to approved shop drawings.
   2. Comply with methods and recommendations of SMACNA Architectural Sheet Metal Manual for flashing configurations required.
   3. Overlap flashing at least 6 inches.
   4. Discrepancies between job site conditions and shop drawings shall be brought to the attention of the Architect for resolution.
   5. Cutting and Fitting
      a. Cut panels neat, square, and true with shearing action cutters. Torch or power saw cutting is prohibited.
      b. Openings 6 inches and larger: Shop fabricate and reinforce to maintain original load capacity.
      c. Openings less than 6 inches: Field cutting is acceptable.

C. Accessories: Install trims, panel closures, flashings according to Drawings and manufacturer's recommended details.
D. Sealant Installation: Apply according to approved shop drawings and SMACNA Architectural Sheet Metal Manual recommendations.
E. Installation Tolerances: Match dimensional tolerances of framing or substrate.

3.04 CLEANING

A. Repairs
   1. Touch up paint is not required for panels with scratches that do not expose metal.
   2. Panels or flashings with finish damage exposing metal or with substrate damage shall be replaced.
B. Cleaning and Waste Management: At completion of each day's work and at work completion, sweep panels, flashings, and gutters clean. Do not allow fasteners, cuttings, filings, or scraps to accumulate.

END OF SECTION

SECTION 07 53 00 - ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Elastomeric roofing membrane, adhered conventional application.
B. Rigid insulation, flat and tapered.
C. Flexible flashings.
D. Elevated roof paver system.
E. Accessories including but not limited to stack boots and walkway pads.

1.02 RELATED REQUIREMENTS

A. Section 05 31 00 - Steel Decking: Product requirements for acoustical insulation for deck flutes, for placement by this section.
B. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.
C. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings, reglets.
D. Section 07 71 00 - Roof Specialties: Copings, roof expansion joint covers, and scuppers to be included in roofing system warranty. Gutters and downspouts.
E. Section 07 72 00 - Roof Accessories: Roof-mounted units; prefabricated curbs.
F. Section 22 10 06 - Plumbing Piping Specialties: Roof drains.
G. Section 26 41 13 - Lightning Protection for Structures.

1.03 REFERENCE STANDARDS

A. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2020.
B. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane 2015.
C. FM DS 1-28 - Wind Design 2016.
D. NRCA (RM) - The NRCA Roofing Manual 2019.
E. UL (DIR) - Online Certifications Directory Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, and fasteners.
C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and paver layout.
D. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
E. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, and supplementary instructions given.
F. Installer's qualification statement.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience, and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
B. Store materials in weather protected environment, clear of ground and moisture.
C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
D. Protect foam insulation from direct exposure to sunlight.

1.08 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather.
B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 90 degrees F.
C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form signed by Installer, covering Work of this Section, including all components of membrane roofing system such as roofing membrane, base flashing, roof insulation, and walkway products, for the following warranty period:
    1. Warranty Period: Two years from date of Substantial Completion.
C. Manufacturer's Warranty: Manufacturer's Warranty standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
    1. Warranty Period: 25 years from date of Substantial Completion.
    2. Coverage: Material and labor.
    3. Include edge metal in Roofing System Warranty. See Section 077100.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. EPDM Membrane Materials:
    1. Carlisle Roofing Systems, Inc: www.carlisle-syntec.com.

2. Firestone Building Products, LLC: www.firestonebpco.com.
3. Versico, a division of Carlisle Construction Materials Inc: www.versico.com/sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ROOFING

A. Elastomeric Membrane Roofing: One ply membrane, fully adhered, over insulation and coverboard.

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 1-60, in accordance with FM DS 1-28.

C. Acceptable Insulation Types - Constant Thickness Application
1. Uniform thickness polyisocyanurate board.

D. Acceptable Insulation Types - Tapered Application:
1. Uniform thickness polyisocyanurate board covered with tapered polyisocyanurate board.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane: Ethylene-propylene-diene-terpolymer (EPDM); non-reinforced; complying with minimum properties of ASTM D4637/D4637M.
1. Thickness: 0.060 inch (60 mil).
2. Sheet Width: 120 inch, minimum; factory-fabricate into largest sheets possible.
3. Tensile Strength: 1,200 psi.
4. Elasticity: 50 percent with full recovery without set.
5. Solar Reflectance: 0.75, minimum, initial, and 0.64, minimum, 3-year, certified by Cool Roof Rating Council.
6. Thermal Emittance: 0.84, minimum, initial, and 0.87, minimum, 3-year, certified by Cool Roof Rating Council.
7. Color: White.

B. Seaming Materials: Standard synthetic-rubber polymer primer and 6-inch wide minimum, butyl splice tape with release film.

C. Membrane Fasteners: As recommended by and approved by membrane manufacturer.

D. Flexible Flashing Material: Same material as membrane.

2.04 COVER BOARD

A. Fiberglass Mat Faced Gypsum Roof Board:
1. Thickness: 5/8 inch.
2. Width: 4 feet.
3. Length: 8 feet.
4. Weight: 2.5 lb/sq. ft.
5. Surfacing: Fiberglass mat with non-asphaltic coating.
6. Flexural Strength, Parallel (ASTM C473): 100 lbf, minimum.
7. Flute Span (ASTM E661): 8 inches.
8. Permeance (ASTM E96): greater than 17 perms.
9. R-Value (ASTM C518): 0.67.
10. Water Absorption (ASTM C1177): Less than 10 percent of weight.
11. Compressive Strength (Applicable Sections of ASTM C472): 900 pounds per square inch.
12. Surface Water Absorption (ASTM C473): Not more than 2 grams.
13. Acceptable Products:
a. DensDeck Prime, Georgia-Pacific Gypsum.

2.05 RIGID INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type II, Class 1, cellulose felt or glass fiber mat both faces; Grade 2 and with the following characteristics:
   1. Compressive Strength: Minimum 20 psi.
   2. Long-term thermal resistance (LTTR): Minimum R-5.6 per inch.
   3. Board Size: 48 by 96 inch.
   4. Board Edges: Square.
   5. Flat insulation
      a. Thickness: As indicated in drawings, built up in multiple layers as required.
         1) Base layer thickness: Minimum 1.7 inches.
         2) Total thickness: As required to achieve minimum R-rating, but not less than 5 1/2 inches.
      b. R-value: Minimum R-30.
   6. Tapered insulation: Slopes as indicated on Drawings, fabricated in fewest layers possible.
      a. Minimum base slope: 1/4 inch per foot.
      b. Cricket slope: As indicated in Drawings. If not so indicated, then as required for 1/2 inch per foot minimum cricket valley slope.
      c. Drain sumps: 4'-0" square; 1/2 inch per foot slope.

2.06 ACCESSORIES

A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
B. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
   1. Composition: Roofing membrane manufacturer's standard.
   2. Size: As indicated.
   3. Surface Color: Black.
C. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self-adhering.
D. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
E. Membrane Adhesive: As recommended by membrane manufacturer, and:
   1. Provide low-VOC, solvent-based EPDM bonding adhesive that complies with Ozone Transport Commission (OTC) Model Rule, Single Ply Roofing Adhesives; www.otcair.org.
F. Membrane Adhesive Primer: As recommended by membrane manufacturer, and:
   1. Provide low-VOC, solvent-based EPDM adhesive primer that complies with Ozone Transport Commission (OTC) Model Rule, Single Ply Roofing Adhesive Primers; www.otcair.org.
G. Insulation Adhesive: As recommended by insulation manufacturer.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION - METAL DECK

A. Install preformed acoustical glass fiber insulation strips, specified in Section 05 31 00, in roof deck flutes and in accordance with manufacturer's instructions.
   1. Protect strips against weather.
   2. Immediately install cover board over the installed strips. Do not install more strips than can be covered in the same day.
   3. Protect exposed edges of strips overnight.

3.03 INSULATION

A. Attachment
   1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements.
      a. At areas with exposed structure below, size fasteners for a maximum ¾ inch penetration below deck, and locate in top flute of deck.
      b. At areas with acoustical deck, size fasteners so that they do not penetrate the bottom surface of the deck.
   2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
      a. At contractor’s option, second layer of insulation may be mechanically fastened in areas without exposed ceilings.
B. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
C. On metal deck, place boards with long sides parallel to deck flutes. Bear board edges on flutes.
D. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
E. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
F. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.
   1. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
G. Do not apply more insulation than can be covered with membrane in same day.
H. Install cover board over insulation with long joints in continuous straight lines and end joints staggered. Attach cover board with adhesive, following manufacturer recommendations.
   1. For multilayer locations, lay subsequent coverboard layers with joints staggered minimum 6 inch from joints of preceding layer.

3.04 INSTALLATION - MEMBRANE

A. Apply elastomeric membrane roofing system in accordance with manufacturer's recommendations.
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 and membrane at rate required by manufacturer. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
   1. Protect white surface from discoloration from bonding adhesive.
   2. Do not place bonding adhesive containers or lids on white membrane surface.
E. Overlap edges and ends and seal seams by contact tape, minimum 6 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
F. At intersections with vertical surfaces:
   1. Extend membrane up a minimum of 8 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to termination bar.
G. Around roof penetrations, seal flanges and flashings with flexible flashing.
H. Install roofing expansion joints where indicated. Make joints watertight.
   1. Install prefabricated joint components in accordance with manufacturer's instructions.
I. Coordinate installation of roof drains and related flashings.
J. Coordinate installation of counterflashings installed under other sections.

3.05 ROOF WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.06 FIELD QUALITY CONTROL

A. Owner will provide testing services in accordance with Section 01 40 00 - Quality Requirements, Contractor to provide temporary construction and materials for testing.
B. Require site attendance of roofing and insulation material manufacturers weekly during installation of the Work.

3.07 CLEANING

A. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.
B. Remove markings from finished surfaces.
C. 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.
D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 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

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated flashings and counterflashings.
B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Installation of flashing materials embedded in masonry.
B. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.
C. Section 07 25 00 - Weather Barriers: Installation of weather barriers and interfaces with flashing materials.
D. Section 07 53 00 - Elastomeric Membrane Roofing: Elastomeric flashings for membrane roofing.
E. Section 07 71 00 - Roof Specialties: Manufactured trim products and assemblies associated with roofs, including flashings, copings, gutters, and downspouts.
F. Section 07 72 00 - Roof Accessories: Manufactured metal roof curbs.
G. Section 07 92 00 - Joint Sealants: Sealing of non-lapping joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).
D. SMACNA (ASMM) - Architectural Sheet Metal Manual, latest edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. Shop Drawings: Indicate material, shapes of individual profiles, arrangements of profiles with respect to each other, installation details with respect to adjacent construction, jointing patterns, jointing details, terminations, and fastening methods.
B. Samples: Submit two samples of finished metal, 6 by 6 inch in size, illustrating finish color.

1.06 QUALITY ASSURANCE

A. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.
B. Maintain one copy of SMACNA (ASMM) and CDA A4050 on site.
C. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.07 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

2.01 SHEET MATERIALS

A. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gage (0.0156 inch) thick; smooth No. 4 - Brushed finish.

2.02 FLASHING TYPES

A. Flashing Type 1: Two-piece interlocking type:
   1. Material: Stainless steel.
   2. Configurations shall be as shown on drawings.
   3. Where cap flashings or counter flashings occur, they shall be of two-piece construction with a receiver having a special vertical locking slot that requires no malleting or bending to hold the insert member in place.
   4. Keyed or corrugated flashings are unacceptable.
   5. Where flashings do not turn up behind walls, terminate with a 1/4" hook dam.
   6. Thru-wall flashings at parapets shall be hemmed flush with the exposed face of face brick.
   7. Fasteners, mastic for sealing and attachment, etc., shall be as recommended by the manufacturer.

B. Flashing Type 2: Masonry thru-wall type:
   1. Stainless steel.
   2. Configurations shall be as shown on drawings.
   3. Installation: Refer to Section 04 20 00 - Unit Masonry.

C. Flashing Type 3: Elastomeric flashing. See Section 07 53 00.

D. Flashing Type 4: Formed metal flashing (Other than Type 1):
   1. Material: Stainless steel.
   2. Configurations shall be as shown on drawings.

2.03 ACCESSORIES

A. Fasteners: Stainless steel, with soft neoprene washers.

B. Outside corner and inside corner material; manufacturer’s standard available units using:
   1. Stainless steel: 26 gauge stainless steel.

C. End dam: Product may be folded in line with the flashing material or utilize preformed end dams by manufacturer using:
   1. Stainless steel: 26 gauge stainless steel

D. Protective Backing Paint: Asphaltic mastic, ASTM D4479 Type I.

E. Sealant to be Concealed in Completed Work: Type 3 as specified in Section 07 92 00.

F. Sealant to be Exposed in Completed Work: Type 1 as specified in Section 07 92 00.

G. Reglets: Surface mounted type, galvanized steel; face and ends covered with plastic tape.

H. Termination Bars: 1 inch wide x 1/8 inch thick; stainless steel.

2.04 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; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type seams or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; solder for rigidity, seal with sealant.

F. Fabricate vertical faces with bottom edge formed outward 3/4 inch and hemmed to form drip.
G. Fabricate flashings to allow toe to extend 4 inches over roofing membrane. Return and brake edges.

2.05 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.
B. Primer: Zinc chromate type.
C. Concealed Sealants: Non-curing butyl sealant.
D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets are in place, and nailing strips are located.
B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips and cleats before starting installation.
B. Install surface-mounted reglets true to lines and levels. Seal top of reglets with sealant.
C. Back-paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. Conform to drawing details and to the following:
    1. SMACNA Architectural Sheet Metal Manual.
B. Insert flashings into reglets to form tight fit; secure in place with plastic wedges; seal flashings into reglets with sealant.
C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where explicitly shown in Drawings or permitted by Architect.
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. Fasten cavity wall flashings to structural back-up with a non-corrosive termination bar and seal the top edge of the flashing with sealant.
G. Seal metal joints watertight.

3.04 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for field inspection requirements.
B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gutters and downspouts.
B. Pipe and penetration flashings

1.02 RELATED REQUIREMENTS

A. Section 07 42 13 - Metal Wall Panels: Copings associated with metal wall panel systems.
B. Section 07 53 00 - Elastomeric Membrane Roofing
   1. Roof warranty requirements.
   2. Elastomeric boot flashings provided with roofing system.

1.03 REFERENCE STANDARDS

A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems 2017.
B. ANSI/SPRI GT-1 - Standard for Gutter Systems Used with Low-Slope Roofs, latest version.
C. NRCA (RM) - The NRCA Roofing Manual 2019.

1.04 SUBMITTALS

A. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
B. Shop Drawings: Indicate configurations and dimensions of components, adjacent construction, required clearances and tolerances, and other affected work.
C. Samples: Submit two appropriately sized samples of coping.
D. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

1.05 WARRANTY

A. Provide a roofing manufacturer's full system warranty to include roof edge systems.
B. See Section 07 53 00 for warranty requirements.
C. Provide a 20-year warranty for painted finishes covering film integrity, color fade, and chalking.

PART 2 PRODUCTS

2.01 COPINGS

A. Manufacturer

1. Basis of Design: Metal-Era, Inc., www.metalera.com.
2. Products from other manufacturers, including but not limited to the following, are acceptable subject to conform with the requirements of this Section.
   a. OMG Roofing Products: www.omgroofing.com/#sle

B. Basis-of-Design Products
1. Cantilevered metal coping: Perma-Tite Cantilever, Saddle Version.
2. Other metal copings: Perma-Tite Double-Tapered Coping.

C. Product Requirements
1. General
   a. Description
      1) Snap-on coping with intermittent clips for capping parapet walls.
      2) Does not require exposed fasteners or joint sealants.
   b. Performance Characteristics:
      1) Snap-on Coping Cap Sections: Capable of expanding and contracting freely, statically engaged onto mechanically secured clips.
      2) Snap-on Coping Cap Joints: Underlayed with concealed splices.
   c. Coping caps:
      1) Material: 0.040” aluminum.
      2) Formed Lengths: 12’-0”.
      3) Finish: Prefinished Kynar.
   d. Intermittent Clips (common properties):
      1) Width: 12”
      2) Fastener Holes: Pre-Punched.
   e. Concealed Splices:
      1) Material: Same as snap-on coping cap.
      2) Finish and Color: Same as snap-on coping cap.
      3) Width: 8”
      4) Sealant Strips: Factory-applied dual non-curing isocryl butyl sealant strips.
2. Double-tapered coping
   a. Intermittent Clip Material: 20 ga. galvanized steel.
3. Cantilevered coping
   a. Description: Coping assembly must cantilever over wall-applied veneers without bearing on them.
   b. Cantilever range: One inch (1") minimum to ten inches (10") maximum.
   c. Approvals
      1) ANSI/SPRI/FM 4435 ES-1 up to 221 psf Vertical and 128 psf Horizontal.
      2) FM Approved Up to 1-120 Perimeter and 1-75 Corner.
      3) Florida Product Approval.
      4) Miami-Dade County Approved.
   d. Intermittent Clip Material
      1) Base: 16 ga. galvanized steel.
      2) Riser: 20 ga. galvanized steel.

2.02 DOWNSPOUTS

A. Manufacturers
1. Basis of Design: Metal-Era, Inc., www.metalera.com.

2. Products from other manufacturers meeting the basis of design specification and design intent include, but are not limited to
   a. Pac-Clad
   b. Hickman Edge Systems

B. Product Requirements
   2. Downspouts
      a. Material: 0.050 inch aluminum, prefinished.
      b. Configuration: As indicated on the drawings.
      c. Sizes: As indicated in Drawings.
      d. Distribution: As shown on the drawings
      e. Color
         1) One or more colors per downspout run, coordinated with backing surface colors as indicated in Drawings, to be selected by Architect from Manufacturer's stock colors.
         2) Joints between downspout sections of different colors to align with transitions between backing surface colors.
   3. Anchorage Devices:
      a. Provide brackets for gutters and downspouts that conform to SMACNA (ASMM) requirements.
      b. Coordinate bracket types with support capacities of backing surfaces.
   4. Warranties
      a. Product Warranty: Five (5)-year workmanship warranty covering replacement or repair of products that are defective in material or workmanship. (All Products)
      b. Finish Warranty: Limited thirty (30)-year warranty for prefinished coil-coated steel and aluminum coated with Kynar 500 standard colors covering fade, chalk, and film integrity.
      c. Wind Warranty for Gutters Only: Thirty (20)-year wind warranty in wind conditions up to 160 mph.

2.03 PIPE AND PENETRATION FLASHINGS

A. Basis of Design
   1. Portals Plus: www.portalsplus.com.
B. Requirements
   1. Base of rounded aluminum, compatible with specified roof systems and capable of accommodating pipes sized between 3/8 inch and 12 inch.

2.04 ACCESSORIES

A. Sealants for Joints in Linear Components: As recommended by component manufacturer.
B. Adhesives for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this section are in place and positioned correctly.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, NRCA (RM) applicable requirements, and the following provisions.
   1. Butt-splice roof expansion joint covers along adjacent lengths using materials and methods recommended by Manufacturer's.
   2. Corners, intersections, and end closures of copings and roof expansion joint covers must be factory-fabricated except where explicitly permitted in Manufacturer's written instructions. Corners formed by field laps and field miters are not acceptable.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
E. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

END OF SECTION

DIVISION 07 SECTION 07 84 13
FIRE PROTECTION, HVAC & PLUMBING PENETRATION FIRESTOPPING
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SECTION 07 84 13 - FIRE PROTECTION, 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.

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.

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.

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 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.

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+
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

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
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+	

*Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF FIRE PROTECTION, HVAC & PLUMBING PENETRATION FIRESTOPPING

SECTION 07 92 00 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS
- A. Section 07 13 00 - Sheet Waterproofing: Sealing cracks and joints in waterproofing substrate surfaces using materials specified in this section.
- B. Section 07 25 00 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.
- C. Section 07 84 00 - Firestopping: Firestopping sealants.
- D. Section 07 95 13 - Expansion Joint Cover Assemblies: Sealants forming part of expansion joint cover assemblies.
- E. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.
- F. Section 08 80 00 - Glazing: Glazing sealants and accessories.
- G. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- H. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS
- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015.
- B. ASTM C834 - Standard Specification for Latex Sealants 2017.
- C. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2018.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.
- G. ASTM C1311 - Standard Specification for Solvent Release Sealants 2014.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).
- J. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015, with Editorial Revision (2017).

1.04 SUBMITTALS
- A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes 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. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
4. Substrates the product should not be used on.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

F. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

G. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

D. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
1. Identification of testing agency.
2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
   a. Test date.
   b. Copy of test method documents.
   c. Age of sealant upon date of testing.
   d. Test results, modeled after the sample form in the test method document.
   e. Indicate use of photographic record of test.

E. Field Quality Control Plan:
1. Visual inspection of entire length of sealant joints.
2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
3. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
   a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1000 linear feet, and one test per 1000 linear feet thereafter, or once per

floor on each elevation.

b. If any failures occur in the first 1000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to Owner.

4. Field testing agency's qualifications.
5. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

F. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

G. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.

H. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inch long.
2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

1.06 WARRANTY

A. Correct defective work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
a. Wall expansion and control joints.
b. Joints between door, window, and other frames and adjacent construction.
c. Joints between different exposed materials.
d. Openings below ledge angles in masonry.

e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.

   a. Joints between door, window, and other frames and adjacent construction.
   b. Joints between plumbing fixtures and adjacent construction.

3. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
4. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   d. Joints where installation of sealant is specified in another section.
   e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, Type 1, unless otherwise indicated.
   1. Type 3 - Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.

C. Interior Joints: Use non-sag acrylic latex sealant, Type 2, unless otherwise indicated.
   1. Interior Expansion and Control Joints: Polyurethane sealant; Type 1A.
   2. Interior Joints at windows, storefront and curtainwall: Polyurethane sealant; Type 1A.
   3. Fire-rated Construction: ASTM C 834, UL Listed.
   4. In Sound-Rated Assemblies: Acoustical sealant; Type 5.
   5. Type 7 - Narrow Control Joints in Interior Concrete Slabs Exposed to View: Self-leveling polyurea sealant.
   6. Interior Wet Areas: Type 6 - Mildew-Resistant Silicone Sealant: not expected to withstand continuous water immersion or traffic. Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 JOINT SEALANTS - GENERAL

A. Sealant Types Summary:
   1. Type 1: Non-Staining Silicone.
   2. Type 1A: Polyurethane.
   3. Type 2: Acrylic Emulsion Latex
   4. Type 3: Non-Curing Butyl Sealant
   5. Type 4: Fire resistant foam sealant: Refer to Section 078400 - Firestopping.
   6. Type 5: Acoustical Sealant
   7. Type 6: Mildew-Resistant Silicone Sealant
   8. Type 7: Self-Leveling Polurea Sealant

2.03 NONSAG JOINT SEALANTS

A. Type 1 - Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
   1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
   2. Non-Staining To Porous Stone: Non-staining 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. Color: To be selected by Architect from manufacturer's standard range.
5. Cure Type: Single-component, neutral moisture curing.
6. Service Temperature Range: Minus 65 to 180 degrees F.
7. Manufacturers:
   a. Dow Chemical Company; 795 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   b. Sika Corporation; Sikasil WS-295: www.usa-sika.com/#sle.
   c. Pecora Corporation; 890NST: www.pecora.com.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Type 1A - Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.
4. Service Temperature Range: Minus 40 to 180 degrees F.
5. Manufacturers:
   a. Pecora Corporation; DynaTrol 1-XL: www.pecora.com.
   b. Sika Corporation; Sikaflex-15 LM: www.usa-sika.com/#sle.
   c. Tremco Commercial Sealants & Waterproofing; Dymonic 100: www.tremcosealants.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

C. Type 2 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

D. Type 3 - Non-Curing Butyl Sealant: Solvent-based; ASTM C1311; single component, non-sag, non-skinning, non-hardening, non-bleeding; vapor-impermeable; intended for fully concealed applications.

E. Type 4: Fire resistant foam sealant: Refer to Section 078400 - Firestopping.

F. Type 5 - Acoustical Sealant for Concealed Locations: ASTM C 834, UL Listed.
1. Composition: Acrylic latex emulsion sealant.
2. Applications: Use for concealed locations only:
   a. Acoustical application: Sealant bead between top stud runner and structure and between bottom stud track and floor.
3. Products:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant: www.pecora.com.
   b. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant: www.us.hilti.com.
   c. USG Company; Sheetrock Brand Acoustical Sealant; www.usg.com.

G. Type 6 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.
2. Manufacturers:
   a. Pecora Corporation: www.pecora.com.
   b. Sika Corporation; Sikasil GP: www.usa-sika.com.

2.04 SELF-LEVELING SEALANTS

A. Type 7 - Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough

to support concrete edges under traffic.

1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
2. Color: To be selected by Architect from manufacturer's standard colors.
3. Joint Width, Minimum: 1/8 inch.
4. Joint Width, Maximum: 3/4 inch.
5. Joint Depth: Provide product suitable for joints from 1/8 inch to 1 inch in depth excluding space for backer rod.
6. Manufacturers:
   a. Adhesives Technology Corporation; Crackbond JF-311: www.atcepoxy.com/#sle.
   b. ARDEX Engineered Cements; ARDEX ARDISEAL RAPID PLUS: www.ardexamericas.com/#sle.
   c. Euclid Chemical Company; EUCO QWIKjoint UVR: www.euclidchemical.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   2. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
   3. Manufacturers:
      a. Nomaco, Inc; SOF Rod: www.nomaco.com.
B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 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.
D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
   1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
   2. Notify Architect of date and time that tests will be performed, at least 7 days in advance.
   3. Record each test on Preinstallation Adhesion Test Log as indicated.
   4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.

5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 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.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Perform acoustical sealant application work in accordance with ASTM C919.
D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
   1. Width/depth ratio of 2:1.
   2. Neck dimension no greater than 1/3 of the joint width.
   3. Surface bond area on each side not less than 75 percent of joint width.
E. Install bond breaker backing tape where backer rod cannot be used.
F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
G. 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.
H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.
D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
E. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width; i.e. at low temperature in thermal cycle. Report failures immediately and repair.

END OF SECTION

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thermally insulated hollow metal doors with frames.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

1.03 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.

1.04 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; 2022.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

E. 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; 2023, with Editorial Revision.

F. 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; 2023….

G. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

H. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

J. ASTM E413 - Classification for Rating Sound Insulation; 2022.

K. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

M. ITS (DIR) - Directory of Listed Products; Current Edition.

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; 2011.

P. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.

Q. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.

R. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

S. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.

T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

U. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.

V. UL (DIR) - Online Certifications Directory; Current Edition.

W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

X. UL 752 - Standard for Bullet-Resisting Equipment; Current Edition, Including All Revisions.

Y. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
   1. Provide hollow metal frames from SDI Certified manufacturer.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
   2. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
   3. Steelcraft, an Allegion brand: www.allegion.com/sle.
   4. Technical Glass Products: www.tgpamerica.com.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Sound-Rated Hollow Metal Doors and Frames:
   1. AMBICO Limited: www.ambico.com/#sle.
   2. Overly Door Company: www.overly.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

C. Bullet-Resistant Hollow Metal Doors and Frames:
   1. AMBICO Limited: www.ambico.com/#sle.
   2. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
   3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.

4. Overly Door Company: www.overly.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements

2.02 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.

B. Materials
   1. Doors and frames to be constructed from formed sheet steel or structural shapes and bars.
      a. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
      b. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
      c. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
   2. Manufacturer's standard fully adjustable head and jamb seals and bottom edge sweeps
   3. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door.
   4. Door Edge Profile: Beveled, both sides.
   5. Typical Door Face Sheets: Flush. Refer to Door Schedule for additional information.
   6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
   7. 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.
      a. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
      b. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets
   8. Zinc Coating for Typical 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.

C. 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.

2.03 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

2.04 HOLLOW METAL DOORS

A. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.

B. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

C. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware". Wire nut connections are not acceptable.

E. Door Finish: Factory primed and field finished.

F. 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 2 - Seamless.
      d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   2. Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
   3. Door Thickness: 1-3/4 inches, nominal.
   4. Top and Bottom Closures: Flush with top of faces and edges.
   5. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape.

2.05 HOLLOW METAL FRAMES

A. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

B. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   1. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

C. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

D. Frame Finish: Factory primed and field finished.

E. 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 A60/ZF180 coating.
   2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
   3. Weatherstripping: Separate, see Section 08 71 00.

F. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

G. Jamb Anchors: Provide number and spacing of anchors as follows:
   1. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      a. Two anchors per jamb up to 60 inches high.
      b. Three anchors per jamb from 60 to 90 inches high.
      c. Four anchors per jamb from 90 to 120 inches high.
      d. Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
   2. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      a. Three anchors per jamb up to 60 inches high.
      b. Four anchors per jamb from 60 to 90 inches high.
      c. Five anchors per jamb from 90 to 96 inches high.
      d. Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      e. Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

H. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

I. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

2.06 FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

2.07 ACCESSORIES

A. Glazing: As specified in Section 08 80 00.
B. Removable Stops: Formed sheet steel, shape as indicated on drawings, butted corners; prepared for countersink style tamper proof screws.
C. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
D. 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.
E. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

B. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

C. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

D. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

E. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

F.

3.03 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. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 08 71 00.

F. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.
   1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
   3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
   4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

G. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

H. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.04 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.
   1. Non-Fire-Rated Standard Steel Doors:
      a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
      b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
      c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
      d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
   2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING AND CLEANING

A. Remove grout and other bonding material from hollow metal work immediately after installation.

B. Adjust for smooth and balanced door movement.

C. Adjust sound control doors so that seals are fully engaged when door is closed.

D. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

E. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable

3.06 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 71 00 - DOOR HARDWARE

PART 1 GENERAL

1.1 **SUMMARY**

A. Section Includes:
   1. Hardware for swinging Aluminum, Hollow Metal and Wood Door Openings.

B. Related Sections:
   1. Section 01 25 13 – Product Substitution Procedures
   2. Section 06 20 00 – Finish Carpentry
   3. Section 08 11 13 – Hollow Metal Doors and Frames

1.2 **REFERENCES**

A. Use the following references to properly detail, schedule, furnish and install finish hardware items.
   1. NFPA 80 – Standard for Fire Doors and Other Opening Protectives (2007)
   2. DHI Installation Guide for Doors and Hardware (1984)
   3. DHI Sequence and Format for the Hardware Schedule (1996)
   4. ANSI/BHMA A156.4 – Door Controls – Closers (2013)
   5. ANSI/BHMA A156.13 – Mortise Locks and Latches Series 1000 (2012)
   6. ANSI/BHMA A156.18 – Materials and Finishes (2012)

1.3 **SUBMITTALS**

A. Schedule:
   1. Provide submittals in accordance with 01 33 00 – Submittal Procedures.
   2. Provide hardware schedule in vertical format on 8-1/2-inch by 11-inch paper or electronic format. Conform to DHI publication Sequence and Format for Hardware Schedule using Architect's door numbers and hardware set numbers.
   3. Provide elevation drawings for openings with electrical hardware and access control devices with each hardware schedule. Include illustration of opening, operational description, electrified hardware components, legend, approximate mounting location and size of enclosures, size and quantity of conductors, facility name and date.

B. Product Data: Provide one set of manufacturer's catalog and technical data for each hardware item used, highlighting design, function, fasteners, accessories, and options to facilitate review with each hardware schedule submitted.
C. Templates: Provide two sets of manufacturer's templating information for mortised and template hardware upon receipt of approved hardware schedule to the door and frame supplier(s). Include requirements for internal reinforcements required for surface mounted hardware.
D. Wiring Diagrams:
   1. Three sets point-to-point diagrams specially developed for each opening that requires electrical hardware, with hardware delivery to jobsite. Reference elevation drawings submitted with hardware schedule using Architect's opening numbers.

2. Three sets riser diagrams for openings requiring power supplies or access control. Include placement of power supplies, distance of wire runs from power supply, cable quantity and number and gauges of wires.

E. Keying Schedule: Arrange meeting with Owner, Architect, and finish hardware supplier to determine keying requirements immediately upon receipt of finish hardware schedule.

1.4 CLOSEOUT SUBMITTALS

A. Furnish operations and maintenance manual is accordance with Section 01 78 28 – Operations and Maintenance Data and as follows:

1. Furnish one copy of manual at date of Substantial Completion in a 2-1/2-inch thick binder labeled with project information, date and name and contact information for the hardware supplier.
2. Include in manual:
    a. Copy of approved hardware schedule, including door numbers and locations. Highlight fire rated door to aid in annual fire door inspection.
    b. Copy of approved keying schedule.
    c. Catalog data for each product.
    d. As-installed "wiring diagrams" for each opening connected to power.
    e. Parts list for locksets, exit devices, and door closers.
    f. Installation templates and instructions.
    g. Warranty information.
    h. Name, address, and phone number of local representatives for each manufacturer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Materials:
    1. Screws and Fasteners: Fifty of each screw and fastener required for general maintenance of hinges, locks, closers, exit devices, and sealing systems.
    2. Deliver to Owner remaining finish hardware fasteners and special installation tools upon completion of Project.

1.6 QUALITY ASSURANCE

A. Supplier:
    1. Furnish hardware from recognized supplier who has warehousing facility within 100 miles of project location, and who has actively supplied hardware for similar projects in the vicinity for a minimum of five years.
    2. Supplier shall employ an Architectural Hardware Consultant (AHC), as certified by Door and Hardware Institute, on staff full time to administer and supervise project.

B. Installer: Install hardware using installers who have actively installed commercial door hardware for a minimum of five years, and are familiar with hardware installation of type required on this Project.

C. Pre-Installation Meeting:
   1. Prior to installation of hardware, arrange for manufacturer's representatives of locksets, door closers, and exit devices to hold a jobsite meeting to instruct the installing personnel on the proper installation of their products.
   2. Send a letter of compliance, indicating when this meeting was held, and who was in attendance, to the Architect and Owner.

D. Fire Rated Door Openings:
   1. Comply with NFPA 80.
   2. Furnish nationally recognized testing agency label or stamp on hardware for labeled openings.
   3. Only labeled locks or latches or fire exit hardware can be used on fire rated openings.
   4. Where UL requirements conflict with Drawings or Specifications, furnish hardware conforming to the UL requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Jointly check in hardware, upon delivery to jobsite, against approved hardware schedule with hardware supplier. Record shortage or damage and replace or repair as necessary.
   2. Deliver hardware to be installed during fabrication of doors and frames, to manufacturer.

B. Storage:
   1. Store hardware in a secure, dry, temperature-controlled room on shelving to protect against loss, theft and damage.
   2. Store items too long for shelving on pallet, off the floor.

C. Marking and Packaging:
   1. Deliver hardware to jobsite in manufacturer's original packaging marked to correspond with approved hardware schedule with Architect's door numbers and hardware sets.
   2. Mark all locksets, exit devices, cylinders, auxiliary hardware and key switches with keyset symbol.
   3. Replace any wet or damaged packaging with new.

1.8 WARRANTY

A. Furnish warranties in accordance with Section 01 78 36 – Warranties. Extended or limited warranties shall be as follows:
   1. Mortise Locks: Lifetime
   2. Door Closers: Thirty (30) Years
   3. Exit Devices: Five (5) Years

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The following manufacturers were used in the hardware sets.

1.	Butt Hinges	McKinney	MCK
2.	D.P. STRIKE	Trimco	TRM
3.	Locks and Latchsets	Corbin Russwin	COR
4.	Cylinders and Cores	Corbin Russwin	COR
5.	Surface Closers	Corbin Russwin	COR
6.	Manual Flushbolts	Trimco	TRM
7.	Thresholds and Gasketing	Pemko	PEM
8.	Door Sweep	National Guard Products	NGP

B. Submit requests for substitution in accordance with Section 01 25 13 Product Substitution requirements and as follows:
   1. Provide catalog data with product information highlighted or bubbled to facilitate review in addition to physical samples in the specified finish and function. Product must meet or exceed level or design intended and/or function established by specified products.

2.2 MATERIALS

A. Screws and Fasteners:
   1. Provide manufacturer's recommended fasteners of proper type, material and finish.
   2. Provide self-tapping screws for sweeps and stop applied weatherstripping.
   3. Utilize through-bolts for the attachment of door closers and exit devices on non-reinforced doors only. Finish: match door face.
   4. Exposed screw heads: phillips type.

B. Hinges:
   1. Type:
      a. Five-knuckle, full mortise, ball bearing.
      b. Furnish heavy weight hinges on heavy doors and doors expected to have high frequency use.
   2. Quantity:
      a. One pair of hinges for all doors up to 5 feet high. Furnish one additional hinge for every 2'-6" in height or fraction thereof.
      b. Four hinges at dutch doors up to 7'-6" in height.
   3. Size:
      a. For 1-3/4-inch thick doors up to 3 feet wide: 4 ½-inches high
      b. For 1-3/4-inch thick doors over 3 feet wide: 5-inches high
      c. For all doors over 1-3/4-inches thick: 5-inches high
      d. Size in width shall minimally clear door trim.
   4. Application:
      a. NRP (non-removable pin) at exterior doors and reverse bevel doors with locking hardware.
      b. Electric hinges: have sufficient number of concealed wires to accommodate electrical function of hardware. Furnish junction box and mortar shield.
   5. Acceptable manufacturers and types:

Type	Best	McKinney	Hager	Ives
Standard Weight	FBB179	TB2714	BB1179	5BB1

Heavy Weight	FBB168	T4B3786	BB1168	5BBHW

C. Door Bolts and Dustproof Strikes:
1. Flush bolts:
   a. Manual Flush bolts: Two for inactive leaf of locked pairs of doors at non-occupied rooms.
   b. Acceptable manufacturers and types:

Bolt/Door Type	Trimco	Burns	McKinney
Manual Metal	3917	590	FB01M-2

2. Dustproof Strikes:
   a. Dustproof strikes to match manufacturer of Flush bolts.
   b. Acceptable manufacturers and types:

Bolt/Door Type	Trimco	Burns	McKinney
Manual Metal	3911	545	DPS3

D. Locksets:
1. Mortise Locks:
   a. Conform to ANSI/BHMA A156.13, Series 1000 Operational Grade 1.
   b. Latchbolt with appropriate throw for fire rated doors and pairs of doors in accordance with manufacturers listing.
   c. Lock functions as specified in hardware schedule.
   d. Electrical functions as specified in hardware schedule, 24VDC.
   e. Lever design: PSA
   f. Backset: 2-3/4-inch
   g. Strike single door: ANSI 4-7/8-inch with proper lip length to minimally clear trim.
   h. Strike pair of doors: flat lip strike sized to fit flush with face of door.
   i. Furnish wrought strike box.
   j. Lever trim shall function in a bi-directional motion.
   k. Acceptable manufacturers and types:

Dorma (dormakaba USA)	Schlage (Allegion)	Corbin Russwin (ASSA ABLOY)
M9000 series	ND Series	ML2000 Series

2. Cylinders:
   a. Provide mortise and rim cylinders and cores from same manufacturer as locksets, for all locksets, exit devices, cylinder dogging, key switches and auxiliary hardware.
   b. Appropriate cam and blocking rings for proper installation

E. Keys & Keying
1. Cylinders: All new lock cylinders to be master keyed for the existing Factory Grand Master Key System. All locks and cylinders shall be furnished with full size interchangeable keyed construction.
2. Provide construction cores and keys during construction period. Construction control and operating keys and cores are not part of permanent keying system or furnished on same keyway (or key section) as permanent keying system.
3. Permanent Keys and Cores: Prepare permanent cores and keys in accordance with keying schedule. Provide Masterkeys and other Security Keys.
4. Furnish keys in the following quantities:

a. 2 each Change keys each keyed core.
b. 6 each Construction Masterkeys.
c. 2 each Construction Control keys.
d. 2 each Control keys.

5. Install permanent cores in locksets.
6. Return construction cores to Hardware Supplier.

F. Surface Door Closers:
1. Conform to ANSI/BHMA A156.4 Grade 1.
2. Heavy duty high silicon aluminum alloy or cast iron body closers.
3. Furnish manufacturers recommended size, arms and configuration for door and frame application required.
4. Closer arms shall accommodate project applications as specified.
5. Furnish brackets, spacers, support shoes, and plates for complete and proper installation.
6. Acceptable manufacturers and types:

Dorma (dormakaba USA)	LCN (Allegion)	Corbin Russwin (ASSA ABLOY)
8900 Series	4041XL Series	DC 8000 Series

G. Overhead Door Stop:
1. Provide overhead stop or overhead stop/holder for interior doors as specified. Provide overhead stop for interior doors and at any door that swings more than 140 degrees before striking a wall, open against equipment, casework, sidelights, and/or where conditions do not allow a wall stop or a floor stop presents a tripping hazard.
2. Where overhead holders are specified provide friction type at doors without a closer and positive type at doors with a closer.
3. Acceptable manufacturers:

ABH	Rixson	Glynn Johnson
9000 Series	9 Series	90 Series
1020 SL Series	6 Series	100S Series

H. Door Stops:
1. Convex, cast, wall stops.
2. Furnish fastener suitable for wall condition.
3. Provide wedge type stop for doors with push/pulls.
4. Where wall stops are inappropriate provide universal dome type floor stops.
5. Acceptable manufacturers and types:

Type	Trimco	Burns	Rockwood
Wall Stop	1270CXSV	560	400
Floor Stop	1211	521	441H

I. Thresholds and Gasketing:
1. Thresholds:
a. Returned closed ends at openings where threshold extends beyond frame face.
b. Bumper threshold with silicone insert where scheduled.
c. Furnish anti-slip surface on all thresholds.
d. Coordinate door undercuts with door hardware.

e. Acceptable manufacturers and types:

Type	National Guard	Pemko	Legacy
Saddle	513	271	3545
Saddle	425	171	3556
Bumper	896ADJ	--------	-------

2. Gasketing:
   a. Rigid jamb weatherstrip with replaceable neoprene insert.
   b. Include self-adhesive two-sided tape in addition to manufacturer's standard fastener.
   c. Meeting-stile gasketing required at exterior pairs of doors and doors in smoke partitions.
   d. TPE adhesive fire/smoke gasketing at fire and smoke "S" labeled openings
   e. Door sweep with neoprene insert for exterior out-swing doors.
   f. Acceptable manufacturers and types:

Type	National Guard	Pemko	Legacy
Rigid	700 NA	2891_PK	56924
Door Sweep	200 NA	315CN	793

2.3 FINISHES

A. Conform to ANSI/BHMA A156.18.

1.	Butt Hinges	630	Stainless Steel
2.	Locks and Latches	630	Stainless Steel
3.	Door Closers	689	Spray Painted Aluminum
4.	Protection Plates	630	Satin Stainless Steel
5.	Stops and Holders	630	Satin Stainless Steel
6.	Thresholds/Gasket	AL	Anodized Mil Finished Aluminum

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify doors and frames are plumb, square, level and true and free from defects that would prevent proper installation of finish hardware.
B. Verify power is run to doors requiring electrified hardware.
C. Wash down masonry walls and complete painting and staining of doors and frames prior to installation of hardware.
D. Correct conditions that inhibit a proper installation before continuing with work.

3.2 INSTALLATION

A. Install hardware in compliance with the DHI publication, Installation Guide for Doors and Hardware.
B. Drill and countersink items not factory prepared for fasteners.

C. Mount closers on room-side of corridor doors, inside of exterior doors, and stair-side of stairway doors. Use necessary arms, brackets, spacers and plates to accommodate auxiliary hardware and special applications.
D. Install fire door assemblies to maintain clearances at door edge to frame and meeting edge of pairs of doors in compliance with NFPA 80, providing 1/8-inch clearance at the hinge edge, lock edge, head and between pairs. Provide maximum 3/4-inch undercut at door bottom. Where panic thresholds are used, undercut door to allow 1/8-inch clearance between door and threshold.
E. Trim, cut, and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Set thresholds in bed of mastic sealant, forming tight seal between threshold and surface to which set.
F. Use only fasteners furnished by manufacturer for installation as recommended by manufacturer.
G. Install blocking material for all wall mounted door stops at height appropriate to contact door trim.
H. Install weather-strip prior to installation of door closers and exit devices. Do not cut or notch weather-strip.
I. Locate electric hinges at second hinge from bottom of frame.
J. Termination of wiring: Ensure wiring is in place and is connected for proper operation of hardware.

3.3 FIELD QUALITY CONTROL

A. Verify doors open and close smoothly without rubbing or catching and have positive latching where scheduled. Verify fire rated doors are installed with clearances in compliance with NFPA 80.

B. Test electrified hold open devices tied into fire alarm system to confirm release upon activation of fire alarm. Test electrified hardware and access control to verify systems operate as directed in mode of operation. Where hardware is found to be inoperable, repair or replace with new.

3.4 ADJUSTING AND CLEANING

A. Upon substantial completion, make final adjustments to door closers and other items of hardware after balance of heating and ventilating equipment to ensure doors close and latch properly.
B. Clean and polish all exposed hardware surfaces in accordance with manufacturer's recommended procedures.
C. Clean or repair pencil or tool marks from adjacent surfaces damaged or soiled by work of this Section.
D. Recycle cardboard boxes and paper products used in packaging and transport of finish hardware.

3.5 PROTECTION

A. Remove hardware prior to painting or finishing door and frame. Wrap or mask exposed hardware that cannot be removed until date of substantial completion to avoid exposure to paint, solvents, and abuse.
B. Repair or replace hardware damaged during construction at least two weeks prior to date of substantial completion.

3.6 SCHEDULES

A. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.

B. Where items of hardware are not definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

Manufacturer List

Code	Name
ABH	ABH Manufacturing Inc.
BST	Best Access Systems
DRM	Dorma Door Controls
MCK	McKinney
NGP	National Guard Products
PEM	Pemko
PRE	Precision Hardware
TRM	Trimco Products
SAR	Sargent
ASSA	Assa Abloy

Finish List

Code	Description
N	Off White
AL	Aluminum
626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
316S	316 Satin Stainless Steel
626W	Weatherized Satin Chrome
GREY	Grey
US26D	Chromium Plated, Dull
US32D	Stainless Steel, Dull

Hardware Sets

Hdwe. Set: 41 New double doors to storage shed				
(2) 3'-0 X 7'-0" X 1 ¾: HMD/HMF				
6	Full Mortise Hinge	TB2714 4 ½"x 4 ½" NRP	US32D	MCK
1	Dust Proof Strike (inactive leaf)	3910	626	TRM
2	Flush Bolt (inactive leaf)	3917	630	TRM
1	Mortise Lock	ML2049 PSA	630	COR
1	Construction Core	CT6R CMK	630	COR
1	CORE	8000 MK	630	COR
1	COORDINATOR	3094B2	600	TRM
2	DOOR CLOSER	DC8210	689	COR
1	THRESHOLD	2005 AV 72	AL	PEM
2	GASKET	2891_PK	AL	PEM
2	Door Sweeps	200NA	689	NGP

END OF SECTION

SECTION 08 85 13 – GLAZING SEALANTS

PART 1 – GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:
   1. Elastomeric glazing sealants including structural glazing.
B. RELATED REQUIREMENTS:
   1. Section 08 87 23 "SAFETY AND SECURITY FILMS"

1.2 REFERENCE STANDARDS

A. ASTM International (ASTM): www.astm.org:
   1. ASTM C 661 - Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer
   2. ASTM C 719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
   3. ASTM C 1135 - Test Method for Determining Tensile Adhesion Properties of Structural Sealants
   4. ASTM C 1184 - Standard Specification for Structural Silicone Sealants.
   5. ASTM C 1193 - Standard Guide for Use of Joint Sealants.
   6. ASTM C 1330 - Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
B. Sealant, Waterproofing, and Restoration Institute (SWRI): www.swrionline.org:
   1. SWRI Validation Program.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.
B. Preinstallation Conference: Conduct conference at Project Site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joint sealant product specified, including:
   1. Preparation instructions and recommendations.
   2. Standard drawings illustrating manufacturer's recommended sealant joint profiles and dimensions applicable to Project.
B. Structural Sealant Joint Design: Provide calculations for structural bite, deadload support, glueline thickness, shear, and other parameters, Affidavit that drawings, specifications, and design data provided by Architect have been reviewed and are approved as acceptable application of manufacturer’s structural silicone sealant and comply with manufacturer’s warranty requirements.

1. Shop Drawings: Show details of proposed sealant joints, indicating dimensions, materials, structural bite, glueline thickness, joint profile, and support framing.

B. Samples for Verification: For each sealant color selected.
C. Samples for Color Selection: For each joint sealant type.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified applicator.
B. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
C. Preconstruction compatibility and adhesion test reports for structural glazing.
D. Manufacturer’s instructions for installation and field quality control testing.
E. Preconstruction field-adhesion test reports.
F. Field quality control adhesion test reports.
G. Warranty: Sample of unexecuted manufacturer and installer special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Experienced Installer equipped and trained for application of joint sealants required for this Project with record of successful completion of projects of similar scope.
B. Single Source Responsibility: Provide glazing sealants by a single manufacturer responsible for testing of Project substrates to verify compatibility and adhesion of joint sealants.
C. Preconstruction Field-Adhesion Testing: Prior to installing joint sealants, field test adhesion to joint substrates using ASTM C 1193 Method A or method recommended by manufacturer. Verify adhesion is adequate. Modify joint preparation recommendations for failed joints and re-test. Submit written report to Architect.

1.7 PROJECT CONDITIONS

A. Do not install silicone sealants when shop conditions exceed temperature range limits or other non-standard dust or dirt conditions exist.
B. Do not install sealants when ambient or surface temperatures are outside of range recommended by glazing sealant manufacturer.

1.8 WARRANTY

A. Special Installer's Warranty: Original statement on Installer's letterhead in which Installer agrees to repair or replace joint sealants that demonstrate deterioration or failure within warranty period specified.
   1. Warranty Period: Two years from date of Substantial Completion.
B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that demonstrate deterioration or failure under normal use within warranty period specified.
   1. Warranty Period for Silicone Sealants: 20 years date of Substantial Completion.

C. Warranty Conditions: Special warranties exclude deterioration or failure of joint sealants in normal use due to structural movement resulting in stresses on joint sealants exceeding sealant manufacturer's written specifications, joint substrate deterioration, mechanical damage, or normal accumulation of dirt or other contaminants.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Manufacturer:
   1. Dow Corning Corporation, Midland MI; website: www.dowcorning.com/construction
B. Substitutions: See Section 01 60 00 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for in Section 01 60 00 - Product Requirements.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants and accessory materials that are compatible with one another, with joint substrates, and with materials in close proximity under use conditions, as demonstrated by sealant manufacturer by testing and related experience.
B. Standard Compliance:
   1. Joint Sealants: Comply with ASTM C 920 and other specified requirements for each liquid-applied joint sealant.
   2. Structural Glazing Sealants: Comply with ASTM C 1184 and other specified requirements for each liquid-applied structural glazing sealant where indicated.
C. Stain Test Characteristics: Where sealants are required to be nonstaining, provide sealants tested per ASTM C 1248 as non-staining on porous joint substrates indicated for Project.

2.3 SILICONE GLAZING SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant GS# 1: ASTM C 920, Type S, Grade NS, Class 50, Use NT; ASTM C 1184; SWRI validation.
   1. Basis of Design Product: DOW CORNING® 995 Silicone Structural Sealant.
   2. Hardness, ASTM D 2240: 35 - 45 durometer Shore A, minimum.
   3. Volatile Organic Compound (VOC) Content: 34 g/L maximum.
   4. Color: As selected by Architect from manufacturers full line of not less than 3 colors].
   5. Ultimate Tensile, ASTM D 412: 300 psi (2.2 MPa), at 21 day cure (Dumbbell)
   6. Ultimate Tensile, ASTM C 1135: 160 psi (1.1 MPa), at 21 day cure (TA Joint)

2.4 ACCESSORIES

A. Joint Substrate Primers: Substrate primer recommended by sealant manufacturer for application.

B. Cylindrical Sealant Backing: ASTM C 1330, Type B non-absorbent, bi-cellular material with surface skin, or Type O open-cell polyurethane, as recommended by sealant manufacturer for application.
C. Bond Breaker Tape: Polymer tape compatible with joint sealant materials and recommended by sealant manufacturer.
D. Glazing Setting Blocks and Spacers: Inorganic type compatible with silicone sealant and recommended by sealant manufacturer.
   1. Acceptable materials include silicone, alcryn, polyurethane foam tape, and vinyl extrusions.
   2. Test setting blocks and spacers for compatibility prior to installation.
E. Masking tape: Non-staining, non-absorbent type compatible with silicone sealant and adjacent surfaces.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine joint profiles and surfaces to determine if work is ready to receive joint sealants. Verify joint dimensions are adequate for development of sealant movement capability. Proceed with joint sealant work once conditions meet sealant manufacturer's recommendations.
B. Aluminum Framing:
   1. Verify framing surfaces to receive glazing are flat and smooth without slots, serrations, and other irregularities.
   2. Verify aluminum framing has alodine, anodized, fluorocarbon paint, polyester powder coat finish, or other acceptable finish or material.

3.2 PREPARATION

A. Structural Silicone Joint Design: Install sealant in joint design configuration recommended by manufacturer and as follows:
   1. Glueline thickness: 1/4 inch (6 mm) minimum and not to exceed 1/2 inch (13 mm).
   2. Structural Bite: 1/4 inch (6 mm) minimum and equal to or greater than glueline thickness.
   3. Bite-to-Glueline Ratio: 3:1 or less.
   4. Design and fill joint using manufacturer's recommended sealant application procedures for use in retrofit protective glazing.
B. Joint Surface Cleaning: Clean joints prior to installing joint sealants using materials and methods recommended by sealant manufacturer.
   1. Remove laitance, form-release agents, dust, and other contaminants.
   2. Clean porous and nonporous surfaces utilizing chemical cleaners acceptable to sealant manufacturer.
      a. Use two-cloth solvent wipe in accordance with ASTM C 1193.

3.3 APPLICATION

A. Masking: Mask adjacent surfaces to prevent staining or damage by contact with sealant or primer.
B. Joint Priming: Prime joint substrates when recommended by sealant manufacturer or when indicated by preconstruction testing or experience. Apply recommended primer using sealant manufacturer's recommended application techniques.
C. Joint Backing: Select joint backing materials recommended by sealant manufacturer to be compatible with sealant material. Install backing material at depth required to produce profile of joint sealant allowing optimal sealant movement. Install without gaps, twisting, stretching, or puncturing backing material. Use gage to ensure uniform depth to achieve correct profile, coverage, and performance.
    1. Install bond breaker tape over substrates when sealant backings are not used.
D. Spacers and Setting Blocks: Install as indicated on drawings and reviewed shop drawings. Ensure joint openings and recesses are accurately sized.
E. Temporary Glass Support: Use temporary fasteners, clips, two-sided adhesive, and other means to retain glass panels while sealant is applied and allowed to cure as approved by the design professional.
F. Sealant Application: Install sealant using methods recommended by sealant manufacturer for use in retrofit protective glazing installations.
G. Cleaning: Remove excess sealant using materials and methods approved by sealant manufacturer that will not damage joint substrate materials.
    1. Remove masking tape immediately after tooling joint without disturbing seal.
    2. Remove excess sealant from surfaces while still uncured.
H. Allow sealant to fully cure before adhesive is stressed. Use test specimens formed at time of sealant application to verify curing time. When cured, remove temporary glass supports.
I. Ensure installed sealant is not painted as part of other construction operations.

3.4 WEATHER BARRIER TRANSITION APPLICATION

A. Preparation: Prepare field of weather barrier surface and surface of adjacent substrate in accordance with sealant manufacturer's written instructions. Perform field adhesion testing to determine need for application of primer. Clean surfaces to dust free, and perform solvent wipe where recommended.
B. Application: Apply bead of recommended liquid joint sealant to each side of joint in bead size recommended by manufacturer. Press transition extrusion into sealant using roller to ensure uniform and complete contact. Lap vertical and horizontal joints as indicated in manufacturer's instructions. Trim transition material. Remove excess sealant.

3.05 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Perform adhesion tests in accordance with manufacturer’s instructions and with ASTM C 1193, Method A.
    1. Perform 5 tests for the first 1000 feet (300 m)of joint length for each kind of sealant and joint substrate, and one test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per building elevation, minimum.
    2. For sealant applied between dissimilar materials, test both sides of joint.
B. Remove sealants failing adhesion test, clean substrates, reapply sealants, and re-test. Test adjacent sealants to failed sealants.

C. Submit report of field adhesion testing to Architect indicating tests, locations, dates, results, and remedial actions taken.

3.6 GLAZING SEALANT SCHEDULE

A. Structural glazing adhesive joints in retrofit protective glazing installations.
   1. Joint Sealant: Single-component neutral-curing non-staining silicone sealant GS# 1.
   2. Joint Sealant Color: As selected by Architect from manufacturer's full range

END OF SECTION

SECTION 08 87 23 - SAFETY AND SECURITY FILMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Security film system for glazing.

1.2 RELATED REQUIREMENTS

A. 07 92 00 - Joint Sealants

1.3 REFERENCED STANDARDS

A. ASTM F3561 - Standard Test Method for Forced-Entry-Resistance of Fenestration Systems After Simulated Active Shooter Attack.
B. ASTM F588 - Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact.
C. ASTM D1044 - Standard Test Method for Resistance of Transparent Plastics to Surface Abrasion by the Taber Abraser.
D. ASTM E308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE System.
E. ASTM E903 - Standard Methods of Test for Solar Absorbance, Reflectance, and Transmittance of Materials Using Integrating Spheres.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements, for submittal procedures
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Record of product certification for safety requirements.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Typical installation methods and details.
C. Verification Samples: Two representative units of each type, thickness, pattern, and color. Sample size: 6 inches by 6 inches.
D. Test Reports: Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.
E. Specimen Warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of ten years successful experience.
B. Installer Qualifications: certified by glazing film manufacturer.
C. Source Limitations: Provide each type of product from a single manufacturing

source to ensure uniformity.

D. Clearly label each film roll with product designation and lot number.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
B. Protect from damage due to weather, excessive temperature, and construction operations.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

A. Manufacturer's standard limited warranty unless indicated otherwise.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Impact Security LLC:
400 Glover St.
Marietta, GA 30060
Web: https://www.defenselite.com
B. Substitutions: See Section 01 60 00 - Product Requirements.
1. For any product not identified as "Basis of Design", submit information as specified for in Section 01 60 00 - Product Requirements.

2.2 SYSTEM DESCRIPTION

A. Film Material: Optically clear polyester film with a durable abrasion-resistant coating on one side and UV-stabilized pressure-sensitive adhesive on the other.
B. Adhesive Material: Pressure-sensitive weatherable acrylic adhesive applied uniformly, ensuring optical clarity and no distortion when viewed from a distance of 10 feet (3 m) at angles up to 45 degrees.

2.3 PERFORMANCE REQUIREMENTS

A. Standards Compliance:
1. Forced-Entry Rating Level: RiotLite 27 mil film meets the requirements of ASTM F3561 Level 3 when installed on 1/4 inch (6.35 mm) single pane

tempered glass with structural caulk anchor, installed on aluminum commercial glazing frames.

2. Forced-Entry Resistance: RiotLite 27 mil film meets the requirements of ASTM F588, Type D, Grade 40.

2.4 SECURITY FILM SYSTEM FOR GLAZING

A. Basis of Design: RiotLite Security Film, 27 mil Thickness
   1. Performance Properties on Single Pane 1/4 inch (6.35 mm) Clear Glass:
      a. Solar Heat Gain Coefficient: 0.82.
      b. Visible Light Transmitted: 85 percent.
      c. Visible Light Reflected (Interior): 8 percent.
      d. Visible Light Reflected (Exterior): 8 percent.
      e. U-Value: 1.03.
      f. UV Block: 99 percent.
      g. Total Solar Energy Rejected: 19 percent..
      h. Glare Reduction: 1 percent
   2. Product Strength Data:
      a. Tensile Strength: 32,000 PSI.
      b. Break Strength: 700 lbs per inch (12.5 kg per mm).
      c. Puncture Strength: Greater than 355 lbs (161 kg).
      d. Elongation: Greater than 200 percent.
      e. Peel Strength: Greater than 5 lbs per inch (0.1 kg per mm).

PART 3 – EXECUTION

3.1 EXAMINATION

A. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.
B. Examine glass surfaces to receive new film and verify that they are free from defects and imperfections, which will affect the final appearance.
C. Correct all such deficiencies before starting the film application process.

3.2 PREPARATION

A. Clean window and window framing surfaces thoroughly using a neutral cleaning solution. Scrape inside surface of window glass with a stainless steel razor blade with a clean, sharp edge to ensure the removal of any foreign contaminants without damage to the glass surface.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.

B. Installation must be performed by a manufacturer certified installer.
C. Cut film to specifications utilizing a sharp razor blade neatly and square at a uniform distance of 1/16 inch (1.6 mm) of the window-sealing device.
D. Apply film using a wet application method with clean water and slip solution to facilitate positioning of the film onto the glass.
E. Use a stiff polyurethane squeegee to remove excess water from the underside of the film and maximize adhesive bonding of the pressure sensitive adhesive.
F. Upon completion, film may have a dimpled appearance from residual moisture. Said moisture shall, under reasonable weather conditions, dry flat with no moisture dimples within a period of 90 days when viewed under normal viewing conditions.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

A. Clean film using common non-abrasive window cleaning solutions.
B. Avoid ammonia-based cleaners for metallized constructions.
C. Do not use abrasive type cleaning agents and bristle brushes which could scratch the film.
D. Repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 87 33 - WINDOW FILM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural Window Film:

1.2 RELATED SECTIONS

A. Section 08 87 23 – Security Film System for Glazing.

B. Section 08 44 23 - Structural Sealant

1.3 REFERENCES

A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

B. ASHRAE - American Society for Heating, Refrigeration, and Air Conditioning Engineers; Handbook of Fundamentals.

C. ASTM International (ASTM):
1. ASTM D 882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
2. ASTM D 5895 - Standard Test Methods for Evaluating Drying or Curing During Film Formation of Organic Coatings Using Mechanical Recorders.
3. ASTM E 84 - Standard Method of Test for Surface Burning Characteristics of Building Materials.
4. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
5. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

D. Consumer Products Safety Commission 16 CFR, Part 1201 - Safety Standard for Architectural Glazing Materials.

E. NFRC 100/200 (Formerly ASTM E903) - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.

1.4 PERFORMANCE REQUIREMENTS

A. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use:
1. Flame Spread Index: no greater than 25.
2. Smoke Developed Index: no greater than 55.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00.

B. Product Data: Manufacturer's current technical literature on each product to be used,

including:
1. Manufacturer's Data Sheets.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Installation methods.

C. Verification Samples: For each film specified, two samples representing actual film color and pattern.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
1. Provide documentation that the adhesive used on the specified films is a Pressure Sensitive Adhesive (PSA).

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
a. Name of building.
b. The name and telephone number of a management contact.
c. Type of glass.
d. Type of film and/or film attachment system.
e. Amount of film and/or film attachment system installed.
f. Date of completion.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Follow Manufacturer's instructions for storage and handling.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

B. In order to validate warranty, installation must be performed by an Authorized 3M dealer and according to Manufacturer's installation instructions. Verification of Authorized 3M dealer can be confirmed by submission of active 3M dealer code number.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Architectural Finish Films: Glass finishes field-applied application to glass or plastic material as visual opaque or decorative film.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements provide 3M Commercial Solutions; 3M CRYSTAL Glass finishes, DUSTED or comparable product by one of the following:

a. Avery Dennison
b. Madico

B. Material Properties:
1. Film: Vinyl.
2. Option to Electrocut (by other than Manufacturer).
3. Adhesive: Acrylic, Pressure Sensitive, Permanent.
4. Liner: Silicone-coated Polyester.
Thickness (Film and Adhesive without Liner): 3.2 mils (81 microns).
5. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84, Class A:
a. Flame Spread: 25 maximum.
b. Smoke Developed: 450 maximum.

C. Optical Performance:
1. Decorative / Privacy Glazing Film:
a. Ultraviolet Transmittance (ASTM E 903): 27 percent.
b. Visible Light Transmittance (ASTM E 903, ASTM E308): 85 percent.
c. Visible Light Reflectance (ASTM E 903): 79 percent.
d. Solar Heat Transmittance: 76 percent.
e. Solar Heat Reflectance: 7 percent.
f. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.93.

PART 3 EXECUTION

3.1 EXAMINATION

A. Film Examination:
1. If preparation of glass surfaces is the responsibility of another installer, notify

Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

a. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.

2. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
3. Commencement of installation constitutes acceptance of conditions.

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.

C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

3.3 INSTALLATION

A. Film Installation, General:
1. Install in accordance with manufacturer's instructions.
2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
4. Apply film to glass and lightly spray film with slip solution.
5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
8. If completing an exterior application, check with the manufacturer as to whether edge sealing is required.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A. Metal stud wall framing.
- B. Gypsum sheathing.
- C. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS
- A. Section 05 40 00 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.
- C. Section 07 21 00 - Thermal Insulation
- D. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- E. Section 07 92 00 - Joint Sealants: Sealing gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS
- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).
- B. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.
- C. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.
- D. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- E. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2012.
- F. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- G. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- J. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- K. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- L. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- M. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- N. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- O. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
- P. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- Q. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- R. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as

Sheathing; 2017.
S. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
T. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018 (Reapproved 2023).
U. ASTM C1288 - Standard Specification for Fiber-Cement Interior Substrate Sheets; 2023.
V. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
W. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
X. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2023.
Y. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
Z. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
AA. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
BB. ASTM E413 - Classification for Rating Sound Insulation; 2022.
CC. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
DD. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.
EE. UL (FRD) - Fire Resistance Directory; Current Edition.
FF. UL 752 - Standard for Bullet-Resisting Equipment; Current Edition, Including All Revisions.
GG. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
HH. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.
B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
B. Product Data:
1. Provide data on metal framing, gypsum board, glass mat faced gypsum board, accessories, and joint finishing system.
2. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
C. Steel Framing Industry Association (SFIA) Certification:
1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.
D. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
E. Ballistic Test Reports: Indicate compliance of bullet-resistant sheathing and wallboard assemblies with specified requirements.

1.06 QUALITY ASSURANCE
A. SFIA Code Compliance Certification Program: www.CFSteel.org/#sle: Use metal studs and connectors certified for compliance with International Building Code.

B. Manufacturer Qualifications: Member of Steel Stud Manufacturers Association (SSMA): www.ssma.com/#sle.
C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.07 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

2.01 GYPSUM BOARD ASSEMBLIES
A. Provide completed assemblies complying with ASTM C840 and GA-216.
1. See PART 3 for finishing requirements.
B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
D. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216.
E. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD). Refer to Drawings for UL Assembly Numbers.

2.02 METAL FRAMING MATERIALS
A. Material and Product Requirements Criteria: AISI S201.
B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
1. Structural Grade: As required to meet design criteria.
2. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.
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.
4. Substitutions: See Section 01 60 00 - Product Requirements.
D. Structural Steel Framing for Application of Gypsum Board: See Section 05 40 00.
E. 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/240 at 5 psf.
1. Studs: C-shaped with knurled or embossed faces with knurled or embossed faces.
2. Gauge: 33 mil (20 gage) minimum
3. Runners: U shaped, sized to match studs.
4. Ceiling Channels: C-shaped.
5. Flexible Track: Flexible framing consisting of adjustable leg straps and pivoting, hinged

track brackets designed to provide curved framing assemblies of varying radii.
6. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
7. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.
   a. Products:
      1) ClarkDietrich; Sound Clip (CDSC): www.clarkdietrich.com/#sle.
      2) PAC International, Inc; RSIC-1: www.pac-intl.com/#sle.
      3) Substitutions: See Section 01 60 00 - Product Requirements.

F. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
G. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
H. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   3. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
      a. Products:
         1) ClarkDietrich; BlazeFrame RipTrak: www.clarkdietrich.com/#sle.
         2) FireTrak Corporation; Posi Klip: www.fire-trak.com/#sle.
         3) Metal-Lite, Inc; The System: www.metal-lite.net/#sle.
         4) Super Stud Building Products, Inc; Slotted Deflection Track: www.buysuperstud.com/#sle.
         5) Substitutions: See Section 01 60 00 - Product Requirements.
I. Non-structural Framing Accessories:
   1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
      a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
      b. Height: 35-3/4 inches.
      c. Products:
         1) ClarkDietrich; Pony Wall (PW): www.clarkdietrich.com/#sle.
         2) Substitutions: See Section 01 60 00 - Product Requirements.
J. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. CertainTeed Corporation: www.certainteed.com/ceilings-and-walls/#sle.
      b. USG Corporation; Drywall Suspension System: www.usg.com/#sle.
      c. Armstrong World Industries, Inc.: www.armstrongceilings.com .
      d. Chicago Metallic Drywall Grid System: www.rockfon.com.
      e. Substitutions: See Section 01 60 00 - Product Requirements.
   2. General:
      a. Classification: ASTM C-635 Heavy duty classification
      b. Use G90 galvanized components for exterior applications.
   3. Components:
      a. Main Beam: double-web construction (minimum 0.0179 inch prior to protective

coating, ASTM C645), hot dipped galvanized (per ASTM A653); 1-11/16 inch web height, 1-1/2 inch flange.

b. Primary Cross Tees: double-web steel construction (minimum 0.0179 inch prior to protective coating, ASTM C645), hot dipped galvanized (per ASTM A653); 1-1/2 inch web height with rectangular bulb and pre-finished 1-1/2 inch knurled flange

c. Wall Molding: Locking Angle Molding, 1-1/4 inch x 1-1/4 inch with pre-engineered locking tabs punched 8 inches on center, knurled surface, screw stop hem, pre-punched holes in top flange, 4" O.C., .018 mil.

2.03 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.
5. Substitutions: See Section 01 60 00 - Product Requirements.
6. Glass Mat Faced Products:
   a. CertainTeed Corporation; 5/8" GlasRoc Interior Type X: www.certainteed.com/#sle.
   b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Interior Extreme Fire-Shield Gypsum Panel: www.goldbondbuilding.com/#sle.
   c. USG Corporation; Sheetrock Brand Glass-Mat Panels Mold Tough Regular 5/8 in. (15.9 mm): www.usg.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
4. Core Type: Type X, all locations
5. Type X Thickness: 5/8 inch.
6. Edges: Square.
7. Glass Mat Faced Products:
   a. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing: www.certainteed.com/#sle.
   b. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing: www.gpgypsum.com/#sle.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.
   d. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
   e. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: See Section 07 21 00.
B. Acoustic Sealant: As specified in Section 07 92 00; Type 5.
C. Water-Resistive Barrier: See Section 07 25 00.
D. Beads and Beads: ASTM C1047, paper-faced galvanized steel , unless noted otherwise.

1. Corner Beads: Low profile, for 90 degree outside corners.
2. Expansion Joints:
   a. Fire-Resistance Rated: 2 hours when joint system tested in accordance with UL 2079.
   b. Type: V-shaped metal with factory-installed protective tape.

E. Decorative Metal Trim:
1. Material: Extruded aluminum alloy 6063-T5 temper.
2. Finish: Anodized, clear.
3. Type: Profile as selected from manufacturer's standard range.
   a. Products:
      1) Fry Reglet Architectural Metals: www.fryreglet.com..
      2) Gordon Inc: www.gordon-inc.com/#sle.
      3) Pittcon Industries: www.pittconindustries.com/#sle.
      4) Substitutions: See Section 01 60 00 - Product Requirements.

F. Vertical Closure Between Partitions and Window Mullions: Extruded aluminum partition closures, pre-assembled and spring loaded to provide a tight fit for vertical junctures of partitions and window walls:
1. Extruded aluminum extrusions: 6063-T5 temper
   a. Finish: Acrylic-Polyester powder coat, as selected from manufacturer's standard colors.
2. Acoustical insulation: batt, factory-installed.
3. Manufacturer and Product: Mullion Mate Series 30, Gordon Inc.: www.gordon-inc.com.
4. Accessories: Provide partition end caps, aluminum extrusions to match partition thickness.

G. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
2. Joint Compound: Setting type, field-mixed.

H. High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
1. Products:
   a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfacer with M2Tech: www.certainteed.com/#sle.
   b. USG Corporation; USG Sheetrock Brand Tuff-Hide Primer-Surfacer: www.usg.com/#sle.
   c. Substitutions: See Section 01 60 00 - Product Requirements.

I. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

J. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
1. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special

friction studs.
1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.
B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
   1. Level ceiling system to a tolerance of 1/1200.
   2. Laterally brace entire suspension system.
C. Studs: Space studs at 16 inches on center.
   1. Extend partition framing to structure where indicated and to ceiling in other locations.
   2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
E. Standard Wall Furring: Install at concrete and concrete walls scheduled to receive gypsum board, not more than 4 inches 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches 24 inches on center.
   1. Orientation: Horizontal.
   2. Spacing: At 16 inches on center.
F. Resilient Sound Isolation Clips: Install resilient sound isolation clips, and where applicable, associated furring sections and channels, in accordance with clip manufacturer's written instructions.
G. Blocking: Install wood blocking for support of:
   1. Framed openings.
   2. Wall-mounted cabinets.
   3. Plumbing fixtures.
   4. Toilet partitions.
   5. Toilet accessories.
   6. Wall-mounted door hardware.
   7. Handrails and grab bars
   8. Wall brackets
   9. Display cases, bulletin boards, tack and markerboards.
   10. Monitor mounts.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
   Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt

end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

C. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

F. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically vertically, with edges butted tight and ends occurring over firm bearing.
   1. Seal joints, cut edges, and holes with water-resistant sealant.
   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.
   5. Horizontal Installation: Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud
   6. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
   7. 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.

G. Cementitious Backing Board: Install over steel framing members and steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

H. Installation on Metal Framing: Use screws for attachment of gypsum board.

I. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

J. Bullet Resistant Sheathing and Wallboard:
   1. Install bullet-resistant sheathing according to manufacturer's written recommendations and with manufacturer-approved fasteners.
   2. Cover all joints between boards with a 4-inch strip of the same thickness material as the boards, centered on the joint.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use fiberglass joint tape, embed with setting type joint compound and finish with setting type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

1. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
2. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

D. 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.
2. Taping, filling, and sanding are not required at base layer of double-layer applications.

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.09 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

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 DESCRIPTION OF WORK

A. Provide all plant, labor, materials, accessories, equipment and incidentals required to complete Painting and Coating work, including but not necessarily limited to, the following:

1. Surface preparation, priming and finish painting and coating of surfaces, except as otherwise specified.
2. Multiple colors, patterns, borders, fields and designs as indicated and/or selected by the Architect.
3. Finish painting and coating primed surfaces, except as otherwise indicated.
4. Exposed to view structural steel, joists, decking, lintels, covered and bare pipes and ducts (including color coding), hangers and the like along with primed metal surfaces of mechanical and electrical equipment, unless otherwise indicated, are to be painted and are included in the work of this section.
5. Do not paint prefinished items, conceal surfaces, finished metal surfaces, operating parts and labels.
6. Where touch-up painting and coating work is required, re-finish the entire surface plane.
7. All other surfaces, not specifically noted, that require painting or coatings.

B. Paint or coat exposed surfaces, except where the finish schedule indicates that a surface or material is not to be painted, coated or is to remain natural. If the schedules do not specifically mention an item or a surface, paint or coat the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting and coating work includes field finishing of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

C. Following categories of work are not included as part of field applied finish work or are included in other sections of these specifications.

1. Shop Priming: Shop priming of ferrous metals items is included under various sections covering structural steel, miscellaneous metal, hollow metal work and similar items.

2. Factory finished materials and equipment, including aluminum doors and frames, aluminum windows, skylights, curtain walls, exterior wall louvers, toilet partitions, toilet accessories, architectural woodwork to extent shop finished, prefinished wood doors, storage shelving, lockers, visual display board trim, prefinished gravel stop, coping and fascia, metal edges, flashing, cyclone fence, acoustic plaster, and similar items.
3. Painting, coating and identification systems for mechanical and electrical work is specified in Plumbing, HVAC and Electrical Contracts Divisions, except as otherwise indicated.
4. Unless otherwise indicated, painting and coatings are not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, furred areas, pipe spaces, duct shafts, lift shafts.
5. Do not paint moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts, unless otherwise indicated.

1.3 REFERENCES

A. SSPC (The Society for Protective Coating) – Steel Structures Painting Manual

B. EPA (Environmental Protection Agency) Method 24

C. UL (Underwriters' Laboratories)

D. ASTM E 84 – Test method for Surface Burning Characteristics of Building Materials

E. OTC (Ozone Transport Commission)

F. Applicable state requirement for VOC (Volatile Organic Compounds)

1.4 DEFINITIONS

A. Sheen: Specular gloss readings in accordance with ASTM D52

1.	Flat	less than 5	(measured at 85 degrees)
2.	Eggshell	5-20	(measured at 60 degrees)
3.	Satin	15-35	(measured at 60 degrees)
4.	Low Luster	25-35	(measured at 60 degrees)
5.	Semi-Gloss	30-65	(measured at 60 degrees)
6.	Gloss	65 or more	(measured at 60 degrees)

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's descriptive product data for each paint and coating product finish system specified. Include block fillers and primers. Product data shall include the product name and number, product descriptive performance data, (generic classification or binder type), manufacturer's stock number and date of manufacture, contents by volume for pigment and vehicle constituents, thinning, mixing, application and curing instructions, color name and number, and VOC content and . Submit certification on manufacturer's letterhead certifying all paint and coating products being provided are in compliance with VOC requirements as required by all applicable local and state regulatory agencies with initial submittal and again at time of application. Submit manufacturer's printed application instructions and methods, including mixing, surface preparation, compatible primers and topcoats, recommended wet and dry film thickness.

B. Prior to delivery of materials to the site, the Painting subcontractor shall submit for approval, the names and products of the manufacturer to be used. This list shall be on the manufacturer's letterhead and as detailed as the list specified below in Painting and Coating Schedule. The list shall include the specific brands of paints, coatings and finishes that will be provided for each differing surface, plus a statement that the products are suitable for the purposes intended and that they comply with the Specifications. This list shall identify where each product will be used within the project, and on what surface. Submission of manufacturer's materials list and certification of compliance shall receive Architect's approval and/or comment prior to ordering materials.

C. Colors and Samples: Colors shall be selected by the Architect. The Architect will furnish the Painting subcontractor a schedule of colors and locations of various colors.

1. Selected color may or may not be ready mixed colors. Painting subcontractor shall furnish all colors, whether ready mixed, intermixed or special. The Architect will not be restricted in number of colors selected.
2. Submit for Architect's preliminary approval two 6" x 8" stepped brush out samples defining each separate coat. First coat shall be 50% than specified finish coat color. Each succeeding coat shall be 50% lighter than specified finish coat color. Include block fillers and primers of each standard and intermix color selected in a step down fashion on a leneta display card by the approved painting and coating manufacturer and each color shall have manufacturer's identification designation thereon. Provide brush out samples on actual wood surfaces of the appropriate species for transparent finished woods.
3. Identify each sample with color name and number; and product name and number
4. Final acceptance of colors will be from samples applied on the job.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has complete painting and coating system applications similar in material and extent to that indicated for this Project with a record of successful in service performance. Applicator for textured systems shall be one who is approved by the textured system manufacturer for proper application of the system.

B. Source limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Material application shall be applied under adequate illumination, evenly spread and smoothly applied, free of runs, sags, holidays, lap marks, air bubbles, and pin holes to assure a smooth finish.

D. Mock-Ups: Where directed provide a field sample 10 feet long by 10 feet wide (or ceiling height), completed door frame unit, as applicable, in each paint system specified. Modify as directed until accepted.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the job site in original unbroken sealed containers with manufacturer’s labels intact and in strict accordance with manufacturer's written recommendations. Each container shall be inspected and approved prior to being opened for use. Maintain containers in clean condition, free of foreign materials and residue.

B. Take every precaution against fire. Store materials in tightly covered containers, in a well ventilated locked area with ambient temperatures continuously maintained at not less than 45 deg. F (7 deg. C) and in accordance with manufacturer’s written requirements. Keep rags, waste, debris, and materials which may constitute fire hazard in water-filled closed, tightly covered, properly labeled, metal containers for daily removal. If tarpaulins are used, they shall be kept neat and no smoking shall be permitted within the space. Provide and maintain proper Class C hand fire extinguishers in the immediate area and all personnel shall be instructed in their use and informed of their location.

C. Take every precaution against the hazards of fume inhalation. Keep all areas well ventilated at all times. Where natural ventilation is insufficient to provide suitable conditions, provide special fans. If necessary, provide suitable face masks for mechanics.

1.8 PROJECT CONDITIONS

A. Apply paints and coatings only when temperature of surfaces to be painted or coated and surrounding air temperatures is above 50 and below 90 deg F. (10 and 35 deg. C), unless otherwise permitted by and in accordance with manufacturer's printed instructions.

B. Do not apply paint and coatings in snow, rain, fog, mist, or when relative humidity exceeds 70 percent and the surface temperature is at least 5 deg, F (3 deg. C) above the dew point. Prevent wide variation of temperature that might result in condensation on freshly coated surfaces.

C. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 50 deg. F (3 deg. C) for 24 hours before, during and 48 hours after application of finishes.

D. Painting and coating work may be continued during inclement weather if areas and surfaces to be finished are enclosed and heated within temperature and ambient limits specified by the manufacturer during application and drying periods.

E. Take moisture readings of surfaces to be finished on a daily basis with a reliable electronic moisture meter and record moisture readings. Moisture content shall not vary more than the amount allowed by the paint manufacturer's written requirements and recommendations.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional (2) percent, but not less than 1 gal. (3.8 L) of each material and color applied.

2. Label each container with color, type, gloss and room locations in addition to manufacturer's clear and unobstructed label.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S QUALITY

A. Materials shall be the highest quality grade (first line architectural), products of their respective kinds. Primers, stains and finish(es) of each coating system shall be of the same manufacturer.

B. Product identification and basis of design is for quality reference only. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following, or approved equal.

1. Sherwin Williams
2. Benjamin Moore
3. PPG

C. Coatings for each system shall be the product of the same manufacturer to ensure compatibility of systems. Substitutions of equivalent products of other manufacturers may be submitted for approval providing the products submitted are of the same types, have label analyses similar to those specified, meet or exceed the performance criteria, and are suitable for the use intended as approved by the Architect.

D. Use thinning materials only as specified by manufacturer's labeled directions for each type of paint and coating. All coatings shall conform to all Federal, State and Local Regulations including VOC rules and air quality standards in effect at the Project location at the time of application.

2.2 MATERIALS GENERAL

A. Material Compatibility:

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

B. VOC Content of Field-Applied Interior paints, primers, stains, and transparent finish coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints, primers, stains, and transparent finish coatings that are applied in a fabrication or finishing shop:

1. Primers and Undercoaters: VOC content of not more than 100 g/L.
2. Flat Paints, Coatings: VOC content of not more than 50 g/L.
3. Nonflat Paints, Coatings: VOC content of not more than 50 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
5. Clear Wood Finishes, Varnishes: VOC not more than 275 g/L.
6. Clear Wood Finishes, Lacquers: VOC not more than 275 g/L.
7. Floor Coatings: VOC not more than 50 g/L.
8. Waterproofing Sealers: VOC not more than 250 g/L
9. Sanding Sealers: VOC not more than 275 g/L
10. All Other Sealers: VOC not more than 200 g/L
11. Shellacs, Clear: VOC not more than 730 g/L.
12. Shellacs, Pigmented: VOC not more than 550 g/L.
13. Stains: VOC not more than 100 g/L.

C. Colors: As indicated, or if not indicated, as selected by the Architect from manufacturers full range.

2.3 PAINTING AND COATING SCHEDULE

A. The following is a general guide for the finish painting required, but does not include every surface or material to be finished or painted. Paint schedule is based on each Manufacturer's first line quality products. Substitution products shall be accompanied by manufacturer's literature establishing evidence of the same; and interior products shall also be in compliance with VOC limits and shall not contain restricted Chemical Components described above.

B. Each of various undercoats of paint other than natural finishes to be a slightly different shade from the preceding coat stepping up to color selected in order to verify number of coats applied.

2.4 EXTERIOR PAINT AND COATING SCHEDULE

A. Shop Primed Ferrous Metal – gloss acrylic enamel:
1. Prime Coat: touch up as necessary
   a. Sherwin-Willams: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series
   b. Benjamin Moore: M-28 Acrylic Metal Primer

c. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel
2. Finish Coats: 2 coats
   a. Sherwin-Williams: S-W Pro Industrial Acrylic Gloss Coating, B66 Series
   b. Benjamin Moore: M-28 Acrylic Gloss Enamel
   c. PPG: Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamel

B. Ferrous Metal – gloss acrylic enamel:
1. Prime Coat: 1 coat
   a. Sherwin Williams: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series
   b. Benjamin Moore: M-28 Acrylic Metal Primer
   c. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel
2. Finish Coats: 2 coats
   a. Sherwin-Williams: S-W Pro Industrial Acrylic Gloss Coating, B66 Series
   b. Benjamin Moore: M-28 Acrylic Gloss Enamel
   c. PPG: Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamel

C. Galvanized Ferrous Metal: Provide the following finish systems over galvanized ferrous metal:
1. Primer: 1 coat
   a. Sherwin-Williams: S-W: DTM Acrylic Primer/Finish, B66W1 for galvanized steel.
   b. Benjamin Moore: M-28 Acrylic Metal Primer
   c. PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel
2. Finish Coats: 2 Coats gloss,
   a. Sherwin-Williams: S-W: DTM Acrylic Coating B66.
   b. Benjamin Moore: M-28 Acrylic Gloss Enamel
   c. PPG: Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamel

2.5 INTERIOR PAINT AND COATING SCHEDULE

A. Shop Primed Ferrous Metal – semi gloss acrylic enamel: Provide the following finish systems over Shop Primed Ferrous Metal – semi gloss acrylic enamel.
1. Shop Primed Ferrous Metal – semi gloss acrylic enamel:
   a. Prime Coat: touch up as necessary
      1) Sherwin-Williams: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series
      2) Benjamin Moore: M-04 Acrylic Metal Primer
      3) PPG: Pitt-Tech Interior/Exterior Primer/Finish DTM Industrial Enamel
2. Finish Coats: 2 coats
   a. Sherwin-Williams: ProMar 200 Interior Latex semi semi-gloss
   b. Benjamin Moore: Super Spec Semi-Gloss Enamel 276
   c. PPG: Pitt-Tech Interior/Exterior High Gloss DTM Industrial Enamel

B. Gypsum Board - flat latex: to match existing paint finishes and paint colors.
1. Prime Coat: 1 coat
   a. Sherwin-Williams: S-W ProMar 200 Zero VOC Latex Primer, B28W2600
   b. Benjamin Moore: Super Spec Latex Enamel Undercoater and Prime Sealer 253 Primer
   c. PPG: Speedhide Pro-EV Zero Interior Latex Primer

2. Finish Coats: 2 coats
    a. Sherwin-Williams: ProMar 200 Interior Latex flat
    b. Benjamin Moore: Super Spec Latex flat 275
    c. PPG: Speedhide Pro-EV Zero Interior Flat

C. Gypsum Board - Eggshell latex: to match existing paint finishes and paint colors.
1. Prime Coat: 1 coat
    a. Sherwin-Williams: S-W ProMar 200 Zero VOC Latex Primer, B28W2600
    b. Benjamin Moore: Super Spec Latex Enamel Undercoater and Prime Sealer 253 Primer
    c. PPG: Speedhide Pro-EV Zero Interior Latex Primer
2. Finish Coats: 2 coats
    a. Sherwin-Williams: ProMar 200 Interior Latex Eg-Shel
    b. Benjamin Moore: Super Spec Latex Eggshell Enamel 274
    c. PPG: Speedhide Pro-EV Zero Interior Eggshell

D. Gypsum Board - Semi-Gloss latex: to match existing paint finishes and paint colors.
1. Prime Coat: 1 coat
    a. Sherwin-Williams: S-W ProMar 200 Zero VOC Latex Primer, B28W2600
    b. Benjamin Moore: Super Spec Latex Enamel Undercoater and Prime Sealer 253 Primer
    c. PPG: Speedhide Pro-EV Zero Interior Latex Primer
2. Finish Coats: 2 coats
    a. Sherwin-Williams: ProMar 200 Interior Latex Semi-Gloss Enamel
    b. Benjamin Moore: Super Spec Latex Semi-Gloss Enamel 274
    c. PPG: Speedhide Pro-EV Zero Interior Semi-Gloss

E.

2.6 MISCELLANEOUS

A. Miscellaneous Items:

1. Provide multiple colors, patterns, borders, fields and designs as indicated, or if not indicated, as selected by the Architect.
2. Items not specifically detailed or mentioned in specifications but necessary to be painted for proper completion of job, shall be painted in accordance with instructions from Architect.

PART 3 - EXECUTION

3.1 INSPECTION

A. Applicator shall examine areas and conditions under which painting work is applied and take moisture readings with a reliable electronic moisture meter in sufficient area in each space and as often as necessary to determine the proper moisture content for application and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not

proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator and in accordance with paint manufacturer's written requirements for surface preparation. Starting of painting work will be construed as Applicator's acceptance of such faces and conditions within any particular area.

3.2 SURFACE PREPARATION

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's written instructions and recommendations and as herein specified, for each particular substrate condition.

B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted or provide surface-applied protection prior to surface preparation and painting operations.

C. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed item.

D. Contractor shall prepare all surfaces, walls, ceilings, metal frames, etc., which are to be painted, including but not limited to, scraping, sanding, spackling, patching etc. as necessary to remove loose particles, paint, mildew, greasy residue, splatters, burrs, graffiti, surface decals, surface applied texture materials, mastic, glue, etc. Repoint and/or spackle holes, voids, defects, etc. to form a smooth level surface. Remove nails, screws, anchors and the like. Sand existing metal frames, etc. to smooth out edges of various paint layers.

E. Clean surfaces to be painted before applying paint or surface treatments. Remove dirt, oil and grease using an oil and grease emulsifier such as Moore's M83 or approved equal in accordance with SSPC-SPI Method B2 prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly painted surfaces.

F. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated of oil, grease, dirt loose mill scale and other foreign substances by solvent or mechanical cleaning (SSPC – SP-1).

G. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum base solvent and artificial abrasive pad.

3.3 MATERIALS PREPARATION

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and if necessary, strain material before using.

3.4 APPLICATION

A. General: Apply paint in accordance with manufacturer's written instructions and recommendations. Use applicators and techniques best suited for substrate and type of material being applied. Apply according to recommended dry film thickness and recommended square foot per gallon.

B. Apply materials under adequate illumination, evenly spread and smoothly applied, free of runs, sags, holidays, lap marks, air bubbles, and pin holes to assure a smooth finish.

C. Apply additional coats when undercoat, stains or other conditions show through final paint coat, until paint film is of uniform finish, color and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces. Deep color base primers are to be used under deep finish colors to achieve proper color appearance.

D. Paint surfaces behind moveable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

E. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.

F. Sand lightly all abrasions and damaged spots, between each succeeding enamel, varnish coat, textured paint coat, and degloss previous painted surfaces if necessary. Spot prime water soluble stains. Reprime prior to applying finish coats as required.

G. Omit first coat (primer) on metal surfaces that have been shop primed- and touch-up painted, unless otherwise indicated. Bare areas are to be spot primed.

H. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

I. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the under coat.

J. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

K. Prime Coats: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others. Prime coats shall be of the same manufacturer as the top coat.

L. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

M. Pigmented (Opaque) Finished: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

N. Provide satin finish or semi-gloss for final coats as indicated in the painting schedule, unless otherwise indicated.

O. Guarantee: Manufacturer shall warrant material to conform to specification and be free of manufacturing defects for a period of one year. Applicator will guarantee that its installation of materials conforms to manufacturer's recommendations shall further guarantee its workmanship connected with the installation for a period of one year from the date of installation.

P. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

Q. Touch-up work: Touch-up work shall be the responsibility of the Painting Subcontractor.

3.5 CLEAN-UP AND PROTECTION

A. Clean-up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.

B. Upon completion of painting work, clean window glass, plumbing fixtures, etc., and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting as acceptable to Architect.

D. Provide ***'Wet Paint'*** signs as required to protect newly painted finishes. Remove temporary protective wrappings provided for protection of their work, after completion of painting operations.

E. At completion of work of other trades, Painting Subcontractor shall touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION

SECTION 10 74 49 – MODULAR LANDING AND RAMP SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Rubber threshold transitions ramp at curb.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. Federal Register, 28 CFR - Americans with Disabilities Act and Accessibility Guidelines (ADAAG).

B. American National Standards Institute (ANSI) (www.ansi.org) A117.1 - Accessible and Usable Buildings and Facilities (standard and Commentary).

C. ASTM International (ASTM) (www.astm.org):
   1. C1026 - Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling.
   2. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   3. D395 - Standard Test Methods for Rubber Property - Compression Set.
   4. D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
   5. D2240 - Test Method for Rubber Property - Durometer Hardness.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate transition locations, dimensions, and relative floor heights.
   2. Product Data: Manufacturer's descriptive data, attributes, and performance characteristics.
   3. Samples: (6) 4 inch long samples showing each profile.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2 years documented experience in work of this Section.

B. Regulatory Requirements: Provide transition strips complying with ADAAG. ANSI A117.1-2017

1.5 WARRANTIES

A. Furnish manufacturer's 10 year warranty providing coverage against defects in materials and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Transition Ramps: Glass finishes field-applied application to glass or plastic material as visual opaque or decorative film.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements provide EZ-ACCESS; TRANSITIONS Angled Entry Mat 2-1/2" or comparable product by one of the following:

a. Silver Spring; DH-TR-2.5
b. Electriduct; CR-RPS-WC-2.5

2.2 MATERIALS

A. Transition Ramps:
1. Composition: 100 percent reclaimed 20 mesh minus crumb rubber with urethane binders, formed by compression molding.
2. Standard heights of single or multiple piece construction.
3. Attributes:
   a. Tensile strength: Minimum 630 PSI, tested to ASTM D412.
   b. Compression: Maximum 7.84 percent, tested to ASTM D395.
   c. Hardness: Shore A 65, tested to ASTM D2240.
   d. Absorption: Maximum 0.75 percent, tested to ASTM C1026.
   e. Density: 1.01 grams per cubic meter.
4. Performance requirements:
   a. Static coefficient of friction; tested to ASTM C1028:
      1) Dry: 0.95.
      2) Wet: 0.79.
   b. Fixed angle walking: Static coefficient of friction of 0.50, tested for bare foot, Red Wing Iris walking shoes, Converse 2D 1292 tennis shoes, and Naturalizer 78ON73 wedge sandals; tested using male and female personnel facing up and down slope at angle of 27 degrees with running water.

2.3 ACCESSORIES

A. Do not use Liquid Nails or other construction adhesives or non-approved adhesives.

B. Adhesive: Single-component, non-corrosive silicone type; Sikaflex-1a by Sika Corporation.

C. Patching Compound: Type approved by transition manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare surfaces to receive transitions; remove dirt, oil, and loose and foreign matter that could impair adhesion.

B. Fill cracks, holes, and voids over 1/2 inch in width with patching compound; finish flush with adjacent surfaces.

C. Remove bumps and high spots.

D. Abrade highly polished and waxed surfaces.

E. Do not install transitions unless surfaces are dry and free from frost.

3.2 INSTALLATION

A. Cut and fit transitions to meet installation conditions.

B. Bevel, plane, or grind underside of strips when required to accommodate minor inconsistencies in substrate.

C. After fitting, apply adhesive to underside of transition; evenly spread using notched trowel. Allow to dry for 5 to 15 minutes, then position transition on substrate.

D. Press to full bond with substrate.

3.3 PROTECTION

A. Protect installed transitions from traffic for minimum 4 hours after installation.

END OF SECTION

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COMMON WORK RESULTS FOR FIRE PROTECTION
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SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. All work under Division 21 is subject to the Division 01, General Conditions and Special Requirements for the entire contract.

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.

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, and 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 21 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. Install new canopy antifreeze sprinkler systems and extend new fire protection system to serve all areas in accordance with NFPA-13. New canopy fire protection system shall connect to existing fire protection system as required. Hydraulically calculate the entire new and existing system demand and pipe sizes.

I. Modify sprinkler piping, sprinkler head locations, and extend fire protection system as required to accommodate wall changes, ceiling changes, and M/E/P changes. Hydraulically calculate all pipe sizes based on NFPA-13.

J. The existing fire protection system shall remain unless otherwise noted. Re-located fire protection piping, hangers, valves, sprinkler heads, and fire alarm wiring as required to accommodate demolition and new work as shown on the Contract Documents. Install new

heads, piping, and hangers as required.

K. Existing fire protection system, piping, sprinkler heads, and fittings shall be modified to accommodate demolition and installation of new systems.

L. Provide new sprinkler heads where new ceilings and bulkheads are provided. Extend sprinkler piping to coordinate with new ceiling heights, bulkheads, and ductwork, piping and equipment installation. Refer to architectural reflected ceiling plans.

M. Fire protection contractor shall survey existing fire suppression system and submit hydraulic drawings and calculations to State Fire Marshal for review and approval.

N. Remove existing glycol fire protection systems on the front and rear canopies and install new glycol fire protection systems in both areas including all piping, expansion tanks, backflow preventors, valves, tamper switches and glycol.

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 21 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. Existing items of equipment are being relocated under another 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.

1.6 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. ASTM - American Society for Testing and Materials

C. FM - Factory Mutual

D. IBC - International Building Code

E. IEEE - Institute of Electrical and Electronics Engineers

F. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry

G. NEC - National Electrical Code

H. NEMA - National Electrical Manufacturers Association

I. NFPA - National Fire Protection Association

J. UL - Underwriters' Laboratories

K. State of Delaware Fire Protection Requirements.

L. All equipment materials, piping and installation shall comply with the codes and standards listed in the enforceable edition of the Applicable National Fire Protection Association Pamphlets.

M. Fire Protection Systems design, equipment and installation shall comply with the Delaware State Fire Prevention Regulations, latest edition including all Annexes and Addendums.

1.8 SUBMITTALS, REVIEW AND ACCEPTANCE

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect to be in best interest of Owner.

B. After acceptance of Material and Equipment List, submit three (3) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted

items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

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.

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. Antifreeze Fluid (Small Antifreeze Loops)
3. Backflow Preventers
4. Coordinated Drawings
5. Drip Pans
6. Expansion Tanks for Antifreeze Loops
7. Exterior Equipment/Piping Supports
8. Fire Protection System including Hydraulic Calculations, Equipment and Devices

9. Fire Stopping - Methods and Materials
10. Identification System
11. Material and Equipment List
12. Operations and Maintenance Manuals
13. Pipe Materials Including Itemized Schedule
14. Preliminary and Final Pipe Pressure Tests
15. Pressure Gauges
16. Pressure Relief Valves
17. Sprinkler Heads
18. Strainers
19. Test Certificates
20. Valves
21. Weatherproof Assembly Components
22. 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, equipment, and other work performed under Division 21.

C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for fire protection installations.

D. Coordinate electrical work required under Division 21 with that under Division 26. Coordinate all work under Division 21 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.

1.11 CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 21. 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.

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 curbs, 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 CONNECTIONS AND ALTERATIONS TO EXISTING WORK

A. Unless otherwise noted on the drawings, where existing fire protection work is removed, 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 21 connects to existing equipment and 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 21, 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.

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.

E. Fire suppression system will remain active throughout the duration of the project. Contractor shall provide temporary wire baskets to protect sprinkler heads during construction. Include all provisions for fire watch as determined by the Fire Marshal.

1.14 DEMOLITION

A. Unless otherwise noted all existing equipment, piping, etc., shall remain.

B. Where existing equipment is indicated to be removed, all associated piping, conduit, power, controls, insulation, hangers, supports and housekeeping pads, etc. Patch, paint and repair walls/roof/floor to match existing and/or new finishes.

C. Provide necessary piping, valves, temporary feeds, etc., as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time lengths of outages.

D. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

E. Refer to phasing plans for additional requirements.

F. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.

G. The location of all existing equipment, piping, etc., indicated is approximate only and shall be checked and verified. Install all new fire protection work to connect to or clear existing work as applicable.

H. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, Newark Fire Marshal, the Owner and the authorities having jurisdiction.

I. Make provisions and include in bid all costs associated with confined entry/space requirements and all other applicable OSHA regulations.

J. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves and tamper switches.

K. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirely.

L. Existing piping, equipment, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

M. 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.

N. 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.

O. Where piping is removed, remove all pipe hangers which were supporting the removed piping. Patch the remaining penetration voids with like materials and paint to match existing construction.

P. 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.

Q. 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.

R. The Owner shall have the first right of refusal for all devices and equipment removed by the Contractor.

S. 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.

T. 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.

U. Work Abandoned in Place: cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

V. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

W. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

X. After demolition of ceilings install aluminum inverted pie plates above each sprinkler head. Maintain throughout construction phase. Remove with the installation of new ceilings.

1.15 ALTERNATES

A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

1.16 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, 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. Building Line: Exterior wall of building.

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 21 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 21. Where no electrical provisions are made under Division 26, include all necessary electrical work under Division 21.

B. All electrical work performed under Division 21 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 IBC.

C. Provide wiring diagrams with electrical characteristics and connection requirements.

D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than five (5) horsepower.

E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof covering. For extended outdoor storage, remove motors from equipment and store separately.

F. All motors shall be furnished with visible nameplate indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor and efficiency.

G. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.

H. 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.

I. 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.

J. 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 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.

2.3 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 Storage Rooms, Janitor's Closets, and Similar Space = NEMA 4X.

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 fire protection 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. 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 stainless steel including hangers, 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.

D. 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.

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 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, controls, control devices, 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, 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. canopies) provide aluminum access doors/frames.

3.5 PAINTING AND FINISHES

A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.

B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 21 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 in Division 09 and conform to ANSI Standards.

H. All exposed piping, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

I. Refer to Division 09 for additional painting requirements.

3.6 CLEANING OF SYSTEMS

A. Thoroughly clean systems after satisfactory completion of pressure tests and before permanently connecting equipment, and other accessory items. Blow out and flush piping until interior surfaces are free of foreign matter.

B. Flush piping 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 the name of service company used.

C. 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.

D. 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.

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, 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-up sheets for all equipment.

3.10 IDENTIFICATIONS, FLOW DIAGRAMS, ELECTRICAL DIAGRAMS AND OPERATING INSTRUCTIONS

A. Contractor shall submit for approval working fire protection drawings 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 label.

D. Provide three (3) hard copies and one (1) electronic copy of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Operation and Maintenance Booklet as hereinafter specified.

E. All 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 21 Section, "Fire Suppression System 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 fire protection identification. Submit samples of equipment identification cards, piping labels, and valve tags to Engineer for review prior to installation.

G. Provide at least four (4) hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner.

H. Contractor shall demonstrate Sequences of Operation of all fire protection equipment in presence of Owner's representative, and Fire Marshal.

3.11 WALL AND FLOOR PENETRATION

A. All penetrations of partitions, ceilings, roofs and floors by piping or conduit under Division 21 shall be sleeved, sealed, and caulked airtight for sound and air transfer control.

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 Protection 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.

G. For renovation projects where new pipes penetrate existing floors, furnish ground penetrating radar to properly map out acceptable locations for pipe penetrations. Review penetrations with Engineer.

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 fire protection 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.

4. That the entire work shall be water-tight and leak-proof.

3.14 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall have prepared three (3) hardcopies and one (1) electronic copy of the Operation 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 Manuals – Delaware School for the Deaf Renovation – Fire Protection. 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. Manufacturer's extended limited warranties on equipment.
4. Chart form indicating frequency and type of routine maintenance for all fire protection equipment. The chart shall also indicate model number of equipment, location and service.
5. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
6. Provide supplier and subcontractor's names, address, and phone number.
7. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.
8. 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.
9. Access panel charts with index illustrating the location and purpose of access panels.
10. Approved Fire Suppression System Certificates.
11. Start-up reports for equipment.
12. NFPA Test Reports.

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 anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Operations and Maintenance Manuals be reviewed and approved.

3.15 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 manufacturer's literature showing internal wiring.

3.16 PIPING SYSTEMS TESTING

A. The entire new fire protection 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**
Fire Suppression Piping (Refer to NFPA)	200 psi

B. 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.

3.17 PHASING

A. Refer to Architectural Specifications and contract drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with

the State Fire Marshal, the Owner, and Authorities having jurisdiction.

C. Provide dust barriers/partitions, penetration closures, etc., to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Refer to phasing plans for additional requirements.

F. Provide necessary piping, valves, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Temporarily feed new systems with existing system where required.

G. Within thirty days of Award of Contract, the Contractor shall submit a minimum of six (6) copies of the proposed Phasing Plan (Drawings and detailed written description) to the Architect for review and approval based on the general and specific requirements indicated on the Drawings and Specifications. The phasing plan shall reflect the work of all trades. The phasing plan shall be updated as often as needed (i.e. major deviations and/or modified sequence of events) and reviewed during each progress meeting so the facility and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.

H. Due to phased construction, some systems must be operated until later phases are completed.

I. 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.

J. After demolition of ceilings install aluminum inverted pie plates above each sprinkler head (as heat trap). Maintain throughout construction phase. Remove with the installation of new ceilings. Submit to Fire Marshall for review and approval.

3.18 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 COMMON WORK RESULTS FOR FIRE PROTECTION

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:

DIVISION 21 SECTION 21 05 05
FIRE SUPPRESSION SYSTEM PIPING, FITTINGS & VALVES
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SECTION 21 05 05 - FIRE SUPPRESSION SYSTEM PIPING, FITTINGS & VALVES

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.

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.

B. All piping and insulation installed in ceiling plenums must be plenum rated and comply with NFPA and the authority having jurisdiction.

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, MSS SP69 and NFPA-13 unless indicated otherwise.

G. 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.

H. For areas subject to freezing (exterior canopy, etc.), Contractor shall provide and install antifreeze system as required by NFPA-13 and the authority having jurisdiction. Install piping, control valves, tamper switches, test stations, backflow preventers, expansion tanks, sprinkler heads, fill cup, antifreeze, drain valve, etc. as required by NFPA-13 and the authority having jurisdiction.

1.3 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

C. If the product is available domestically it shall be supplied as such.

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. Fire Suppression System Piping (NFPA-13):

a. Piping Above Grade: Steel, schedule 40, ASTM A53, black pipe. Piping 4 inches and smaller shall be ASTM A120, black steel pipe. Sizes 4-inches and above shall be standard weight, black, cast iron with screwed fittings, schedule 10 steel piping shall be acceptable when approved by the authority having jurisdiction. All piping exposed canopies shall be corrosion resistant such as galvanized steel pipe and shall be protected with epoxy paint.

b. Wet Pipe Fittings: Steel fittings shall be ASME B16.9, wrought steel, butt welded. Cast iron fittings shall be ASME 16.1, flanges and flanged fittings. Malleable iron fittings shall be ASME B16.3, threaded fittings. Mechanical grooved couplings shall be malleable iron housing clamps to

engage and lock C shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe. Mechanical formed fittings shall be carbon steel housing with integral pipe stop and O-ring and O-ring uniformity compressed into permanent mechanical engagement onto pipe.

c. Victaulic, Grinnell, or approved equal, grooved end fittings and mechanical couplings shall be used for wet pipe and dry pipe systems 2" and larger. Couplings and fitting shall be UL listed and FM approved. Fittings shall be ASTM A536 ductile iron, ASTM A234 forged steel or ASTM A53 fabricated steel with factory grooved ends designed to accept Victaulic couplings.

d. Victaulic, Grinnell, or approved equal, mechanical couplings shall consist of two ASTM A536 ductile iron housings, pressure-responsive, synthetic rubber gasket and plated steel bolts and nuts.

i. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13. Tongue and recess rigid type couplings shall only be used if the contractor uses a torque wrench for installation. Required torque shall be in accordance with the manufacturer's latest recommendation.

1) 1-1/4" through 8": "Installation Ready" stab-on rigid coupling, designed for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose part. Victaulic FireLock EZ Style 009H (1-1/4" – 4") and Victaulic QuickVic Style 107H (2"-8").

2) 2" and Larger: Standard rigid coupling design. Victaulic Style 07 Zero-Flex.

ii. Flexible Type: use in seismic areas and where required by NFPA-13.

1) 2" through 8": "Installation Ready" stab-on flexible coupling, designed for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. Victaulic QuickVic Style 177.

2) 2" and Larger: Standard flexible coupling design. Victaulic Style 75 or 77.

Fire Suppression System Service	Temperature Range	Gasket Recommendation
Water/Wet Systems	Ambient	Grade EPDM, Type A-C Shaped, FireLock EZ, or QuickVic Design

e. Gate Valves: 2-1/2 inches & larger - listed 175 lb. OS&Y, flanged. 2 inches & smaller - UL/FM listed 175 lb., bronze, screwed. Furnish all sprinkler control valves with slow close manual operator and position indicator. Tamper switches furnish under Division 21.

f. Grooved End Gate Valves: 2-1/2inches and Larger – UL listed/FM approved, 250 psi maximum pressure rating, OS&Y, ductile iron body, bronze mounted, grooved ends. Victaulic FireLock Series 771.

g. Grooved End Butterfly Valves: 2 inches & Larger: UL listed/FM approved, up to 365 psi maximum pressure rating, ductile iron body, nickel-plated ductile iron disc, Nitrile seat, weather-proof actuator with two pre-wired supervisory switches. Victaulic FireLock Series 765 or Series 705.

h. Globe Valves: 2 inches & smaller - 175 lb., bronze, screwed, UL/FM listed.

i. Check Valves: 2-1/2 inches & smaller - UL/FM listed 175 lb., flanged swing check. 2 inches & smaller - listed 175 lb., bronze swing check, screwed.

j. Grooved End Check Valves: 2 inches and Larger: UL listed/FM approved, up to 365 psi maximum pressure rating, ductile iron body, spring-loaded stainless steel or EPDM coated ductile iron disc, nickel-plated or welded-in nickel seat. Victaulic FireLock Series 717H or Series 717.

k. Finish: All exposed fire suppression piping shall be primed and painted with epoxy red paint. White letters shall indicate pipe and indicate direction of flow. Painting shall be provided under Division 09.

l. Special Requirements: All fire suppression piping, valves, fittings and joints shall comply with applicable National Fire Protection Pamphlets (NFPA) local codes, building codes, Fire Marshal, Owner's Insurance Underwriter, and the authority having jurisdiction.

B. Steel pipe shall be similar and equal to National Allied Tube or Wheatland 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

A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260 for pipe 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:

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

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, comply with NFPA-13.

D. Hangers for pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis. Comply with NFPA-13.

E. Hangers for cold pipe sizes 6 inches (150 mm) and over: adjustable steel yoke, cast iron roll, double hanger, comply with NFPA-13.

F. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.

G. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook, comply with NFPA-13.

H. Wall support for pipe sizes 4 inches (100 mm) and over: Welded steel bracket and wrought steel clamp, comply with NFPA-13.

I. Wall support for pipe sizes 6 inches (150 mm) and over: welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll, comply with NFPA-13.

J. Vertical Support: Steel riser clamp, comply with NFPA-13.

K. Floor support for pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support, comply with NFPA-13.

L. Copper pipe support: Carbon steel ring, adjustable, copper plated, comply with NFPA-13.

M. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded, comply with NFPA-13.

N. 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.

O. Victaulic Style 009H, 107H, and 07, Grinnell, or approved equal, rigid couplings may be used with IPS steel piping systems, which meet the support and hanging requirements of NFPA-13. An adequate number of Victaulic Style 177, 75, and 77, Grinnell, or approved equal, flexible couplings shall also be used to compensate for thermal expansion/contraction of the pipe.

P. For Pipe Hangers installed in corrosive environments such as canopies…etc. the same shall be finished with an 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. All valves shall be provided with tamper switches and coordinated with Division 28.

2.4 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 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.

2.5 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.

2.6 DIELECTRIC CONNECTIONS

A. Furnish and install electrically insulated dielectric waterway fittings, unions or flanges, as manufactured by EPCO Sales, Inc., or Victaulic Co. at the following locations:

1. Where steel piping systems join copper piping.
2. 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.
3. Where copper piping connects to expansion tanks.

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. 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 with a waterproof caulking compound.

D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

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 or devices and 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, and installed so that there will be no interference with the installation of the equipment. 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 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 and other fittings shall be readily accessible.

D. 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.

E. 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.

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. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

I. All water containing pipes shall be routed clear of combustion air dampers and louvers to prevent freezing condition when dampers are open.

3.2 PRESSURE GAGE INSTALLATION REQUIREMENTS.

A. Install pressure gages in piping tees with pressure-gage valve located on a pipe at most readable location.

B. Adjust faces of pressure gauges to proper angle for best visibility.

C. Clean windows of gages 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. Do not attempt to repair defective valves; replace with new valves.

G. Install valves as indicated, according to manufacturer's written instructions.

H. Piping installation requirements are specified in other Division 21 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

I. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

J. Locate valves for easy access and provide separate support where necessary.

K. Install valves in horizontal piping with stem at or above the center of the pipe.

L. Install valves in a position to allow full stem movement.

M. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

3.4 PIPE JOINTS INSTALLATION REQUIREMENTS

A. 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.

B. Grooved Joints: Install in accordance with the manufacturer's (Victaulic, Grinnell, or approved equal) guidelines and recommendations. All grooved 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. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A Victaulic factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

C. 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.

D. Where copper piping joins steel piping, approved bronze adapters shall be used.

E. Prohibited Connections: No direct weld, soldered, or brazed connections, without unions

or flanges, shall be made to valves, strainers, apparatus, or related equipment. Right and left couplings, long threads, or caulking of pipe threads or gasket joints will not be permitted.

3.5 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. 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. Comply with NFPA-13.

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 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 engineer's recommendations.

J. 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.

K. Fire protection pipes shall be supported independently of other building trade supports per NFPA-13.

3.6 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 NFPA pamphlets, 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

3.7 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 three (3) 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 the main fire protection riser room. Additional copies shall be provided in each copy of the O&M manuals.

END OF FIRE SUPPRESSION SYSTEM PIPING, FITTINGS & VALVES

DIVISION 21 SECTION 21 10 03
WATER BASED FIRE SUPPRESSION SYSTEM – SPRINKLERS
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SECTION 21 10 03 - WATER BASED FIRE SUPPRESSION SYSTEM - SPRINKLERS

PART 1 - GENERAL

1.1 REFERENCE

A. The conditions of the Contract and General Requirements apply to the work specified in this section. All work under this section shall also be subject to the requirements of Division 21 Section, Common Work Results for Fire Protection and Division 01 Section, General Requirements.

B. Submit complete shop drawings of all equipment utilized with the system in accordance with Division 21 Section, Common Work Results for Fire Protection. Submittals shall include but not be limited to the following fire protection system and accessories:

1. Antifreeze Fluid
2. Ball Drip Valves
3. Expansion Tanks for Antifreeze Loops
4. Pressure Sensing Devices, Valves
5. Pressure/Vacuum Gauges
6. Inspector's Test Station
7. Eccentric Reducers
8. Pressure Switches
9. Valves and Piping
10. Backflow Preventers
11. Flow Switches
12. Tamper Switches
13. Auxiliary Drains
14. Sprinkler Heads

C. Provide sprinklers, piping and associated equipment complete and ready for operation. Equipment materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA-13, NFPA-70, NFPA-14, NFPA-72E, and NFPA-101. Devices and equipment for fire protection service shall be U.L listed or FM approved.

D. All of the equipment and devices shall be included within the project Operations and Maintenance Manuals.

E. Refer to Division 21 Section, Fire Protection Pipes, Valves, and Fittings for pipe materials.

F. Fire Protection Systems design, equipment and installation shall comply with the Delaware State Fire Prevention Regulations, latest edition including all Annexes and Addendums.

1.2 DESCRIPTION

A. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section and as shown on the drawings. The work shall be performed by a licensed sprinkler contractor only. All equipment, piping, devices, and valves shall be sized based on hydraulic calculations. Include a 10 psig safety factor with hydraulic calculations.

B. Layout sprinkler system complete and size all fire protection piping in accordance with requirements of the National Fire Protection Association and the State Fire Marshal. System shall be designed for occupancy as required by applicable codes. Conceal fire protection piping in finished spaces unless indicated otherwise. System drains and inspector's test shall not be located in finished spaces.

C. Sprinkler equipment and work shall conform to requirements of National Fire Protection Association Standard No. 13, No. 14, and No. 24. In addition, all work shall conform to requirements of all codes and regulations of authorities having jurisdiction over this work, including, but not limited to, State Fire Marshal, County Fire Marshal, Life Safety Codes and International Code, and Insurance Underwriter.

D. Preliminary Shop Drawing: Prior to preparing detailed working drawings for submission to State Fire Marshal, submit preliminary sprinkler system layout to the Architect for review and approval. Show all finished ceilings, light fixtures, air diffusers and other ceiling mounted devices. Coordinate sprinkler head types and locations with ceiling types. All sprinkler heads in acoustic tile ceilings shall be centered in the tile.

E. The fire protection contractor shall prepare dimensioned and detailed working drawings, specifications, and hydraulic calculations and submit same to the State Fire Marshal and/or County Fire Marshal for review and approval. Prior to submission to the Fire Marshal, the Fire Protection Contractor shall have all fire protection drawings, submittals, calculations reviewed and approved by a registered Fire Protection Engineer or a level III Nicet Technician. One set of these approved documents shall be provided to the Engineer for record purposes. All costs related to changes required to obtain the Fire Marshal's or Insurance Underwriters' approval shall be the responsibility of the contractor.

F. Manufactured equipment and materials shall be submitted to the Engineer for review and approval, in accordance with the requirements of Division 21 Section, Common Work Results for Fire Protection.

G. Hydraulic calculations should be based on an available water supply as follows:

Static Pressure =	58 psig
Residual Pressure =	50 psig
Flow =	920 gpm
Existing Pipe Material	For Hydraulic Calculations Assume Roughness Coefficient C factor = 100 for all Exterior Piping.

H. Hydraulic calculations shall include a 10 psig safety factor to account for pipe aging and deterioration of water supply.

I. For small areas subject to freezing (loading dock, exterior canopy, etc.), Contractor shall provide and install antifreeze system etc., as required by NFPA-13 and the authority having jurisdiction. Install piping, control valves, tamper switches, test stations, backflow preventers, expansion tanks, fill cup, drain valve, etc. as required by NFPA-13 and the authority having jurisdiction.

J. Where combustible construction materials are located above ceilings, provide above ceiling fire protection in accordance with N.F.P.A-13.

1.3 DELIVERY, STORAGE AND PROTECTION

A. Refer to Division 01 Section, General Requirements: Transport, handle, store, and protect products.

B. Accept equipment and devices on site in factory packing. Inspect for damage. Comply with manufacturer's rigging and installation instructions for all equipment.

C. Protect components from physical damage including effects of weather, water, and construction debris.

D. Provide temporary inlet and outlet caps, and maintain in place until installation.

1.4 EXTRA MATERIALS

A. Provide extra sprinklers under provisions of NFPA-13. Provide suitable wrenches for each sprinkler type and metal storage cabinet.

1.5 PERMITS FROM THE AUTHORITY HAVING JURISDICTION AND FEES

A. Pay all permits, fees, and charges required for this work.

1.6 HYDRANT FLOW TESTS

A. The Fire Protection Contractor shall perform a hydrant flow test.

B. The hydrant flow test shall be performed by the Fire Protection Contractor in the vicinity of each building at no additional cost to the Owner.

C. Where practical, tests shall be performed between 9:00 a.m. and 5:00 p.m. on a normal working day during summer. If conducting the test is impractical during these hours, then a local Fire Department representative shall be present to "observe" the test during "off peak" hours and to acknowledge the correctness of results.

D. The tests shall be submitted for review prior to submitting any hydraulic calculations. The test data shall contain the following:

1. Date of the test
2. Who performed the test and who was present.
3. Site plan indicating locations and diameters of water mains and locations of the hydrants tests.
4. Grade elevation of the hydrant tests
5. Static pressure in psig
6. Flow in GPM
7. Residual pressure in psig
8. Hydrant butt size in inches
9. Hydrant coefficient

1.7 ALTERNATES

A. Refer to Division 01 Section, Alternates - Alternates for description of work under this section affected by alternates.

PART 2 - PRODUCTS

2.1 SPECIALTIES

A. All sprinkler heads shall be U.L. listed and shall be of the same manufacturer throughout the building.

B. Piping shall be in accordance with Division 21 Section, Fire Suppression System Piping, Fittings, and Valves, etc. All exposed fire protection piping in unfinished areas shall be painted with red epoxy paint. White letters shall identify piping and indicate direction of flow. Exposed fire protection piping within finished areas shall be painted in color as determined by the Architect/Engineer.

C. Shut-off valves shall be UL approved O.S. and Y. double disc gate valves or UL/FM approved grooved end butterfly valves.

D. Check valves shall be swing check type or spring-loaded type UL approved for the application.

E. Coordinate the fire protection systems with the fire alarm system specified under Division 26. Provide alarm initiating devices with proper contact arrangement. All electrical wiring shall be furnished and installed under Division 26.

F. Flow control valve, alarm switches and valve supervision shall be furnished and installed under this Division. All wiring shall be accomplished by the electrical contractor, under Division 26. Provide any additional flow control valves, alarm switches, tamper switches and flow switches required by NFPA-13, but not indicated on contract drawings. Coordinate with the alarm system and electrical subcontractor.

G. Pipe and fittings shall meet the requirements of NFPA 13, NFPA-14, and NFPA-24.

H. Wet pipe alarm check valve shall be Victaulic FireLock Series 750, Reliable Automatic Sprinkler Co., Tyco Fire Products, or approved equal. Valve shall be UL listed and FM approved for sprinkler systems with 175 psig maximum working pressure. Provide complete valve trim package including all necessary valves, gauges, fittings, nipples and alarm test. Valve internal components shall be replaceable without removing the valve from the installed position. Valve shall be installed in the vertical position only.

2.2 SPRINKLER HEADS

A. Exposed Area Type:

1. Manufacturers: Victaulic, Viking, Grinnell, Reliable, or approved equal.
2. Sprinkler heads in unfinished or exposed areas shall be Victaulic Model V27, or approved equal. These sprinklers shall be standard, ½ inch upright, pendant or conventional where required. Provide guards where hereinafter indicated. Sprinklers shall be brass with frangible glass bulb temperature rated for specific area hazard. Provide standard brass, screw on flat escutcheon plate.

B. Sidewall type:

1. Manufacturers: Victaulic, Viking, Grinnell, Reliable, or approved equal.
2. Sidewall sprinklers shall be Victaulic Model V27 semi-recessed horizontal sidewall type with matching screw on escutcheon plate. Sprinkler and escutcheon plate finish shall be chrome plated. Frangible glass bulb shall be temperature rated for specific area hazard.

C. Quick Response Type:

1. Manufacturers: Victaulic, Viking, Grinnell, Reliable or approved equal.
2. Sprinkler heads shall be listed quick response sprinklers in accordance with NFPA-13 and NFPA-101. Quick response sprinklers shall be Victaulic Model V27 or approved equal. Model and deflector style shall be as required to accommodate upright, pendant, sidewall or recessed mounting. Sprinklers and escutcheon plates shall be chrome plated. Frangible glass bulb shall be temperature rated for specific area hazard.
3. Sprinkler heads in Janitor's Closets shall be provided with cleanroom seals.

D. The temperature rating of the sprinklers shall be as required by N.F.P.A.-13 and or the authority having jurisdiction.

E. All sprinkler heads installed in lay-in ceiling tiles shall be located in the center of the tile to provide a symmetrical, aesthetic and neat appearance. All sprinkler heads installed in bulkheads, recesses, canopies, and soffits shall be centered to provide a symmetrical, aesthetic and neat appearance.

F. Provide extended escutcheons in rooms with surface mounted lighting fixtures.

G. Additional heads shall be furnished as required by NFPA-13. The heads shall be in a cabinet designed to hold the heads and include one sprinkler head wrench for each type of

sprinkler. Cabinet shall be mounted where indicated in the field.

H. Head guards shall be provided in mechanical spaces, janitors' closets, electrical rooms, and storage areas. Finish for head guards in finished spaces shall be selected by Architect.

I. Sprinkler escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler, by the sprinkler manufacturer.

J. Provide high temperature sprinkler heads for use adjacent to kilns, skylights, autoclaves, heaters, lights, or other high temperature areas.

K. All sprinklers, piping, and pipe hangers installed in corrosive areas (canopies, chemical room…etc.) shall be provided with a protective coating.

2.3 FLEXIBLE SPRINKLER DROPS

A. Stainless Steel Sprinkler Fittings

1. Manufacturer: Victaulic AquaFlex® or Grinnel.
2. In lieu of rigid pipe offsets for concealed locations only, or return bends for sprinkler drops, the Victaulic AquaFlex® stainless steel, multiple-use, sprinkler fitting system may be used to locate sprinklers as required by final finished ceiling tiles and walls. The drop system shall consist of a braided or unbraided (corrugated) type 304 stainless steel flexible tube, a zinc-plated steel 1" NPT male threaded nipple for connection to branch-line piping, and a zinc-plated steel reducer with ½" or ¾" NPT female thread for connection to the sprinkler head. Union joints shall be provided for ease of installation. The flexible drop shall attach to the ceiling grid using a one-piece open gate bracket. The braided drop system is FM approved for sprinkler services to 200 psi and can be installed without the use of tools, and the unbraided system is UL listed for sprinkler services to 175 psi.

2.4 SIGNS

A. Provide 9 inch x 7 inch signs suspended from control valves which indicate the purpose of the valve and its normal position, Central Type A or approved equal.

B. All control, drain, and test connection valves shall be provided with signs indicating purpose.

C. Signs shall be fabricated of an approved material, painted red with white lettering.

D. Signs shall have typed labels. Handwritten labels shall not be acceptable.

2.5 DRAINS

A. The sprinkler systems shall be arranged to be completely drainable. Means of drainage

shall be provided with adequate protection from freezing.

B. Drain valve may be combined with sprinkler alarm test valve and sight glass, G/J Innovations Sure-Test, Reliable Automatic Sprinkler Co., Tyco Fire Products, Victaulic, or approved equal. Valve shall be UL listed with positive off handle for off, test or drain, integral sight glass, orifice size equal to smallest sprinkler orifice and full 1 inch drain.

2.6 ALARM DEVICES

A. Approved water flow switches shall be installed to activate the fire alarm, and annunciate sprinkler flow at a minimum on each floor, each system riser, where indicated on the contract documents and where required by N.F.P.A. or the authority having jurisdiction. Conductors shall be provided under the electric division to provide fire alarm, and annunciation. Activation of the sprinkler system by one sprinkler or equivalent test shall cause the fire alarm system to activate, and the appropriate lamp(s) to activate on the annunciator. An approved test shall be provided for each water flow switch.

B. All valves controlling water supply for sprinklers shall be electrically supervised in accordance with requirements of NFPA 13 and 72A, and provided under this Division. Provide separate valve chart for all fire protection valve indicating valve type, normal position, size, location and type of supervision insert in O&M manual and mount additional copies in fire pump room and mechanical rooms.

C. Valve tamper switches shall be Model OSY2 as manufactured by System Sensor or Model OSYSU-A2 as manufactured by Potter Electric Signal Company or approved equal. The valve tamper switches shall monitor the open position of all OS&Y gate valves. Each tamper switches shall contain two sets of single pole double throw, Form C contacts. All valve tamper switches shall have tamper resistant covers that upon removal of the cover will cause the switches to operate. Tamper switches shall be suitable for 125/250 VAC @ 15 AMPS. All tamper switches shall be U.L. listed and F.M. approved.

D. Pressure type flow switches shall be Model EPS10 as manufactured by System Sensor or Model PS10-2 as manufactured by Potter Electric Signal Company, Tyco Fire Products, United Electric Controls, Viking Corp., or approved equal. Each pressure type flow switch shall contain two sets of single pole double throw switch contacts. All pressure type flow switches shall have tamper resistant covers that upon removal of the cover will cause the switches to operate. Pressure type flow switches shall be suitable for 125/250 VAC @ 10 AMPS. All pressure type flow switches shall be U.L. listed and F.M. approved.

E. Vane Type waterflow switch with retard shall be WFD Series as manufactured by System Sensor or Model VSR-F as manufactured by Potter Electric Signal Company, ADT Security Services, McDonnell & Miller, Viking Corp., Watts, or approved equal. The VAC type waterflow switches shall contain two single pole, double throw form C, snap return switches. All Vane type waterflow switches shall have tamper resistant covers that upon removal of the cover will cause the switches to operate. Vane type waterflow switches shall be suitable for 125/250 VAC @ 10 AMPS. All vane type waterflow switches shall be U.L. listed and F.M. approved.

2.7 GAUGES

A. A listed 3 ½ inch dial spring pressure gauge shall be connected to the top of each standpipe. Gauges shall be located in a suitable place to prevent freezing. Each gauge shall be controlled by a valve having arrangement for draining.

B. Listed pressure gauges with connections not smaller than ¼ inch shall be installed at the system main drain, at each main drain associated with a floor control valve, and above and below each alarm check-valve.

C. All pressure gauges shall be listed and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal and shall be located where they will not be subject to freezing.

2.8 DOUBLE CHECK VALVE BACKFLOW PREVENTER (FIRE PROTECTION SYSTEM)

A. The sprinkler system backflow preventer shall be provided under this Division and coordinated with Plumbing Contractor. Backflow preventer shall be sized for sprinkler demand to limit pressure drop to 5 psig.

B. Backflow preventers for Fire Protection Systems shall be ASSE/AWWA-1015 approved, double check-valve backflow preventer assemblies at sprinkler system water service connections. Units shall be specifically listed for Fire Protection use. Units shall be Watts 709, Ames, Conbraco, Wilkens, or approved equal with OS&Y Gate valves, U.L. listed, F.M. approved, NSF-61 approved. Units shall be suitable for minimum 175 psi working pressure. Backflow preventers shall be factory tested at two (2) times the working pressure encountered or as required by N.F.P.A. Backflow preventer shall be capable of withstanding test pressures per N.F.P.A.

C. Backflow preventer shall be factory finished with epoxy coated paint.

D. Pipe any discharge openings full size, through air gap fittings, to nearest floor drain. Maintain clearances for servicing as required by Plumbing Code and authority having jurisdiction. Discharge piping shall be Type L copper pipe.

E. Provide and install tamper switches on all backflow preventers OS&Y gate valves. Backflow preventer shall be installed between 12 inches and 60 inches above finished floor. Provide 18 inch clearance around backflow preventer for service and maintenance.

2.9 VALVES

A. Provide and install control valves as indicated on contract drawings and as required by N.F.P.A.-13. Gate valves shall be listed O.S. & Y. type. All control valves shall be supervised open. Supervision shall be as required by N.F.P.A.-13. Victaulic Series 705 and 765 grooved end butterfly valves shall be supervised in the open position.

2.10 ANTIFREEZE SYSTEMS

A. For small areas (40 gallons or less) subjected to freezing, where approved by the authority having jurisdiction, antifreeze loops shall be employed to prevent freezing where dry-pipe systems are not indicated.

B. Antifreeze shall be LFP antifreeze as manufactured by Tyco and shall be provided pre-mixed and listed for use in wet sprinkler system. Protection shall be down to -10°F.

C. Furnish and install all devices required by NFPA-13 and the authority having jurisdiction, including, but not limited to control valves, backflow preventers, test stations, expansion tanks, fill cup, drain valves, tamper switches, etc.

D. Do not utilize galvanized piping with any antifreeze systems.

E. Install entire system per NFPA-13, authority having jurisdiction, and manufacturer's requirements. Test antifreeze concentration to verify freeze protection of solution down to -10°F.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install equipment in accordance with manufacturer's instructions.

B. Place pipe runs to minimize obstruction to other work.

C. Place piping in concealed spaces above finished ceilings.

D. Center sprinklers in two directions in ceiling tile and provided piping offsets as required.

E. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

F. Flush entire piping system of foreign matter.

G. Install guards on sprinklers where subject to abuse and where specified.

H. Hydrostatically test entire system.

I. Test must be witnessed by Fire Marshal/authority having jurisdiction/ Owner's insurance underwriter/ Architect/Engineer.

J. Refer to plumbing floor plans for approximate locations of sprinkler zones control valve assemblies and routing of fire protection mains.

K. Locate inspectors test stations for sprinkler zones per NFPA-13. Provide and install drain

piping from all approved terminations. Provide splash blocks for terminations outside. Splash block locations shall be approved by the Architects.

L. The fire protection contractor shall hydraulically prove the most remote area per NFPA-13.

M. Coordinate locations of sprinkler heads with lights, diffusers, ceiling types, etc.

N. Hydrostatically test system at 200 PSI for 4 hours, per NFPA-13.

O. Provide stainless steel, corrosion resistant sprinklers at all loading docks, canopies, etc., as required by NFPA-13.

P. The sprinkler bulb protector must remain in place until the sprinkler is completely installed and before the system is placed in service. Remove bulb protectors carefully by hand after installation. Do not use any tools to remove bulb protectors.

Q. Refer to Architectural Drawings for exact location and extent of all fire rated walls and smoke barriers.

R. Grooved joint piping systems shall be installed in accordance with the manufacturer's (Victaulic) guidelines and recommendations. All grooved 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. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by Victaulic. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

3.3 LAYOUT

A. Coordinate layout and installation of fire protection system with all other buildings structural, mechanical and electrical work. Locate sprinkler heads symmetrically with respect to ceiling tiles, lighting fixtures, registers, grilles, diffusers, etc. Provide piping offsets as required to maintain symmetry. Note that a preliminary sprinkler layout is to be submitted for review. Contractor is cautioned that sprinkler mains must be located to prevent conflict with other work and in any case, sprinkler contractor shall be responsible for coordination of his work with work of other trades.

B. Unless otherwise indicated, the entire building shall be protected throughout with a wet pipe sprinkler system. Where required by NFPA-13 and/or the authority having jurisdiction, install sprinkler heads above and below ceilings.

3.4 WET PIPE SPRINKLER SYSTEM

A. System components shall include, but not be limited to flow control valves, electrical connections to central fire alarm system, check valves, main piping, branch piping, inspector's test, drains, sprinkler heads, backflow preventers, antifreeze, expansion tanks, signs, etc. and all other incidental appurtenances as required.

3.5 VALVE INSTALLATION

A. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.

B. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

C. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain-line connection.

3.6 CONNECTIONS

A. Connect water supplies to standpipes and sprinklers. Include backflow preventers.

B. Connect piping to specialty valves, specialties, fire department connections, and accessories.

C. Connect alarm devices to fire alarm.

D. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire alarm system devices, including low-pressure alarm.

3.7 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that specified tests of piping are complete.

C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

E. Verify that antifreeze systems have correct types of backflow preventers.

F. Verify that fire department connections have threads compatible with local fire department equipment

G. Fill wet-pipe sprinkler piping with water.

H. Energize circuits to electrical equipment and devices.

I. Adjust operating controls and pressure settings.

J. Coordinate with fire alarm tests. Operate as required.

3.8 DRAINS

A. The sprinkler system shall be arranged to be completely drainable. Means of drainage shall be provided with adequate protection from freezing.

3.9 TESTS

A. The sprinkler systems installation shall be hydrostatically tested, inspected, and approved, in accordance with NFPA Standard No. 13 and NFPA Standard No. 25. Test certificate shall be forwarded to the Office of the State Fire Marshal and the Architect as proof of compliance.

B. Tests shall be performed in accordance with the requirements of the Office of the State Fire Marshal and shall prove the systems to be adequate and satisfactory in every respect. All tests shall be performed in the presence of the State Fire Marshal or his representative.

C. Any deficiencies revealed by these tests shall be corrected and the systems shall be retested until acceptable results are obtained.

3.10 AS-BUILT DRAWINGS & PROJECT CLOSEOUT

A. Provide separate as-built drawings of all fire protection systems meeting requirements of General Mechanical Requirements hereinbefore specified.

B. At the completion of the work, provide a sealed plan of the building indicating the locations of all control valves, low point drains, flow switches, and Inspectors Test Stations. The plan shall be neatly drawn and color coded to indicate the portion of the building protected by each system, framed under glass and permanently mounted on the wall adjacent to the system header.

C. Include manufacturers literature, cleaning procedures, replacement parts, lists, and repair data for equipment.

D. Include manufacturers' instructions, start-up data, troubleshooting, check lists for all

equipment.

3.11 WARRANTY

A. The Contractor's attention is directed to the warranty obligations contained in the Article of the General Conditions of the specifications entitled "warranty".

3.12 OWNER TRAINING

A. Upon completion of the project, furnish a complete copy of NFPA-25 to Owner. Provide correspondence indicating that the pamphlet has been turned over to the Owner.

1. Contractor shall provide at least four (4) hours of training to the Owner on the proper inspection, testing, and maintenance of the installed fire protection system.
2. Schedule training with the Owner through the Architect and/or Engineer with at least seven (7) days prior notice.
3. A Victaulic factory-trained field representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

END OF WATER BASED FIRE SUPPRESSION SYSTEM – SPRINKLERS

DIVISION 22 SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING
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SECTION 22 05 00 - 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.

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. Existing items of equipment are being relocated under another 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.

1.6. 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.	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 Industry	-	Manufacturers Standards Society of the Valve and Fittings
N.	NEC	-	National Electrical Code

O. NEMA - National Electrical Manufacturers Association

P. NSF - National Sanitation Foundation

Q. UL - Underwriters' Laboratories

R. 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.

1.8. SUBMITTALS, REVIEW AND ACCEPTANCE

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect to be in best interest of Owner.

B. After acceptance of Material and Equipment List, submit three (3) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

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. Backflow Preventers
3. Bottle Filling Stations
4. Coordinated Drawings
5. Condensate Neutralizers
6. Direct Buried Piping
7. Domestic Water Expansion Tank
8. Domestic Water Heater
9. Drain Valves
10. Drip Pans
11. Electric Water Coolers
12. Equipment Rails
13. Exterior Equipment/Piping Supports
14. Fire Stopping - Methods and Materials
15. Gas Fired Domestic Water Heater
16. Gas Pressure Regulating Valves
17. Gauges
18. High/low Mixing Valves
19. Identification System
20. In-Line Circulators
21. Material and Equipment List
22. Operations and Maintenance Manuals
23. Pipe Guides and Anchors.
24. Pipe Materials Including Itemized Schedule

25. Plumbing Fixtures & Trim
26. Preliminary Testing and Balancing Report
27. Pressure/Temperature Relief Valves
28. Roof Curbs
29. Shock Absorbers
30. Strainers
31. Test Certificates
32. Thermal Insulation Materials Include Table Summary
33. Thermometers and Gauges
34. Vacuum Breakers
35. Valves
36. Vibration Isolation Materials
37. Weatherproof Assembly Components
38. 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.

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, SMACNA, and as required by other divisions of these specifications.

E. All work associated with the existing roof shall be performed so as to maintain the existing roof warranty.

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.

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.

1.15. DEMOLITION

A. Unless otherwise noted all existing equipment, piping, etc., shall remain.

B. Where existing equipment is indicated to be removed, all associated piping, conduit, power, controls, control panels, sensors, tubing, insulation, hangers, supports and housekeeping pads, etc., patch, paint and repair walls/roof/floor to match existing and/or new finishes.

C. Provide necessary piping, valves, traps, temporary feeds, etc., as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time lengths of outages.

D. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

E. Refer to phasing plans for additional requirements.

F. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.

G. The location of all existing equipment, piping, etc., indicated is approximate only and shall be checked and verified. Install all new plumbing work to connect to or clear existing work as applicable.

H. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal,

the Owner and the authorities having jurisdiction.

I. When applicable, make provisions and include in bid all costs associated with confined entry/space requirements in crawl spaces, tunnels and all other applicable OSHA regulations.

J. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves.

K. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirely.

L. Existing piping, equipment, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

M. 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.

N. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing refrigerants. Contractor shall include in his bid all cost associated with the evacuation, removal and disposal of all existing equipment containing refrigerants in accordance with EPA and Health Department requirements.

O. Where piping is removed, remove all pipe hangers which were supporting the removed piping. Patch the remaining penetration voids with like materials and paint to match existing construction.

P. 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.

Q. 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.

R. The Owner shall have the first right of refusal for all plumbing fixtures, devices and equipment removed by the Contractor.

S. All plumbing fixtures, 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 plumbing fixtures, devices and equipment in a safe manner to prevent damage while stored.

T. 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.

U. Work Abandoned in Place: cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

V. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

W. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

1.16. 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.

1.17. 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.

1.18. 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.

1.19. ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

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. 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. Building Line: Exterior wall of building.

1.21. 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.

1.22. 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. EXTRA MATERIALS

A. Provide one set of seals for each type and model of pump provided on the project.

B. Furnish three (3) additional water filters for each electric water cooler and bottle filling station.

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 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 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.

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	86.5 percent	85 percent

G. Three phase motors ½ HP or greater shall be the Duty Master XE by Reliance Electric Company, Super-E Premium Efficiency of Baldor Motor and Drives, E-plus Efficient Standard Duty Motor of the Electric Motor Division of Gould, Inc., the MAC II High Efficiency motor of Westinghouse Electric Corp., the equivalent product of General Electric, or approved equal.

H. 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.

I. 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.

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.

D. 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.

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 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. toilet rooms 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 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.

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 three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Operations and Maintenance Manuals as hereinafter specified.

E. All 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 four (4) hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner.

H. Contractor shall demonstrate Sequences of Operation of all plumbing equipment in presence of Owner's representative and Engineer.

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.

G. For renovation projects where new pipes penetrate existing floors, furnish ground penetrating radar to properly map out acceptable locations for pipe penetrations. Review penetrations with Structural Engineer.

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 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. OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared three (3) 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 Delaware School for the Deaf Renovation – 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 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.

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.

3.15. 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 manufacturer's literature showing internal wiring.

3.16. PIPING SYSTEMS TESTING

A. The entire new plumbing 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**
Domestic Water & Coil Drain Piping	100 psig
Sanitary Water Piping	As specified below

B. All gas piping shall be pressure tested in accordance with 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.

3.17. PHASING

A. Refer to Architectural Specifications and contract drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities having jurisdiction.

C. Provide dust barriers/partitions, penetration closures, etc., to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Refer to phasing plans for additional requirements.

F. Provide necessary piping, valves, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Provide valves, to maintain existing systems in operation until all equipment is connected. Temporarily feed new systems with existing system where required or shown on contract drawings.

G. Within thirty days of Award of Contract, the Contractor shall submit a minimum of six (6) copies of the proposed Phasing Plan (Drawings and detailed written description) to the Architect for review and approval based on the general and specific requirements indicated on the Drawings and Specifications. The phasing plan shall reflect the work of all trades. The phasing plan shall be updated as often as needed (i.e. major deviations and/or modified sequence of events) and reviewed during each progress meeting so the facility and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.

H. Due to phased construction, some systems must be operated at part load conditions until later phases are completed.

I. While work is in progress, except for designated short intervals during which connections are made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

3.18. 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 COMMON WORK RESULTS FOR PLUMBING

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: _____

DIVISION 22 SECTION 22 05 05
PLUMBING PIPING, FITTINGS & VALVES
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SECTION 22 05 05 - 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.

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 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. Domestic Hot, Cold, and Hot Water Recirculating 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 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:
   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.

5. 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 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 mechanical room, or piping installed outside 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.

6. 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. 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:

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

B. Install hangers for storm water and 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. 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. 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.

E. Hangers for pipe sizes ½ to 1 ½ inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.

F. Hangers for cold pipe sizes 2 inches (50 mm) and over: Carbon steel, adjustable, clevis.

G. Hangers for cold pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.

H. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.

I. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook

J. Wall support for pipe sizes 4 inches (100 mm) and over: Welded steel bracket and wrought steel clamp.

K. Vertical Support: Steel riser clamp.

L. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

M. 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.

N. Copper pipe support: Carbon steel ring, adjustable, copper plated.

O. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

P. 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.

Q. For Pipe Hangers installed in corrosive environments such as 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.

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 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.

2.5 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.

2.6 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.

2.7 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.

C. Provide heat conducting compound in wells.

2.8 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.

2.9 PIPING SPECIALTIES

A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of all in-line pumps, 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 piping. Install stainless steel mesh screen and turndown on all gas relief valve/vent piping terminations.

2.10 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.

2.11 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.

2.12 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.

2.13 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 F.

2.14 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 8 feet from the water heaters per the manufacturer's requirements.

2.15 TRANSITION FITTINGS

A. General Requirements:

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

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

C. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description: PVC or CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.

D. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one

of the following:

a. Colonial Engineering, Inc.
b. NIBCO INC.
c. Spears Manufacturing Company.

2. Description: PVC or CPVC four-part union. Include brass threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATION REQUIREMENTS

A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment on devices not to block access to doors, windows, manholes, or other access openings. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment, coils, etc., and installed so that there will be no interference with the installation of the equipment, ducts, etc. All valves and specialties shall be placed to permit easy operation and access and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be installed so as to avoid air or liquid pockets throughout the work. Ends of pipe shall be reamed so as to remove all burrs.

B. All piping shall be graded to convey entrained air to high points where automatic air vents shall be provided. The size of supply and return pipes for each piece of equipment shall in no case be smaller than the outlets in the equipment.

C. All piping shall be run to provide a minimum clearance of 2-inches between finished covering on such piping and all adjacent work. Group piping wherever practical at common elevations.

D. All valves, strainers, caps, and other fittings shall be readily accessible.

E. 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.

U. Where access doors are required, install piping so that valves can be grouped together to minimize the quantity of access doors.

V. Install manufactured U.L. listed firestop collars at all floor/wall penetrations for all PVC 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.

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.

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. ssScrewed Joints: All screwed joints shall be made with tapered threads properly cut. Screwed joints shall be made perfectly tight with a stiff mixture of graphite and oil, applied with a brush to the male threads on the fittings.

D. Soldered Joints and Copper Piping: Joints in copper piping shall conform to the following minimum standards.

1. The pipes shall be cut to a length making certain that the ends are square, using a fins hacksaw blade or tube cutter. The ends of all pipes shall be reamed and all burrs removed.
2. The outside end of the pipe and the cut end of the fitting shall be cleaned with steel wool, sand cloth, or steel wire brush. All dark spots shall be removed.
3. The flux shall be applied evenly and sparingly to the outside end of the pipe and the inside of the outer end of the fitting until all surfaces to be jointed are completely covered. The piping and fitting shall be slipped together and reworked several times to insure an even distribution of the flux.
4. The correct amount of solder per joint for each size pipe shall be used in accordance with the manufacturer's recommendations.
5. Solder joints shall be made by using a direct flame from a torch.
6. On pipe sizes larger than ¼-inch, the fittings and valves in the pipe shall be moved or tapped with a hammer when the solder starts to melt to insure an even distribution of the solder.
7. The excess solder shall be removed while it is still in the plastic state leaving a fillet around the cup of the fitting.
8. Solder joints shall be suitable for working pressure of 100 psig and for working temperature of not less than 250 degrees F. The type of solder and flux used will be submitted for approval. Type 95-5 shall be the minimum standard.
9. Lead and antimony-based solders shall not be used for potable water systems. Brazing and silver solders are acceptable.

E. Where copper piping joins steel piping, approved bronze adapters shall be used.

F. Prohibited Connections: No direct weld, soldered, or brazed connections, without unions or flanges, shall be made to valves, strainers, apparatus, or related equipment. Right and left couplings, long threads, or caulking of pipe threads or gasket joints will not be permitted.

G. 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 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.

4. 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. Vent all gas pressure regulator vent pipes to the building exterior prior NFPA-54 and CSD-1 requirements.

H. 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.

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 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.

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

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 three (3) 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, plumbing, 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 PLUMBING PIPING, FITTINGS & VALVES

DIVISION 22 SECTION 22 07 01
PLUMBING INSULATION
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SECTION 22 07 01 - 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.

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 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 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. All disturbed piping insulation in existing areas shall be re-insulated with insulation type,

density, and thickness as specified for new piping. Insulation damaged due to new work and demolition only shall be replaced unless otherwise noted.

H. On cold systems such as domestic cold water 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.

I. 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.

J. 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 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
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	1-inch thickness
Existing Stormwater Piping that collects condensate	1-inch thickness
Existing Water Cooler Chilled Water Pipe	1-inch thickness

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 high-low mixing valve piping.

2. All Pump Volutes and Strainers.

3. Backflow Preventer Valve Bodies.

4. Expansion Tanks.

5. 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.

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.

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.

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.

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, boiler rooms, janitor’s closets, kitchens, electric rooms, and piping and ductwork 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 PLUMBING INSULATION

SECTION 22 11 13

FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Artesian Water Company (ARTW) Standard Specifications.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service, fire-service mains and combined water service and fire-service mains.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of ARTW. Include tapping of water mains and backflow prevention.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.6 PROJECT CONDITIONS

1. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner.

1.7 COORDINATION

A. Coordinate connection to water main with owner/ARTW.

PART 2 - PRODUCTS

2.1 WATER PIPING

A. All water piping and joints shall be as shown on the plans and in accordance with the ARTW Standard Specifications.

2.2 GATE VALVES

A. All gates are in accordance with the ARTW Standard Specifications.

2.3 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies are in accordance with the ARTW Standard Specifications.
   a. Valve Boxes are in accordance with the ARTW Standard Specifications.

2.4 FIRE HYDRANTS

A. All fire hydrants shall be in accordance with ARTW Standard Specifications.

2.5 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections shall be shown on the plans and in accordance with the ARTW Standard Specifications.:

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Water-Main Connection shall be in accordance with the ARTW Standard Specifications.

3.3 JOINT CONSTRUCTION

A. Make pipe joints in accordance with the ARTW Standard Specifications.

3.4 VALVE INSTALLATION

A. Install valves in accordance with the ARTW Standard Specifications.

3.5 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position in accordance with the ARTW Standard Specifications..

3.6 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install in accordance with manufacture's recommendations and as shown on the plans..

B. Install protective pipe bollards on two sides of each fire department connection. Pipe bollards are in accordance with the State of Delaware Fire Marshal requirements.

3.7 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water-distribution piping to existing water main as shown on the plans.

3.8 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water. Test in accordance with the ARTW Standard Specifications.

3.9 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

3.10 CLEANING

A. Clean and disinfect water-distribution piping in accordance with the ARTW Standard Specifications.

END OF SECTION 22 11 13

DIVISION 22 SECTION 22 40 00
PLUMBING FIXTURES

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SECTION 22 40 00 - 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. 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. City of Newark Code

3. All other authorities have jurisdiction.

G. Comply with the current lead-free laws per the requirements of the state in which the project is being constructed.

H. Provide stops for all plumbing fixtures and equipment. Stops are to be accessible.

I. 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.

J. 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.

K. All fixtures 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. Drinking fountains/bottle filling stations

2. Bubblers

L. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).
2. American Society of Mechanical Engineers (ASME).
3. National Electrical Manufacturers' Association (NEMA).
4. Underwriters Laboratories (UL).

M. Source limitations: Obtain surface wall mounted stainless steel drinking fountains from single source manufacturer.

1.2 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-floor Plumbing Fixtures for Public Use

B. ANSI/ARI 1010 - Drinking-Fountains and Self- Contained, Mechanically Refrigerated Drinking Water Coolers.

C. ANSI/NFPA 70 - National Electrical Code.

D. 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.

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 electric water coolers/bottle filling stations.

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 WATER COOLERS – FOUNTAINS

A. EWC-1 Drinking Fountain, Dual Height, Recessed, Handicapped, Bottle Filling Station (with existing remote water chiller)

1. Basis of Design Product: Subject to compliance with requirements, provide HAWS Model 1011 HSA, connected to existing remote chiller with Model SK3 skirt as indicated on the contract drawings or comparable product by one of the following:

   a. Murdock; Morris International Model A132-VR-BFT, connected to existing remote chiller with Model A0004000-SK4-18 skirt.
   b. Oasis International Model MMRSLSBF, connected to existing remote chiller with Model 036707-001 skirt.

2. Fixture:

   a. Barrier Free
   b. Dual Height with mounting frame
   c. 8 GPH at 90°F ambient provided by existing remote chiller provided by existing remote chiller
   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 brushed type 304 stainless steel.
   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.l.
   o. Provide with brushed stainless steel ADA touch skirt.
   p. Fixture shall project less than or equal to 18.5 inches off of wall.
   q. Stainless steel access panel

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. 3,000 gallon capacity filter
   e. Certified to NSF/ANSI 61, UL 399 and CAN/CSA 22.2 No. 120.
   f. Provide replacement filter pack (3 filters per pack) and turn over to Owner.

4. Provide Carrier as required.
5. Connect fountain to existing remote water chiller.

B. EWC-2 Electric Water Cooler, Dual Height, Surface Mounted, Handicapped, Bottle Filling Station

1. Basis of Design Product: Subject to compliance with requirements, provide HAWS Model 1212SF as indicated on the contract drawings or comparable product by one of the following:

    a. Murdock; Morris International Model A172.8-UG-VR-BF.
    b. Oasis International Model PGV8EBFSL-BRB.

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.l.

3. Enhanced 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 replacement filter pack (3 filters per pack) and turn over to Owner.

4. Refrigerant shall be R-134a or equivalent environmentally friendly refrigerant.
5. Provide Carrier as required.
6. Provide lead drop down wrapper.

2.2 PLUMBING FIXTURE SUPPORTS

A. Support for wall mounted bottle filling stations, drinking fountains, etc.:

B. 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.

C. Flush mounted drinking water cooler supports, Josam 17550 plate type, box steel stanchions, block type cast iron feet.

2.3 FIXTURE STOPS/SUPPLIES

A. For all drinking fountains/bottle filling stations 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 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. Protect chromium plated trim from corrosive solutions used to clean tile work.

E. Install components plumb and level.

F. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

G. Install and secure fixtures in place with wall supports, wall carriers and bolts.

H. 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.

I. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve a complete operating system.

J. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

K. 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.

L. 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.

M. 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.

N. Coordinate with Architectural Drawings before roughing in plumbing.

O. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

P. See site plan for extent of all piping leaving and entering building.

Q. See domestic water riser diagrams for location of valves, shock absorbers, etc.

R. 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.

S. 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.

T. Unless otherwise noted, horizontal sanitary piping shall be pitched 1 percent.

U. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

V. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.

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 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 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.

3.4 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.

3.5 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.

3.6 PREPARATION

A. 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.

3.7 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.8 ADJUSTING

A. Adjust stops, valves, infrared fixtures for intended water flow rate to fixtures without splashing, noise, or overflow.

3.9 CLEANING

A. At completion, clean plumbing fixtures and equipment. Polish all chrome plated faucets, accessories, equipment, and piping.

B. All electric water cooler coils/bottle filling station coils shall be cleaned of all construction dust and debris prior to building occupation by Owner.

3.10 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. Drinking Fountain

a. Standard 36 inches to top of basin rim.
b. Handicapped 34 inches to top of basin rim.

END OF PLUMBING FIXTURES

DIVISION 22 SECTION 22 40 05
PLUMBING EQUIPMENT
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SECTION 22 40 05 - 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, National Standard Plumbing Code , International Plumbing Code, City of Newark 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).

1.2 REFERENCES

A. ANSI A112.26.1 - Water Hammer Arrestors.

B. AWWA C506 - Backflow Prevention Devices - Double Check Valve Types.

C. PDI WH-201 Water Hammer Arresters.

D. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

E. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

F. ANSI/NFPA 54 - National Fuel Gas Code.

G. ANSI/NFPA 70 - National Electrical Code.

H. 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 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 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. Install ball valve on inlet pipe.

2.4 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.

2.5 GAS FIRED DOMESTIC WATER HEATERS

A. Water Heater(s) shall be model BTH as manufactured by A. O. Smith, Lochinvar, State, Bradford White, Rheem, Bock, PVI, Rheem, 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 CPVC 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.

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.

2.6 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.

2.7 HIGH/LOW MIXING VALVES

A. Furnish and install high/low thermostatic controller valves of the size, capacity and arrangement as scheduled on the contract drawings. Units shall be pre-piped.

B. Each unit shall consist of two (2) thermostatic controllers with swivel action check stops, removable cartridge with strainer, stainless steel piston and liquid fill thermal motor with bellows element mounted out of water, inlet manifold piping, pressure reducing valve (PRV), two (2) pressure gauges, two (2) ball valves, bi-metal dial thermometer (3-inch face, range 201 – 240 degrees F), wall bracket, connecting piping and fittings to cabinet limit.

C. All equipment and piping shall be finished in rough bronze and/or copper. Bottom supplies and top outlet. Field insulate adjacent all piping as specified in Division 22 Section, Plumbing Insulation.

D. Complete unit shall be factory assembled and tested.

E. High/low mixing valves shall be Symmons, Lawler, Powers, Acorn, or approved equal.

F. High/low mixing valves must be piped per the manufacturer's recommendations.

G. High/low mixing valves shall be ASSE 1017 rated.

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. Clean and flush domestic water heater tanks after installation. Seal until pipe connections are made.

I. All plumbing, vents in exterior walls shall be offset a minimum of 3'-0" in ceiling at roof before penetration.

J. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

K. 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.

L. 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.

M. 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.

N. Coordinate with Architectural Drawings before roughing in plumbing.

O. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

P. See site plan for extent of all piping leaving and entering building.

Q. See domestic water riser diagrams for location of valves, shock absorbers, balance valves, etc.

R. 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.

S. Cleanouts shall be provided near base of each vertical waste or solid stack. Provide 18" minimum clearance for access.

T. Domestic hot, cold, and HW recirculating water piping shall be installed between ceiling and roof insulation.

U. Unless otherwise noted, horizontal sanitary piping pitches shall be 1 percent.

V. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

W. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.

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.

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 with ball valve.

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.

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. Fasten recessed, wall mounting plumbing specialties to reinforcement built into walls.

E. Secure supplies to supports or substrate.

F. 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.

G. Install water supply stop valves in accessible locations.

H. 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.

I. Include wood blocking reinforcement for recessed and wall mounting plumbing specialties.

J. Install ball valves at all shock absorbers to allow removal for service/replacement.

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:

1. 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.
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 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.

3.6 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 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 CLEANING

A. At completion, clean plumbing equipment.

END OF PLUMBING EQUIPMENT

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SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

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

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

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

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

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

F. Coordinate the work under Division 23 with the work of all other construction trades.

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

1.2 PERMITS AND FEES

A. Obtain all permits and pay taxes, fees and other costs in connection with the work. File necessary plans, prepare documents, give proper notices and obtain necessary approvals. Deliver inspection and approval certificates to Owner prior to final acceptance of the work.

B. Permits and fees shall comply with the Division 01, General Requirements of the specification.

1.3 EXAMINATION OF SITE

A. Examine the site, determine all conditions and circumstances under which the work must be done, and make all necessary allowances for same. No additional cost to the Owner will be permitted for contractors' failure to do so.

B. Examine and verify specific conditions described in individual specifications sections.

C. Verify that utility services are available, of the correct characteristics, and in the correct locations.

1.4 CONTRACTOR QUALIFICATION

A. Any Contractor or Subcontractor performing work under Division 23 shall be fully qualified and acceptable to the Architect/Engineer and Owner. Submit the following evidence when requested:

1. A list of not less than five comparable projects which the Contractor completed.
2. Letter of reference from not less than three registered professional engineers, general contractors or building owners.
3. Local and/or State License, where required.
4. Membership in trade or professional organizations where required.

B. A Contractor is any individual, partnership, or corporation, performing work by contract or subcontract on this project.

C. Acceptance of a Contractor or Subcontractor will not relieve the Contractor or subcontractor of any contractual requirements or his responsibility to supervise and coordinate the work, of various trades.

1.5 MATERIALS AND EQUIPMENT

A. Materials and equipment installed as a permanent part of the project shall be new, unless otherwise indicated or specified, and of the specified type and quality. Existing items of equipment are being relocated under another 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.

1.6 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
D.	ADC		Air Diffusion Council
E.	AMCA		Air Movement and Control Association
F.	ANSI	-	American National Standards Institute
G.	ARI	-	Air Conditioning and Refrigeration Institute
H.	ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
I.	ASME	-	American Society of Mechanical Engineers
J.	ASPE	-	American Society of Plumbing Engineers
K.	ASTM	-	American Society for Testing and Materials
L.	CS	-	Commercial Standard
M.	FM	-	Factory Mutual
N.	IBC	-	International Building Code
O.	IEEE	-	Institute of Electrical and Electronics Engineers

P. MSSP - Manufacturers Standards Society of the Valve and Fittings Industry

Q. NEC - National Electrical Code

R. NEMA - National Electrical Manufacturers Association

S. NFPA - National Fire Protection Association

T. SMACNA - Sheet Metal and Air Conditioning Contractors National Association

U. UL - Underwriters' Laboratories

V. State of Delaware Fire Protection Regulations.

W. All mechanical equipment and materials shall comply with the codes and standards listed in the latest edition of ASHRAE HVAC Applications Handbook, Chapter entitled Codes and Standards.

1.8 SUBMITTALS, REVIEW AND ACCEPTANCE

A. Equipment, materials, installation, workmanship and arrangement of work are subject to review and acceptance. No substitution will be permitted after acceptance of equipment or materials except where such substitution is considered by the Architect to be in best interest of Owner.

B. After acceptance of Material and Equipment List, submit three (3) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the

submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

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.

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. Air Cooled Heat Pumps
3. Horizontal and Vertical Air Handling Units
4. Air Distribution Systems
5. Automatic Temperature Control System and Equipment
6. Carbon Monoxide Detectors
7. Condensate Pumps
8. Coordinated Drawings
9. Drip Pans
10. Duct Materials
11. Electric Heating Coils
12. Electric Wall Mounted Heaters
13. Equipment Rails
14. Exterior Equipment Supports

15. Exterior Pipe Supports
16. Fans
17. Filters
18. Filter Housings/Mixing Boxes
19. Fire Stopping - Methods and Materials
20. Identification Systems
21. Intake Hoods
22. Louvers and Insulated Blank-Off Panels
23. Material and Equipment Lists
24. Operations and Maintenance Manuals
25. Packaged Terminal Heat Pumps
26. Pipe Enclosures
27. Pipe Guides and Anchors
28. Pipe Materials Including Itemized Schedules
29. Preliminary Testing and Balancing Reports
30. Refrigerant Mitigation Controls/Sensors/Interlocks
31. Roof Curbs
32. Split System Heat Pumps, Ductless
33. Test Certificates
34. Thermal Insulation Materials Include Table Summaries
35. Thermometers and Gauges
36. Vibration Isolation Materials
37. Water Heater Flue/Combustion Air Piping
38. Weatherproof Assembly Components
39. 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.

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.

E. All work associated with the existing roof shall be performed so as to maintain the existing roof warranty.

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 the existing and new work in a finished and workman like condition.

1.15 DEMOLITION

A. Unless otherwise noted all existing equipment, piping, ductwork, etc., shall remain.

B. Where existing equipment is indicated to be removed, all associated piping, conduit, power, controls, control panels, sensors, tubing, insulation, hangers, ductwork, supports and housekeeping pads, etc., patch, paint and repair walls/roof/floor to match existing

and/or new finishes.

C. Provide necessary piping, valves, traps, temporary feeds, drips, etc., as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time lengths of outages.

D. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

E. Refer to phasing plans for additional requirements.

F. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.

G. The location of all existing equipment, piping, ductwork, etc., indicated is approximate only and shall be checked and verified. Install all new mechanical/plumbing/fire protection work to connect to or clear existing work as applicable.

H. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.

I. Make provisions and include in bid all costs associated with confined entry/space requirements in and all other applicable OSHA regulations.

J. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves.

K. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirely.

L. Existing piping, equipment, ductwork, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

M. 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.

N. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing refrigerants. Contractor shall include in his bid all cost associated with the evacuation, removal and disposal of all existing equipment containing refrigerants in accordance with EPA and Health Department requirements.

O. Where piping and/or ductwork is removed, remove all pipe or ductwork hangers which were supporting the removed piping or ductwork. Patch the remaining penetration voids with like materials and paint to match existing construction.

P. 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.

Q. 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.

R. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.

S. 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.

T. 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.

U. Work Abandoned in Place: Cut and remove underground pipe a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

V. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

W. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

1.16 DRIVE GUARDS

A. Provide safety guards on all exposed belt drives, motor couplings, and other rotating machinery. Provide fully enclosed guards where machinery is exposed from more than one direction.

B. When available, guards shall be factory fabricated and furnished with the equipment. Otherwise fabricate guards of heavy gauge steel, rigidly braced, removable, and finish to match equipment served. Provide openings for tachometers. Guards shall meet local, State and O.S.H.A. requirements.

1.17 VIBRATION ISOLATION

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

1.18 ALTERNATES

A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

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, embedded in construction or in crawl space.

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. Building Line: Exterior wall of building.

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 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. 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 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. All equipment with A2L refrigerant shall include factory furnished and installed listed refrigerant mitigation controls including refrigerant leak detection sensors, fan speed increase interlock and refrigerant system shutdown for ASHRAE 15.

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.

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 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 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
3HP	89.5 percent	86 percent
5HP and above	89.5 percent	87 percent

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. 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.

K. 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 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.

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. 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.

D. 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.

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 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, kitchens, 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, Geothermal Pump Rooms, Fire Pump Rooms, Mezzanines, and Storage where PVC jacketed shall not require painting. Label and identify and color code as specified.

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.

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.

C. All items of equipment, including motor starters, disconnects and ATC panels shall be furnished with white on black plastic permanent identification cards. Lettering shall be a minimum of ¼ inch high. Identification plates shall be secured, affixed to each piece of equipment, starters, disconnects, panels by screw or adhesive (tuff bond #TB2 or as approved equal).

D. Provide three (3) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Record and Information Booklet as hereinafter specified.

E. All lines piping and ductwork installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and ductwork and service. Refer to Division 23 Section, “HVAC Piping, Fittings, Valves, Etc.” and Division 23 Section, “HVAC Air Distribution”. Color-code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.

F. Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit samples of equipment identification cards, piping labels, ductwork labels, and valve tags to Engineer for review prior to installation.

G. 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 and Engineer.

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. For renovation projects where new pipes or ducts penetrate existing floors, furnish ground penetrating radar to properly map out acceptable locations for pipe/duct penetrations. Review penetrations with Engineer.

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.

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 three (3) 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 – Delaware School for the Deaf Renovation - 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 air conditioning compressors, 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.
11. Access panel charts with index illustrating the location and purpose of access panels.
12. Approved HVAC Inspector and Electrical Inspector Certificates.
13. Start-up reports for equipment.
14. 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.

15. Filter charts indicating equipment served, size, and type of filter required.

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 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.

G. Furnish HVAC equipment with listed factory installed refrigerant mitigation controls, sensors, and interlocks.

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 PHASING

A. Refer to Architectural Specifications and contract drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities having jurisdiction.

C. Provide dust barriers/partitions, penetration closures, etc, to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Refer to phasing plans for additional requirements.

F. Provide necessary piping, valves, piping, conduit, controllers, ATC wiring, etc. as required. Drain and refill piping systems as often as necessary to accommodate phasing and to minimize time length of outages. Temporarily feed new systems with existing system where required or shown on contract drawings.

G. At completion of the first phase the ATC System shall be sufficiently complete to turn over HVAC equipment. All wiring, testing, balancing, commissioning, and programming shall be completed and operational for all equipment in each phase prior to Owner taking ownership of the same.

H. Within thirty days of Award of Contract, the Contractor shall submit a minimum of six (6) copies of the proposed Phasing Plan (Drawings and detailed written description) to the Architect for review and approval based on the general and specific requirements indicated on the Drawings and Specifications. The phasing plan shall reflect the work of all trades. The phasing plan shall be updated as often as needed (i.e. major deviations and/or modified sequence of events) and reviewed during each progress meeting so the facility and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.

I. Due to phased construction, some systems must be operated at part load conditions until later phases are completed.

J. While work is in progress, except for designated short intervals during which connections are made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

3.21 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 COMMON WORK RESULTS FOR HVAC

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: _____

DIVISION 23 SECTION 23 05 05
HVAC PIPING, FITTINGS & VALVES
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SECTION 23 05 05 - 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.

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. 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.

g. 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.

h. 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.

i. 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.

j. Pressure Relief Valves: Straight-through or angle pattern, brass body and disc, neoprene seat, and factory sealed and ASME labeled for standard pressure setting.

2. Cooling Coil A/C Condensate Drain 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. Exterior condensate pipe penetrations must exit exterior wall above flashing. Extend discharge away from exterior walls as detailed.

B. Copper pipe shall be Revere, Anaconda or Chase with approved solder fittings.

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

A. All hangers for metallic piping shall be adjustable, wrought clevis type, or adjustable malleable split ring swivel type, having rods with machine threads. Hangers shall be Grinnell Company's Figure 260, 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:

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

NOMINAL PIPE SIZE IN	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
12	18	7/8

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. Wall support for pipe sizes to 3 inches (76 mm): cast iron hook

G. Vertical Support: Steel riser clamp.

H. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

I. Copper pipe support: Carbon steel ring, adjustable, copper plated.

J. Hanger rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

K. 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.

L. For exterior pipe supports provide stainless steel, supports, brackets, hardware and anchors.

M. For pipe hangers installed in corrosive environments such as 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 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. Unions in stainless steel pipe 2-inches and smaller shall be hexagonal threaded type stainless steel unions, with VicPress ends. Basis of Design: Victaulic Style P584.

D. Flanges for steel pipe over 2 inches shall be 150 psig, forged steel, slip on. Gaskets shall be 1/16 inch thick pre-formed neoprene.

E. Flanges for copper pipe over 2 inches shall be bronze. Gaskets shall be 1/16 inch thick preformed neoprene.

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.

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 water heaters, 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.

2.7 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. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All horizontal mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with

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

B. All piping shall be 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. Unions shall be installed on all bypasses, ahead of all traps, at all connections to equipment, where shown on drawings or where required to facilitate removal of equipment whether shown or not.

E. 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.

F. 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.

G. Install all valves with stem upright or horizontal, not inverted.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, weld and apply one coat of zinc rich primer.

I. Provide clearance for installation of insulation and access to valves and fittings.

J. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

K. All water containing pipes shall be routed clear of combustion air dampers and louvers to prevent freezing condition when dampers are open.

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.

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.

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).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400mm); minimum rod size, 3/8 inch (9.5mm).
7. NPS 2-½ (DN 65): Maximum span, 108 inches (2700mm); minimum rod size, 3/8 inch (9.5mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3m); minimum rod size, 3/8 inch (9.5mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7m); minimum rod size, 1/2 inch (13mm).

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, indoor units, and compressor units. Support piping in accordance with Division 23 Section, HVAC Piping, Fittings, Valves, Etc. Piping shall be sized as recommended by unit manufacturer taking into account length of vertical and horizontal runs, and refrigerant type. Provide and install dual sets of refrigerant piping on all units required to have dual independent circuits.

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.

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 relief piping shall be routed to building exterior as indicated on contract documents and in accordance with ASHRAE 15, latest edition.

MM. Refrigerant monitoring piping shall be connected to refrigerant monitoring equipment and piped per the Manufacturer's requirements.

NN. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.

OO. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.

PP. Install strainers in main liquid line where multiple expansion valves with integral strainers are used.

QQ. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

RR. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

SS. 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 150 psig (1035 kPa) or higher as required by authorities having jurisdiction.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

TT. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

UU. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

VV. Adjust set-point temperature of the conditioned air or chilled-water controllers to the system design temperature.

WW. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Check compressor oil level above center of sight glass.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves, except bypass valves that are used for other purposes.
5. Check compressor-motor alignment, and lubricate motors and bearings.

XX. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

YY. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

ZZ. 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.

3.4 HANGERS 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.

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

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 three (3) 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.

END OF HVAC PIPING, FITTINGS & VALVES

DIVISION 23 SECTION 23 05 48
VIBRATION CONTROLS FOR HVAC, PLUMBING & FIRE PROTECTION EQUIPMENT
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SECTION 23 05 48 - VIBRATION CONTROLS FOR HVAC, PLUMBING AND FIRE PROTECTION EQUIPMENT

PART 1 - RELATED DOCUMENTS

1.1 GENERAL

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to work of this section.

B. All work under this section shall also be subject to the requirements of Division 23 Section, Common Work Results for HVAC.

1.2 SUMMARY

A. Provide all labor and materials necessary to furnish and install vibration control systems on this project as herein specified and/or shown on the drawings.

B. Mount all mechanical equipment on suitable vibration isolators so as to prevent transmission of vibration into or through the building structure. Isolators shall be as manufactured by Mason Industries, Inc., Korfund, Inc., Amber Booth, 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 pump and motor bases, fan and motor bases, cradles, isolation pipe/duct hangers, spring and/or neoprene isolators, neoprene pads, flexible connectors, etc. as a coordinated package by a single manufacturer.

D. Select isolators for uniform static deflections according to distribution of weight; and for not less than the indicated isolation efficiency with the lowest rotational speed of equipment as the disturbing frequency.

E. Isolators and bases shall be stable during stopping and starting of equipment without transverse or eccentric movement of equipment, and shall be designed to resist horizontal forces of equipment which may operate unbalanced.

F. In general, select isolators on the basis of criteria as specified in the ASHRAE Applications Handbook, Latest Edition.

1.3 SUBMITTALS

A. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each.

B. Product Data: Provide schedule of vibration isolator type with location and load on each.

C. Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

D. Manufacturer's Certificate: Certify that isolators are properly installed and adjusted to meet or exceed specified requirements.

1.4 PROJECT RECORD DOCUMENTS

A. Record actual locations of hangers including attachment points.

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 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.

2.9 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.

2.10 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. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.

K. 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.

L. 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.

M. 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.

N. Install in accordance with manufacturer's instructions.

O. Install isolation for motor driven equipment.

P. Install spring hangers without binding.

Q. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

R. 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.

S. 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.

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. Pumps:

1. Provide flexible pipe connections at pump suction and discharge. Mason Industries Type BSS or MFTNC/MFTFU with control rods type ACC or as approved equal.
2. Provide discharge and suction vibration isolaters at all in-line pumps.

C. Air Handling Units

1. All horizontal and vertical air handling units, shall be supported on stable steel springs in series with ribbed neoprene pads selected for not less than 1.0" 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. Outdoor Heat Pump Units: All outdoor heat pump units shall be supported on stable steel springs in series with ribbed neoprene pads and structural rails selected for not less than 1.0" deflection under full operating load. All exterior isolators for heat pump units shall be hot dipped galvanized including all hardware. Mason Industries Type SLF springs or as approved equal. Provide neoprene coated springs.

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 concrete pad.

3.4 MANUFACTURER'S FIELD SERVICES

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

END OF VIBRATION CONTROLS FOR HVAC, PLUMBING & FIRE PROTECTION EQUIPMENT

DIVISION 23 SECTION 23 05 93
TESTING, ADJUSTING & BALANCING FOR HVAC & PLUMBING
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SECTION 23 05 93 - 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.

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 Handling Units
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. Electric Heating Coils
8. Electric Heaters
9. Exhaust Fans
10. Heat Pumps
11. PTACS (Packaged Terminal heat pumps)
12. Refrigerant Mitigation Control Testing.
13. Zone Branch and Main Ducts

Hydronic Systems:

1. Condensate Pumps
2. Condensate overflow safety switches
3. Domestic Re-circulating Systems and Water Heater
4. Flow Meter Fittings
5. High/Low Mixing Valves (Domestic Water)
6. In-line Pumps
7. System Mains and Branches
8. In addition, any existing fans, pumps equipment or air devices specified to be re-used under this project shall be tested and balanced, similar to new fans.
9. Domestic recirculating pump.

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).

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.

B. The plans and specifications have indicated meters, valves, dampers, and other devices for the purpose of adjusting the system to obtain optimum operating conditions. It will be the responsibility of the mechanical contractor to install these devices in a manner that will leave them accessible and readily adjustable. The balancing agency shall provide guidance if there is a questionable arrangement of a control or balancing device.

C. The general contractor, mechanical contractor, temperature control contractor and suppliers of the HVAC equipment shall all cooperate with the balancing agency to provide all necessary data on the design and proper application of the system components.

D. For heat pumps, the manufacturer's start-up agency and Test and Balance Engineer shall assist each other with obtaining proper flow rates and refrigerant pressures.

1.11 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 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. Coil 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, and HVAC terminal unit. At the time of reading, record water flow and entering and leaving water temperatures and pressure drops.
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 pumps shall be related to pump curves in terms of GPM flow and through flow measuring stations, where provided and installed, at each hydronic unit.
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.

D. Testing of Temperature Control Systems as applicable to the project.

1. Air Handling Units

a. Start each air handling unit; verify and document:
- Dampers modulate properly and in the correct sequence.
- Fan(s) ramp to design speed or proper controlled speed.
- 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.: minimum/maximum airflows, outside airflows at unit minimum/maximum volume, and special sequences.
- All end switches and positioners are properly set.

- All temperature sensors are calibrated.
- Reset control sequences operate in response to changes in system temperatures, flows, or pressures.

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.
- Interlocked devices turn off.
- System starts for setback temperature control.
- System starts on a temporary occupancy override.
- All alarms and safeties remain operational.

2. Fan Systems

a. Start each fan or fan system; verify and document:
- Interlocks and lockouts operate in accordance with the sequence.
- Fan(s) ramp 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 temperature sensors are calibrated.

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.
- Emergency mode operation; e.g.: purge air.
- Interlocked devices turn off.
- All alarms and safeties remain operational.

3. Hydronic Systems

a. Start hydronic systems; verify and document:
- All interlocked devices energize.
- All pressure controllers respond to increases or decreases in system pressure.
- All temperature sensors are calibrated.
- The controls have time delay strategy to avoid excessive cycling of pumps.

b. Shut down hydronic systems; verify and document:
- 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. If the temperature is not reading within tolerance, the sensor will be reported to the control contractor for calibration.
   - The room temperature and relative humidity sensors. If the sensors are not reading within tolerance, the sensors shall be reported to the control contractor for calibration.

5. 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.

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. 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. Ensure that all volume dampers and fire dampers 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.
3. Verify that all supply - return - exhaust and transfer grilles; registers, and diffusers are installed, operational, and sealed tightly.
4. 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.
5. 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.
6. Make any necessary changes to the sheaves, belts, and dampers, as required by the balancing agency, at no additional cost to the owner.
7. Install clean filters.
8. 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.
9. All supply, return, exhaust, and relief fans shall be operating and verified for: freedom from 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.
10. All terminal units shall be installed and functional. Controls commissioning shall be complete.
11. For heat pumps, 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, and control devices 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.
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 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. 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 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 General Contractor 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 General Contractor 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)

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 ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems – Duct Design". Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens and indicated perforations.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 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. 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.
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. 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.
11. Identification - Identify the location and area of each grille, diffuser, and register. This information shall be recorded on air outlet data sheets.
12. Description - Record the size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.
13. Minimizing Drafts - Adjust all diffusers, grilles, and registers to minimize drafts in all areas.
14. Where modulating dampers are provided, take measurements and balance at extreme conditions.
15. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
16. For heat pumps assist start-up organization or manufacturer's representative with start-up. Record air flow rates and electrical characteristics prior to refrigerant pressure measurement and settings.
17. For all equipment specified with condensate overflow safety switches/floats test operation of such device and record results. Verify interlock with ATC system.
18. Outside air measurements must be measured and submitted in all modes of operation:
19. 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 flow of water through all coils shall be adjusted by manipulating balancing valves until the rated pressure drop through the coil or metering device is obtained. Perform balancing by measurement of temperature differential in conjunction with air balancing.

C. The balancing agency shall perform the following testing and balancing functions in accordance with the AABC National Standards.

D. All Hydronic equipment, domestic re-circulating pumps, and HVAC pumps shall be Tested and Balanced as described below:

1. Water Treatment - Examine the water in the system and determine if the water has been treated and cleaned. If it has not, request the mechanical contractor to clean and treat the water prior to TAB work
2. Strainers - Request that the mechanical contractor clean all strainers.
3. Air Vents - Check all air vents at the high points of the water system and determine if they are installed and operating.
4. Valves - Set all balancing valves to the full-open position for balancing.
5. Pumps - Adjust all pumps and 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 overloads installed on all pumps. Record in Test and Balance Report.
6. Tolerances - Proceed to balance all coils, pumps, and balance valves to within 5 percent of design requirements.
7. Marking - Mark all settings and record all data after completing the flow readings and coil adjustments.
8. Where available pump capacity (due to diversity) is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
9. Test all A/C condensate pumps for proper operation.
10. Test condensate overflow safety switches.

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.

3.6 TESTING AND BALANCING OF EXISTING SYSTEMS

A. The balancing agency shall perform testing and balancing of existing air handling, fan and pump systems to the extent indicated. Existing air devices and terminals shall be re-tested and balanced where effected by new ductwork modifications.

B. Test and Balance Agency shall assist the mechanical contractor in selection of new sheaves and belts, if required. Re-sheaving of existing air handling units or fans shall be done at no additional cost to owner. Where required, new sheave and belt size calculations shall be forwarded to the Engineer for review and approval.

C. The Test and Balance Agency shall perform air system procedures (here-in before specified) on the following existing systems.

1. Refer to schedule on Contract Drawings.

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:

1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset.
2. Verify that all controlling instruments are calibrated and set for design operating conditions.
3. Verify the accuracy of the final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.

3.9 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. Three (3) 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. General Contractor
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 and PTAC equipment test form:

1. Manufacturer, model number, serial number, arrangement.
2. All design and manufacturer-rated data.
3. Total actual CFM by traverse if practical. If not practical, the sum of the outlets may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.
4. Suction and discharge static pressure of each fan, as applicable. Include pressure drops across coils, 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. 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. Electric Heating Coil, and Electric Unit Heater Test Forms:

1. Manufacturer.
2. Identification/number.
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.

E. 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

F. 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.

G. 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.

H. 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.

I. 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.

J. Air Cooled Heat Pump Test Forms:

1. Manufacturer
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

K. High/Low 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.

L. 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

M. Condensate Over Flow Switches/Floats Test Forms

1. Manufacturer
2. Type
3. Location
4. Equipment shut down verification
5. ATC interlock verification

N. 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.

END OF TESTING, ADJUSTING & BALANCING FOR HVAC & PLUMBING

DIVISION 23 SECTION 23 06 00
HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT
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SECTION 23 06 00 - HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

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

1.2 DESCRIPTION

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

1.3 SUBMITTALS

A. Shop Drawings: Indicate assembly, equipment dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

B. Product Data:

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

1.4 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Include instructions for lubrication, filter replacement, motor and

drive replacement, spare parts lists, and wiring diagrams.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of General Requirements.

B. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

C. Store all equipment in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

D. Comply with manufacturer's installation instructions for rigging, unloading and transporting equipment.

E. Protect all motors, shafts, and bearings from weather and construction dust.

1.6 ENVIRONMENTAL REQUIREMENTS

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

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 5 KA.

PART 2 - PRODUCTS

2.1 CONVENTIONAL DUCTLESS SPLIT SYSTEM HEAT PUMP

A. The heat pump air conditioning system shall be a Mitsubishi Electric, Sanyo, LG, Daikin, Samsung, or approved equal split system. The system shall consist of a slim silhouette, compact ceiling recessed packaged evaporator section with matching Slim Line 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-32 or R-454B refrigerant for 100 feet of refrigerant tubing shall be provided in the condensing unit. A dry nitrogen holding charge shall be provided in the condensing unit. A dry nitrogen holding charge shall be provided in the evaporator. System SEER shall meet or exceed Federal Standards latest edition

B. The units shall have a manufacturer's warranty for a period of two (2) years from date of installation. The compressor shall have a warranty of six 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. Capacity shall be as scheduled on the contract drawings.

C. The indoor unit shall be completely factory assembled and wired. The casing shall be galvanized sheet with grey heat insulation. This unit shall fit in the ceiling and have the capability of attaching a branch supply duct as well as a fresh air duct. The evaporator fan shall be an assembly with a high performance, fan direct driven by a single motor. The fans shall be statically and dynamically balanced and run on permanently lubricated bearings. The indoor unit shall have an adjustable air outlet system offering 4-way air flow, 3-way air flow, or 2-way air flow. The auto air swing vanes shall automatically swing up and down for uniform air distribution. Return air shall be filtered by a long-life filter to provide approximately, 2500 hours of use in a normal office environment before cleaning. The indoor unit shall be covered with a flat panel which protrudes only 1 inch below the ceiling to provide a neat and clean installation. The coils shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tubes joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan shall extend under the coil and piping. An integral drain pan pump capable of lifting condensate 12 inches shall be provided. An integral booster heater shall not be provided to supplement the unit during the heating mode. The unit variable speed compressor shall allow full heating capability and defrost without the need for a booster heater. The unit electrical power requirements shall be as scheduled on the contract drawings.

D. The control system shall consist of two (2) microprocessors interconnected by a single non-polar two wire cable as supplied. Wiring shall run from indoor unit to controller direct. NO SPLICES. When running longer lengths or more than one set of hardwired remote controller wires together, a double insulated, two wire cable equivalent to that provided e.g. Belden 9407 cable, is mandatory or use shielded two wire cable. One microprocessor shall be factory wired and located within the indoor unit. It shall have the capability of sensing return air temperature and indoor coil temperature; receive and process commands from the hardwired remote controller provide emergency operation; control the booster heater and control the outdoor unit. The microprocessor within the wall mounted hardwired remote controller shall provide automatic cooling and heating system changeover; display set point and room temperature; a 24 hour on/off timer so that automatic operation can be set on the timer at one hour intervals from one to twenty-four hours; have self-diagnostic function display; check mode for memory of most recent problem; System shall control continued operation of the air sweep louvers; and provide on-off and system/mode function switching. The heating system shall be controlled so

that only warm air is discharged whenever the fan speed exceeds the very low (VLO) speed. Normal operation of the hardwired remote controller provides individual system control in which one hardwired remote controller and one indoor unit are installed in the same room. The hardwired remote controller shall have the capability of controlling up to a maximum of 50 systems at a maximum developed control cable distance of 1650 feet. The control voltage between the hardwired remote controller and the indoor unit shall be 12 volts, D.C. The control voltage between the indoor unit and the outdoor unit shall be 12 volts D.C. Both 12 VDC shall be generated from the indoor unit microprocessor board. The system shall be capable of automatic restart when power is restored after power interruption. System shall include twenty function self-diagnostics including total hours of compressor run time.

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 one (1) direct drive, propeller type fan arranged for horizontal discharge. The motors shall have inherent protection be of the permanently lubricated type, and resiliently mounted for quiet operation. Each fan shall be provided with a raised guard to prevent contact with moving parts. The variable speed compressor shall be of the high-performance, rotary type with crankcase heater, accumulator and internal thermal overloads. The variable speed compressor shall be mounted so as to avoid the transmission of vibration. The refrigeration system shall be equipped with pressure switch and have the capability to operate with a maximum height difference of 130 feet and overall refrigerant tubing length of 130 feet between indoor and outdoor sections without the need for line size changes, traps or additional oil. Refrigerant flow from the condenser to be controlled by means of a capillary tube. The condenser coil shall be 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. A built-in, low-ambient controller shall allow cooling to 23 degrees F outdoor temperature. The unit electrical power requirements shall be as scheduled on the contract drawings. The outdoor unit shall be placed on vibration isolators and mounted on a concrete pad.

F. High condensate water safety shutdown: Each indoor unit’s detection unit shall be interlocked to alarm and stop the outdoor unit if a high condensate water level is sensed.

G. Refrigerant mitigation controls including refrigerant leak sensors, fan speed increase interlock, and refrigerant system shutdown per ASHRAE 15.

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 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.

B. In-Line Centrifugal Fans

1. 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. Field install motor operated damper.
j. Fans shall be Model SQ as manufactured by Greenheck, Acme Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

2.4 CIRCULATION PADDLE FANS WITH REMOTE REVERSIBLE ROTATION SWITCH

A. Furnish and install high volume, low speed ceiling paddle fans of the size, capacity, and electrical characteristics as shown on contract drawings. Circulation paddle fans shall be Greenheck Model DM or approved equal.

B. Circulation fans shall be multispeed direct drive.

C. Blades of the fan shall be constructed of contour metal and balanced for wobble free operation. Rolled edge blades shall comply with UL specifications for low ceiling applications. (minimum 7 feet blade to floor mounting height).

D. Motor shall be direct drive with sealed ball bearings and die cast motor housing.

E. Down rod shall be provided as needed. Down rods and mounting hardware installation shall be included. Furnish and install heavy duty restraint cable.

F. Furnish each Paddle Fan with a four position fan control. Control shall have settings of “High”, “Medium”, “Low”, and “Off”.

G. Furnish Paddle Fans in color as selected by Architect.

H. Fan shall be reversible. Fan direction shall be able to be changed from speed control switch.

I. Total sound pressure shall not exceed 20 dba.

2.5 PACKAGED TERMINAL HEAT PUMP UNITS

A. The Packaged Terminal Heat Pumps shall be Contractor-furnished and Contractor installed. The units shall be located as shown on the Drawings and each shall consist of a chassis, wall case, outside grille, room cabinet, (sub-base,) and power connector kit. Units shall be listed by UL and CSA, and ARI Certified as to capacity and efficiency and shall be Amana (Model PMH R32 J Models), GE Zoneline, LG, Island Aire, or approved equal. Unit dimensions shall not exceed 42-1/8-inches wide and 16-1/4-inches high with room cabinet in place, and not more than 22-3/4-inches deep from face of room cabinet to face of exterior grille. Units shall be designed to operate on Electrical characteristics as

indicated on the contract drawings.

B. Chassis: Unit heat pump chassis shall be the standard product of the manufacturer and shall be shipped in protective cartons so as to preclude damage. Cartons shall be appropriately marked at the factory with wording sufficient to warn handlers against improper stacking, up-ending, rolling, or dropping. Chassis shall be slide-in type, ready to operate after installation. Each shall consist of the following sections and components:

1. Hermetically-sealed refrigerant system with external vibration-isolated rotary-type compressor, condenser and evaporator coils and capillary refrigerant control. Cooling shall be possible down to an outdoor temperature of 35 degrees F and below without damage to the compressor.
2. Air flow system consisting of one permanently lubricated two-speed fan motor for the outdoor fan and a separate permanently lubricated two-speed fan motor for the indoor fan. Out-door fan shall be multi-blade axial-flow design made of non-corrosive material. Indoor fan shall be of a forward curved cross-flow design. Only the indoor fan shall run during the heating cycle on resistance heat models. All motors on the exterior side of the weather barrier shall be of an enclosed design to reduce the effects of moisture and corrosion.
3. A fan cycle switch shall permit continuous indoor fan operation; or, to permit energy-saving intermittent indoor fan operation where the fan runs only when the compressor or heater is operating.
4. A positive cooling condensate disposal system which meets the test requirements of ARI Standards 380-90 (80 degrees F dry bulb, 75 degrees F wet bulb, 80 percent relative humidity) for Packaged Terminal Heat Pump Units.
5. Condenser and evaporator coils shall be constructed of copper tubing and aluminum plate fins with enhancements necessary to achieve EER and COP rating of the unit.
6. Indoor and outdoor airflows that match the capacity of the coils for efficient heat transfer. Water blow-off shall not occur on the indoor coil.
7. Indoor discharge air louvers adjustable without tools to four settings from 15 degrees off vertical to 60 degrees off vertical.
8. Easily accessible slide controls for unit operation and thermostat setting. Controls shall be covered by a hinged door.
9. Slide-out washable filters accessible from top of unit without requiring removal of room cabinet. Provide one additional set of filters for all units. Turn over to the Using Agency.
10. Positive closing fresh air damper located within the chassis operated by concealed manual control. Provide motor operated damper interlocked with packaged terminal heat pump.
11. Thermistor temperature sensing device to measure room temperature and control operation of unit.
12. Electronic temperature limiting, transparent to User, to permit seven independent heating limits and seven independent cooling limits.
13. Freeze Sentinel to automatically activate the electric resistance heater and fan motor to warm and circulate indoor air to help prevent damage due to freezing temperatures. Freeze Sentinel shall operate as long as unit is connected to powered electrical circuit.
14. Provide remote mounted hard wired programmable thermostat with dual stage

heating, dual stage cooling, and fan speed adjustment (Amana PHWT-A200).

C. Heat pump units shall automatically phase-in partial electric resistance heat operation, if outdoor temperature is below 45 degrees F, simultaneously with heat pump if heat pump alone is unable to maintain room temperature, or switch over to full electric resistance heat if room temperature continues to decline or the outdoor temperature falls below 25 degrees F. If outdoor temperature is above 45 degrees F, unit shall lock-out electric resistance heat and operate on heat pump alone.

D. Heat pump unit shall include reverse Cycle Defrost that automatically begins a defrost cycle when microprocessor determines criteria for defrosting has been met. Defrosting shall be accomplished by systematically ceasing heat pump operation, pausing to allow internal refrigerant pressures to equalize, then operating the compressor with the flow of refrigerant reversed, to allow the hot gas to flow through the outdoor coil melting the accumulated frost. Unit shall automatically reinitiate heat pump operation, again pausing to allow refrigerant pressures to equalize.

E. In the event of compressor failure during heat pump operation, unit shall automatically switch to electric resistance heat to maintain selected room temperature regardless of outdoor temperatures.

F. Unit shall have means of electrical connection listed by Underwriters Laboratories and compatible with the unit's capacity, which shall conform with National Electrical Code (NEC) and local codes. Units shall be provided with a permanent electrical connection kit complete with conduit, wiring harness, and integral fuse.

G. To remove condensate from the wall case, an external drain adapter with drain tube shall be installed.

H. Wall Case: Wall case shall be constructed of not less than 18 gauge, zinc-coated phosphatized steel and shall have a protective baked-on enamel finish. Bottom of steel wall case shall be treated with petroleum microcrystalline wax for added corrosion protection and shall meet ASTM B-1178, 1800 hour hot air aerated salt spray test. Cases shall be installed through exterior walls where shown on the plans and shall be level from side to side and from front to rear to ensure proper operation of condensate system(s). They shall be secured to the wall at both sides using nails or other appropriate fastening devices. In no instance shall fasteners be used through the bottom in order to retain the water integrity of the bottom of the wall case. Outside weather panels shipped with the cases shall remain in place until the outdoor air louvers and chassis are installed, at which time they are to be removed and discarded by the installer.

I. Sub-Base: Each unit shall have a field-installed UL Listed electrical sub-base. The sub-base shall be attached to the lower inside flange of the wall case prior to installation in the exterior wall and shall include adjustable screws at the bottom corners to permit exact leveling of the wall case. The sub-base shall have side panels adjustable from a minimum of 2-3/8-inces to a maximum of 13-3/4-inches to enclose the area under the wall case.

J. Outside Grille: Each unit shall be equipped with a resin architectural grille with flange. Grille shall be custom color and shall be selected by the Architect. Furnish with outside

air motor operated damper and actuator .

K. Room Cabinet: Each unit shall have a matching, easily removable, textured finish, wrap-around room side cabinet molded of high temperature styrene to resist corrosion and damage.

L. Weather Resistance: Complete unit including outside louver shall be submitted to an independent agency for weather resistance and water infiltration test. Air infiltration test to be conducted in accordance with ASTM E283-91. With static air pressure differential of 1.57 lb./ft.2 (1.93-inch H20) equivalent to 63 mph wind, 5.0 gal./ft.lb.2 (8-inch rain/ft.2/hr.) for 15 minutes and there shall be no leakage into the room.

M. Approvals: Units shall be certified under the ARI Certification Program and listed by UL and CSA.

N. Service: Submit complete information with bid covering service availability, to whom service on units shall be assigned, complete address and phone number, including phone number of emergency service personnel. Also, state whether or not the service proposes to offer a service contract to be effective after the first year warranty expires, and, if so, cost and coverage of such contracts.

O. Start-Up, Adjust, Demonstrate: The Manufacturer shall be responsible for the Initial starting of units, adjustments thereto, etc., to place them in required operating condition, and shall demonstrate to the Owner, or his representative, the operation of units for both summer and winter functions.

P. Warranty: The warranty shall be a full one year parts and labor on entire unit plus an additional full four years parts and labor for the sealed refrigerating system, including service call for diagnosis, and transportation to and from service shop, if necessary, at no charge to customer. The warranty shall also include a limited 2nd through 5th year parts-only warranty for fan motors, switches, thermostat, heater, heater protectors, compressor overload, solenoids, circuit boards, auxiliary controls, thermistors, freeze sentinel, frost controls, capacitors, varistors, and indoor blower bearing.

Q. Installation: Units shall be installed according to the Manufacturer's recommendations.

R. Refrigerant mitigation controls: Factory furnished and installed U.L. listed refrigerant mitigation controls including refrigerant leak sensors, fan speed increase interlock, and refrigerant system shutdown per ASHRAE 15. Refrigerant shall be R-32 or R-454B.

2.6 AIR CONDITIONING / CONDENSATE PUMPS

A. Provide and install air conditioning, water heater, condensate pumps of the size, capacity, and electrical characteristics as shown on the contract drawings. Units shall be Little Giant, Beckton, Diversitech, or approved equal.

B. Units shall be U.L. listed and CSA certified. Each pump shall include 6 ft power cord with 3 prong molded 115 volt plug and thermal overload protection or with pigtail lead in lieu of plug and cord, removing the plug shall not violate the pump manufacturer’s

warranty, nor shall it void the pump's U.L. listing. Include low voltage safety switch with polypropylene float that shall be wired to cut-off the indoor unit in the case of malfunction. Safety switch should be connected to a Class II low voltage safety device.

C. Housing shall be constructed of high impact resistant polystyrene, ABS impeller and volute, and stainless steel shaft. Mount units directly below adjacent indoor units as detailed and pipe discharge with check-valve as shown on the drawings.

D. Water heater condensate pump shall be specifically engineered and listed for use with high temperature boiler and water heater acidic condensate.

E. Refer to Division 23 Section, "Instrumentation and Controls of HVAC and Plumbing Systems".

2.7 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).

2.8 EXTERIOR PIPE 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 CARBON MONOXIDE DETECTORS

A. Provide and install plug-in type, U.L. listed, carbon monoxide (CO) detector at all locations indicated on the Contract Drawings.

B. The carbon monoxide detectors shall alarm whenever the CO concentration is exceeded. Carbon monoxide detectors shall be manufactured by First Alert, Night Hawk or approved equal.

C. Units shall be suitable for electrical characteristics as scheduled on the Contract Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Verify structure, mounting supports and membrane installations are completed to the proper point to allow installation of roof mounted equipment, where applicable.

C. Examine rough-in requirements for all piping systems to verify actual locations of piping connections prior to installation.

D. Verify that electrical work installation is in accordance with manufacture's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until electrical work is acceptable to equipment installer. Coordinate sizes of all thermal overloads with Division 26.

E. Do not proceed until unsatisfactory conditions have been corrected.

F. Provide wiring diagrams of all equipment as specified in Division 23 Section, Common Work Results for HVAC.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install all equipment in accordance with manufacturer's installation instructions, in accordance with state and local code requirements, and in accordance with the contract drawings. Install all equipment plumb and level, to tolerances as required by the manufacturer of each item of equipment. Maintain manufacturer recommended clearances around and over all equipment.

B. Coordinate vibration isolation requirements with all equipment in accordance with Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment.

C. Coordinate all electrical requirements with Division 26.

D. Coordinate all indoor and outdoor equipment pad locations and sizes with approved shop drawing submittals. Provide operating weights of equipment to Structural Engineer for review. Coordinate equipment pad locations and sizes with the Concrete Contractor or General Contractor. Furnish anchor bolts which are to be inserted in concrete pads to concrete installer.

E. Verify piping arrangements of all equipment with the contract drawings.

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 and heat pumps to be shipped to project in modules where space constraints require the same. Field erect components as required.

3.3 FIELD QUALITY CONTROL

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

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

C. Charge all refrigerant systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.

D. Verify proper motor sizes, voltages, thermal overloads, nameplate data, etc. All

equipment voltages and current shall be recorded to insure that motors are operating below their service factors. Test and Balance Engineer shall record electrical data before continuous or permanent operation.

3.4 DEMONSTRATION

A. 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 AIR COOLED CONDENSING UNIT INSTALLATION REQUIREMENTS

A. Mount outdoor unit as detailed on drawings.

B. Supply initial charge of refrigerant and oil as required.

C. Install refrigerant piping between condensing unit and indoor unit per manufacturer's instructions. Furnish and install all accessories, refrigerant specialties, valves between indoor equipment and remote air cooled condensing unit.

D. Size refrigerant piping in accordance with condensing unit manufacturer's instructions.

E. Set condensing unit on vibration isolators and level.

F. Comb out fins on condensing unit where deformed or bent. Replace or repair broken fins.

G. Coordinate electrical characteristics with equipment supplied.

H. Install all section, liquid, hot gas bypass and hot gas re-heat piping as required by the condensing unit manufacturer.

3.7 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 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 characteristics.

J. Install wind baffles when required for low ambient operation. Locate wind baffles facing the predominant wind direction in winter.

3.8 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 interlock all auxiliary electric heating coil air flow proving switches and high limit temperature safeties with the ATC system.

3.9 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.

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.

3.10 INCREMENTAL EQUIPMENT INSTALLATION REQUIREMENTS

A. Coordinate installation of all incremental units (PTACs., etc.) with architectural and electrical work.

B. Packaged Terminal Heat Pump (PTHP) Unit: Install as indicated. Coordinate to assure

correct recess size for recessed units.

C. Unit Ventilators Packaged Terminal Heat Pump (PTHP) Unit: Locate as indicated, level and shim units, and anchor to structure. Coordinate exact location of wall louvers. Where indicated install shelving and auxiliary cabinetry. Where indicated provide wall trim pieces for continuous wall-to-wall installation.

D. Units with Cooling Coils: connect drain pan to condensate drain

E. Coordinate cover openings for all thru-the-wall units with architectural work. Coordinate installation of wall sleeves in finished wall assembly; seal and weather proof.

F. Vacuum out all units and replace filters prior to turning over the same to the owner.

G. Electrical: Connect units to wiring systems and to ground as indicated and instructed by manufacturer.

H. 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.

I. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

J. Lubricate bearings on fan.

K. Check fan-wheel rotation for correct direction without vibration and binding.

L. Start unit according to manufacturer's written instructions.

1. Complete manufacturer's startup checks.

M. After starting and performance test, change filters.

3.11 SPLIT SYSTEM EQUIPMENT INSTALLATION REQUIREMENTS

A. Mount indoor and outdoor units as detailed on contract drawings. Install units level and plumb.

B. Supply initial charge of refrigerant and oil as required.

C. Install all interlock and control wiring between indoor units, outdoor units and thermostats.

D. Install all indoor and outdoor units on vibration isolators.

E. Install outdoor units on concrete pads as hereinbefore specified or on roof curb as indicated on drawings.

F. Install refrigerant suction, liquid, and hot gas re-heat lines between indoor and outdoor units per manufacturers instructions. Connect precharged refrigerant tubing to components quick connect fittings. Install tubing to allow access to unit.

G. Size all refrigerant piping per manufacturers instructions.

H. Connect drain lines to condensate pans.

I. Provide auxiliary drain pans on all horizontal units. Pipe drain to closest floor drain or as indicated on drawings.

J. Comb out evaporator coil and condensing unit fins.

K. Install quantity and size of refrigerant pipes per the heat pump unit manufacturer's requirements.

3.12 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.

3.13 AIR COOLED HEAT PUMP UNIT INSTALLATION REQUIREMENTS

A. Examine areas and conditions for compliance with requirements for installation tolerances, other specific conditions, and other conditions affecting performance of air source heat pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine piping and electric rough-in installations for air source heat pumps to verify actual locations of piping connections before installation.

C. Install air source heat pumps according to manufacturer's written instructions.

D. Install units level and plumb, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

E. Piping Connections: Drawings indicate the general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect refrigerant piping to fan coil units and heat pumps. Size and install refrigerant piping per heat pump unit manufacturer.
2. Connect heat pump drain pan to nearest indirect waste connection, air conditioning condensate pump or as indicated.

F. Duct Connections: Connect supply and return ducts to heat pumps with flexible duct connections. Provide transitions to match unit duct-connection size. Completely seal and insulate where ductwork connects to unit and filter rack.

G. Connect low voltage float condensate overflow safety switch wiring to heat pumps.

H. 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.

I. Replace filters used during construction. Seal all return air ducts to filter racks. Seal air tight al filter racks.

J. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of air source heat pumps, including piping and electrical connections. Report results in writing.

1. Test and adjust controls and safeties.
2. Replace damaged and malfunctioning controls and equipment.
3. Test and record refrigerant pressures, air flow rates, electrical characteristics. Start-up company and test and balance engineer. Must both be present during start-up to simultaneously record the above data.
4. Test reversing valve.

K. Engage a factory-authorized service representative to train Owner's maintenance

personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
2. Review data in the maintenance manuals specified in Division 01.
3. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

L. Maintain minimum of 24 inches clear space at heat pump filter access. Provide manufacturer required clearances for service at ATC control panel, fan section, compressor section and electrical section. Maintain sufficient clear space below units to allow lowering and raising of unit in the future.

M. All air source heat pumps shall be provided with auto-restart in the event of a power outage. Units shall automatically be enabled to re-start when power is restored.

N. Mount indoor and outdoor units as detailed on Contract Drawings. Install units level and plumb.

O. Supply initial charge of refrigerant and oil as required.

P. Install all interlock and control wiring between indoor units, outdoor units, and space sensors.

Q. Install all indoor and outdoor units on vibration isolators.

R. Install outdoor units as indicated on drawings.

S. Install refrigerant suction and liquid lines between indoor and outdoor units per manufacturers instructions. Connect pre-charged refrigerant tubing to components quick connect fittings. Install tubing to allow access to unit.

T. Provide auxiliary drain pans on all horizontal units. Pipe drain to closest floor or as indicated on drawings.

U. Comb out evaporator coil and heat pump unit fins.

END OF HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT

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OUTDOOR HEAT PUMP UNITS
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SECTION 23 06 05 - OUTDOOR HEAT PUMP UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This section includes the design, controls and installation requirements for air-cooled heat pump units.

B. Division 23 Section 230610, Indoor Horizontal Air Handling Units and Division 23 Section 230615, Indoor Vertical Air Handling Units.

1.2 QUALITY ASSURANCE

A. Unit shall be certified in accordance with UL Standard 60335-2-40 and CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

B. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

C. System Seasonal Energy Efficiency Ratio (SEER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

D. Energy Efficiency Ratio (EER) shall be equal to or greater than prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

E. Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL label.

1.3 SUBMITTALS

A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided.

B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, clearances, and connection details. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be shipped with doors bolted shut to prevent damage during transport and thereafter while in storage awaiting installation.

B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

1.5 WARRANTY

A. Manufacturer shall provide a 2 year parts and labor warranty on the entire unit. 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 and refrigerant.

B. Compressors shall carry a 5 year parts warranty from date of original equipment shipment from the factory.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Products shall be provided by the following manufacturers:

1. AAON, Trane, Mitsubishi, or approved equal.
2. Substitute equipment may be considered for approval that includes at a minimum:

a. R-454B refrigerant
b. Hinged access doors with lockable handles
c. Variable capacity compressor with 10-100% capacity
d. 2,500 hour salt spray tested exterior corrosion protection
e. Designed, engineered, and manufactured in the United States of America
f. All other provisions of the specifications must be satisfactorily addressed

2.2 CONDENSING UNITS

A. General Description

1. Air-Source heat pump condensing unit shall include compressors, air-cooled condenser coils, condenser fans, suction and liquid connection valves, accumulator, receiver, reversing valve, filter driers with check valves, and thermal expansion valves.

2. Unit shall be factory assembled and tested including leak testing of the coil and run testing of the completed unit. Run test report shall be supplied with the unit in the control compartment.
3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
4. Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
5. Installation, Operation and Maintenance manual shall be supplied within the unit.
6. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's access door.
7. 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 access door.

B. Construction

1. Unit shall be completely factory assembled, piped, and wired and shipped in one section.
2. All cabinet walls, access doors, and roof shall be fabricated of G90 galvanized steel panels.
3. Unit shall be specifically designed for outdoor application.
4. Access to compressors and control components shall be through hinged access doors with quarter turn, lockable handles.
5. [HPO-3] Access to condenser coils and fans is through removable access panels.
6. 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.
7. Unit shall include forklift slots.

C. Electrical

1. Unit shall be provided with standard power block for connecting power to the unit.
2. Control circuit transformer and wiring shall provide 24 VAC control voltage from the line voltage provided to the unit.
3. Unit shall have a 5kAIC SCCR.
4. Air-source heat pump shall include a defrost cycle to prevent frost accumulation on the outdoor coil during heat pump heating operation. Defrost cycle shall begin when outdoor coil temperature is below a fixed setpoint and have a fixed 10 minute run time, or end when the outdoor coil temperature is above a fixed setpoint. Defrost timer, with 30/60/90 minute selectable defrost cycle interval time, shall be factory installed in the controls compartment. During defrost cycle all compressors shall energize, reversing valve shall energize, and auxiliary heat shall energize.
5. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
6. 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.
7. Unit shall be provided with remote stop/start terminals which require contact closure for unit operation. When these contacts are open the low voltage circuit is broken and the unit will not operate.

D. Refrigeration System

1. Unit shall be provided with one independently circuited R-454B variable capacity scroll compressor with thermal overload protection. Variable capacity scroll compressor shall be capable of modulation from 10-100% of its capacity.
2. Each compressor shall be furnished with a crankcase heater.
3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged access doors shall provide access to the compressors.
4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
5. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides, and service valves for liquid and suction connections. Liquid line filter driers shall be factory provided and installed. Field installed refrigerant circuits shall include the low side cooling components, refrigerant, thermal expansion valve, liquid line and insulated suction line.
6. Unit shall include a factory holding charge of R-454B refrigerant and oil. Adjusting the charge of the system will be required during installation.
7. [HPO-4,7][HPO-5,6] Unit shall be configured as an air-source heat pump. Refrigeration circuit shall be equipped with a bi-flow liquid line filter drier, reversing valve, suction line accumulator, liquid line receiver, and thermal expansion valve with internal check valve. Reversing valve shall de-energize during the heat pump heating mode of operation. The matching indoor air handler must include a thermal expansion valve with internal check valve.
8. [HPO-1,2] Unit shall be configured as an air-source heat pump. Refrigeration circuit shall be equipped with a bi-flow liquid line filter drier, reversing valve, suction line accumulator, liquid line receiver, and a bypass loop with check valve around a thermal expansion valve. Reversing valve shall de-energize during the heat pump heating mode of operation. The matching indoor air handler must include a bypass loop with check valve around the thermal expansion valve.
9. [HPO-3] Unit shall be configured as an air-source heat pump. Each refrigeration circuit shall be equipped with a bi-flow liquid line filter drier, reversing valve, suction line accumulator, liquid line receiver, and a bypass loop with check valve around a thermal expansion valve. Reversing valve shall de-energize during the heat pump heating mode of operation. The matching indoor air handler must include a bypass loop with check valve around the thermal expansion valve.
10. [HPO-1,2][HPO-4,7][HPO-5,6] Shall be equipped with a 5 minute off delay timer to prevent compressor short cycling.
11. [HPO-3] Each capacity stage shall be equipped with a 5 minute off delay timer to prevent compressor short cycling. Each additional capacity stage shall be equipped with an adjustable, 20 second delay timer to prevent multiple capacity stages from starting simultaneously.
12. Units shall be provided with a suction pressure transducer on each refrigeration circuit.

E. Fans

1. Condensing unit shall be provided with an electrically commutated motor (ECM) condenser fan, condenser head pressure controller, and discharge pressure transducers for modulating head pressure control to allow cooling operation down to 35°F. Fan motor shall be weather protected, single phase, direct drive, and totally enclosed air over (TEAO) with electronic protection.

F. Coils

1. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
2. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
3. Coils shall be hydrogen leak tested.

G. Controls

1. Unit shall be provided with a terminal block for field installation of controls. Option shall include factory installed isolation relays.
2. Factory furnish and install listed refrigerant mitigation controls including fan interlocks, refrigerant sensors, and refrigerant shutdown per ASHRAE 15.

PART 3 - EXECUTION

3.1 INSTALLATION, OPERATION, AND MAINTENANCE

A. Installation, Operation and Maintenance manual shall be supplied with the unit.

B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF CONDENSERS/CONDENSING UNITS

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INDOOR HORIZONTAL AIR HANDLING UNITS
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SECTION 23 06 10 - INDOOR HORIZONTAL AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 23 Section 230605, Outdoor Heat Pump Units.

1.2 GENERAL DESCRIPTION

A. This section includes the design, controls, and installation requirements for indoor air handling units.

1.3 QUALITY ASSURANCE

A. Unit shall be certified in accordance with UL Standard 60335-2-40 and CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

B. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

C. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

D. Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL label.

1.4 SUBMITTALS

A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided. Run test report shall be supplied with the unit in the control compartment’s literature packet, and also available electronically after the unit ships.

B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, clearances, and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with detail for power and control systems and differentiate between factory installed and field installed wiring.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be on a wooden pallet with skeleton crating prior to shipment to prevent damage during transport and thereafter while in storage awaiting installation.

B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

C. Unit shall be handled carefully to avoid damage to components, enclosures and finish.

D. Unit shall be stored in a clean, dry place protected from weather and construction traffic in accordance with Installation, Operation and Maintenance manual instructions.

1.6 WARRANTY

A. Manufacturer shall provide a 2 year parts and labor warranty. 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 air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Products shall be provided by the following manufacturers:

1. AAON, Trane, Mitsubishi, or approved equal.
2. Substitute equipment may be considered for approval that includes at a minimum:

a. R-454B refrigerant
b. VFD driven direct drive backward curved plenum supply fans
c. Double wall cabinet construction
d. Insulation with a minimum R-value of 6.25
e. Double-sloped stainless steel drain pans
f. Hinged access doors with lockable handles
g. LED service lights in the control panel
h. Designed, engineered, and manufactured in the United States of America
i. All other provisions of the specifications must be satisfactorily addressed

2.2 AIR HANDLING UNITS

A. General Description

1. Indoor air handling units shall include filters, supply fans, and the following:

a. DX evaporator coil
b. electric heaters
c. low voltage terminal block for field installed controls by others

2. Unit shall have a draw-through supply fan configuration and discharge air horizontally.
3. Unit shall be factory assembled and tested including leak testing of the coils and run testing of the supply fans and factory wired system. Run test report shall be supplied with the unit in the control compartment's literature packet, and also available electronically after the unit ships.
4. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
5. Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
6. Installation, Operation and Maintenance manual shall be supplied within the unit.
7. 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.
8. 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. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam injected panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 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. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel and prevents exterior condensation on the panel.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. 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. Access doors shall be flush mounted to cabinetry.
6. Units shall include double-sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit with a 1" MPT fitting.
7. Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.
8. Unit shall include factory wired control panel compartment LED service lights.

C. Electrical

1. Unit shall be provided with an internal control panel with separated low and high voltage control wiring. Access to internal control panel shall be through service access door with removable pin hinges and lockable quarter turn handle.
2. Unit shall be provided with standard power block for connecting power to the unit.

3. Unit shall include a factory installed 24V control circuit transformer.
4. Unit shall have a 5kAIC SCCR.
5. 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.
6. Unit shall be provided with remote safety shutdown terminals for wiring to a field installed smoke detector, firestat, or building safety automatic shutdown system.

D. Supply Fans

1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.
2. Blower and motor assembly shall be dynamically balanced.
3. Motor shall be IE5 efficiency permanent magnet totally enclosed motor. Variable frequency drive shall be factory wired and mounted in the unit.
4. Blower and motor assembly shall utilize neoprene gasket.
5. Access to supply fan shall be through removable bolted access panels on the top and bottom of the unit.
6. Removable access panels and supply duct flanges shall be interchangeable.

E. Cooling Coil

1. Access to cooling coil shall be through hinged access door with lockable quarter turn handles.
2. Evaporator Coil

    a. Coil shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
    b. Coil shall two circuits and interlaced circuitry.
    c. Coil shall be 6 row high capacity and 12 fins per inch.
    d. Coil shall be hydrogen leak tested.
    e. Coil shall be furnished with factory installed thermostatic expansion valves. The sensing bulbs shall be field installed on the suction line immediately outside the cabinet.
    f. Coil shall have right hand external piping connections. Liquid and suction connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.

F. Refrigeration System

1. Air handling unit and matching condensing unit shall be capable of operation as an R-454B split system heat pump.
2. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
3. Unit shall be configured as heat pump. Refrigeration circuit shall be equipped with a thermal expansion with an external check valve on the indoor coil.
4. Reversing valve, outdoor coil thermal expansion valve, bi-flow filter drier, and liquid line receiver shall be factory installed in the matching AAON condensing unit.

G. Electric Heating

1. Unit shall include an electric heater consisting of electric heating coils, fuses, contactors, and a high temperature limit switch, with capacities as shown on the plans.
2. Electric heating access shall be through service access door with removable pin hinges and lockable quarter turn handle and then a bolted service access panel with handle
3. Electric heating coils shall be located in the reheat position downstream of the supply fan.
4. Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). A 0-10 VDC heating control signal shall be field provided to control the amount of heating.

H. Filters

1. Unit filter access shall be through service access door with piano hinges and draw latches.
2. Unit shall include 2 inch thick, pleated panel filters with MERV rating of 8, upstream of the cooling coil.

I. Controls

1. Unit shall be provided with a proof of airflow switch. When airflow is not detected, other electrical components cannot power on.
2. Unit shall be provided with an internal control panel with separated low and high voltage control wiring.
3. Field Installed Controls by Others

    a. Controls shall be field provided and field installed by others. Unit shall be provided with a terminal block and a supply air setpoint potentiometer.

4. Factory furnish and install listed refrigerant mitigation controls including fan interlocks, refrigerant sensors, and refrigerant system shutdown/fan speed increase per ASHRAE 15.

PART 3 - EXECUTION

3.1 INSTALLATION, OPERATION AND MAINTENANCE

A. Installation, Operation and Maintenance manual shall be supplied with the unit.

B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF INDOOR HORIZONTAL AIR HANDLING UNITS

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SECTION 23 06 15 - INDOOR VERTICAL AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 23 Section 230605, Outdoor Heat Pump Units.

1.2 GENERAL DESCRIPTION

A. This section includes the design, controls, and installation requirements for indoor air handling units.

1.3 QUALITY ASSURANCE

A. Unit shall be certified in accordance with UL Standard 60335-2-40 and CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.

B. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.

C. Unit Seasonal Energy Efficiency Ratio (SEER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

D. Unit shall be safety certified by ETL and be ETL US and ETL Canada listed. Unit nameplate shall include the ETL label.

1.4 SUBMITTALS

A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided. Run test report shall be supplied with the unit in the control compartment's literature packet, and also available electronically after the unit ships.

B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, clearances, and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with detail for power and control systems and differentiate between factory installed and field installed wiring.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be on a wooden pallet with skeleton crating prior to shipment to prevent damage during transport and thereafter while in storage awaiting installation.

B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

C. Unit shall be handled carefully to avoid damage to components, enclosures and finish.

D. Unit shall be stored in a clean, dry place protected from weather and construction traffic in accordance with Installation, Operation and Maintenance manual instructions.

1.6 WARRANTY

A. Manufacturer shall provide a 2 year parts and labor warranty. 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 air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Products shall be provided by the following manufacturers:

1. AAON, Trane, Mitsubishi
2. Substitute equipment may be considered for approval that includes at a minimum:

a. R-454B refrigerant
b. VFD driven direct drive backward curved plenum supply fans
c. Double wall cabinet construction
d. Insulation with a minimum R-value of 6.25
e. Double-sloped stainless steel drain pans
f. Hinged access doors with lockable handles
g. LED service lights in the control panel
h. Designed, engineered, and manufactured in the United States of America
i. All other provisions of the specifications must be satisfactorily addressed

2.2 AIR HANDLING UNITS

A. General Description

1. Indoor air handling units shall include filters, supply fans, and the following:

a. DX evaporator coil
b. electric heaters
c. low voltage terminal block for field installed controls by others

2. Unit shall have a draw-through supply fan configuration and discharge air vertically.
3. Unit shall be shipped in two sections and factory tested including leak testing of the coils and run testing of the supply fans and factory wired system. Run test report shall be supplied with the unit in the control compartment's literature packet, and also available electronically after the unit ships.
4. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
5. Unit components shall be labeled, including pipe stub outs, refrigeration system components and electrical and controls components.
6. Installation, Operation and Maintenance manual shall be supplied within the unit.
7. 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.
8. 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. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam injected panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel and prevents exterior condensation on the panel.
3. Unit shall be designed to reduce air leakage and infiltration through the cabinet. 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.
4. Access doors shall be flush mounted to cabinetry.
5. Units shall include double-sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit with a 1" MPT fitting.
6. Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.
7. Unit shall include factory wired control panel compartment LED service lights.

C. Electrical

1. Unit shall be provided with an internal control panel with separated low and high voltage control wiring. Access to internal control panel shall be through service access door with piano hinges and lockable quarter turn handle.
2. Unit shall be provided with standard power block for connecting power to the unit.
3. Unit shall include a factory installed 24V control circuit transformer.

4. Unit shall have a 5kAIC SCCR.
5. Unit shall include high and low voltage quick connects for easy wiring at installation.
6. 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.
7. Unit shall be provided with remote safety shutdown terminals for wiring to a field installed smoke detector, firestat, or building safety automatic shutdown system.

D. Supply Fans

1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.
2. Blower and motor assembly shall be dynamically balanced.
3. Motor shall be IE5 efficiency permanent magnet totally enclosed motor. Variable frequency drive shall be factory wired and mounted in the unit.
4. Blower and motor assembly shall utilize neoprene gasket.

E. Cooling Coil

1. Access to cooling coil shall be through hinged access door with lockable quarter turn handles.
2. Evaporator Coil

    a. Coil shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
    b. Coil shall be 4 row and 14 fins per inch.
    c. Coil shall be hydrogen leak tested.
    d. Coil shall be furnished with factory installed thermostatic expansion valves. The sensing bulbs shall be field installed on the suction line immediately outside the cabinet.
    e. Coil shall have right hand external piping connections. Liquid and suction connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.

F. Refrigeration System

1. Air handling unit and matching condensing unit shall be capable of operation as an R-454B split system heat pump.
2. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
3. Unit shall be configured as heat pump. Refrigeration circuit shall be equipped with a thermal expansion with an internal check valve on the indoor coil.
4. Reversing valve, outdoor coil thermal expansion valve, bi-flow filter drier, and liquid line receiver shall be factory installed in the matching AAON condensing unit.

G. Electric Heating

1. Unit shall include an electric heater consisting of electric heating coils, fuses, contactors, and a high temperature limit switch, with capacities as shown on the plans.
2. Electric heating access shall be through service access.
3. Electric heating access shall be through service access door with piano hinges and lockable quarter turn handle and then a bolted service access panel with handle.
4. Electric heating coils shall be located in the reheat position downstream of the supply fan.
5. Electric heater shall have full modulation capacity controlled by an SCR (Silicon Controlled Rectifier). A 0-10 VDC heating control signal shall be field provided to control the amount of heating.

H. Filters

1. Unit filter access shall be through service access door with piano hinges and draw latches.
2. Unit shall include 2 inch thick, pleated panel filters with MERV rating of 8, upstream of the cooling coil.

I. Controls

1. Unit shall be provided with a proof of airflow switch. When airflow is not detected, other electrical components cannot power on.
2. Unit shall be provided with an internal control panel with separated low and high voltage control wiring.
3. Access to internal control panel shall be through an access door with piano hinges and lockable quarter turn handles.
4. Field Installed Controls by Others
5. Controls shall be field provided and field installed by others. Unit shall be provided with a terminal block and a supply air setpoint potentiometer.

PART 3 - EXECUTION

3.1 INSTALLATION, OPERATION AND MAINTENANCE

A. Installation, Operation and Maintenance manual shall be supplied with the unit.

B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.

C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF INDOOR VERTICAL AIR HANDLING UNITS

DIVISION 23 SECTION 23 07 01
HVAC INSULATION
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SECTION 23 07 01 - 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, 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 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.

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. All disturbed piping insulation in existing areas shall be re-insulated with insulation type, density, and thickness as specified for new piping. Insulation damaged due to new work and demolition only shall be replaced unless otherwise noted.

J. On cold systems such as refrigerant piping and cooling coil drain piping 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.

K. Fittings and valves shall be insulated with pre-formed fiberglass fittings, fabricated sections of fiberglass pipe insulation, Fiberglass pipe and tank insulation, Fiberglass blanket insulation, or insulating cement. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings. Where applicable, Victaulic PVC fitting valve and coupling covers shall be utilized. Victaulic PVC covers shall be installed with matching pipe insulation jacketing material, vinyl tape solvent weld adhesive and appropriate fasteners.

1. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with a suitable weather or vapor-resistant mastic as dictated by the system location and service. Finish valve installation with a Tyvac jacket with ends that secure to adjacent piping.
2. On hot systems where fittings are to be left exposed, insulation ends should be

beveled away from bolts for easy access.

3. On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion. All gauge and thermometer penetrations and extensions shall be correctly sealed and insulated to prevent surface condensation. Install oversized hangers to prevent penetrations of pipe insulation vapor barrier.

L. 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.

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 Refrigerant Piping	1-inch thickness

2.4 DUCTWORK INSULATION MATERIALS AND THICKNESSES

A. Insulate all supply, return, relief, and combustion air, 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 air handling units and heat pumps, shall require external insulation in addition to internal lining specified hereinafter. All other ducts indicated to be provided with interior lining shall not require additional exterior insulation.

C. Where a vapor barrier is required, all joints, seams, tears, punctures, and other penetrations shall be closed with 3-inch (7.5cm) pressure-sensitive tape matching the facing or with vapor barrier coating reinforced with 3-inch (7.5cm) glass scrim tape.

D. Contractor-applied internal linings shall be as specified and installed as hereinafter specified.

E. 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.

F. All disturbed ductwork insulation in existing areas shall be re-insulated with insulation type and thickness as specified for new ductwork. Duct insulation damaged due to installation of new work and demolition only shall be replaced.

G. 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.

2.5 ACCESSORY MATERIALS

A. Accessory materials installed as part of insulation work under this section shall include, but not be limited to:

1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.

2. Field-applied jacketing materials - sheet metal, plastic, canvas, fiber glass cloth, insulating cement; PVC fitting covers, PVC jacketing.
3. Support Materials - Hanger straps, hanger rods, saddles.
4. Fasteners, weld pins/studs, speed clips, insulation washers.
5. Metal mesh or expanded metal lagging.

B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

2.6 FIELD-APPLIED JACKET

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Johns Manville; Zeston.
   b. P.I.C. Plastics, Inc.; FG Series.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: 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.

2.7 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.

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, 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:

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 "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 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. Jacket all existing ductwork when new insulation is installed on the same.

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, kitchens, electric rooms, storage rooms, janitor closets, 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.

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 HVAC INSULATION

DIVISION 23 SECTION 23 09 00
INSTRUMENTATION AND CONTROLS OF HVAC AND PLUMBING SYSTEMS
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SECTION 23 09 00 - 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. All work associated with the automatic temperature control system shall be performed by personnel regularly and directly employed by the Automatic Temperature Controls Contractor.

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 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 systems as required by the sequence of operation. 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 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 or Mechanical 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 as 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 accordance with the specifications and drawings and shall include, but not be limited to the automatic temperature control of the following:

1. Horizontal and Vertical Air Handling Units/Outdoor Heat Pump Units
2. Carbon Dioxide Sensors
3. Condensate Overflow Safety Switches
4. Domestic Hot Water Systems
5. Ductless Units
6. Duct Detector Fan Interlocks
7. Electric Heating Equipment
8. General Exhaust Systems
9. Mechanical Room Heat and Ventilation Control
10. Miscellaneous interlocks required for gas systems, ventilation systems, etc.
11. Packaged Terminal Heat Pump Units
12. Plumbing Systems
13. Domestic Recirculating Pumps
14. Refrigerant Mitigation Controls
15. Thermostats/Humidistats
16. Unit Heater Control
17. Ventilation Systems
18. Water Heater

L. All labor, material, equipment and thermostats 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.

1.2 DEFINITIONS

A. RTD: Resistance temperature detector.

1.3 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.

1.4 COORDINATION

A. Coordinate location of thermostats 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, 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.

1.5 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 and control diagrams.

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, switches, dampers, heat pumps, ductless units, PTAC units, energy recovery modules, etc.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 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 contractor shall respond to the job site with qualified technicians within a 4 hour period for any emergency relating to the control system.

E. This agreement shall include emergency service during normal working hours.

1.7 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.

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, 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.

C. Field quality-control test reports.

D. 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.

E. 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.

1.8 TRAINING

A. The training time period shall be coordinated with the School of the Deaf system's facility Engineer. The 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. He shall arrange to instruct the Owner's representative on the operation of the control system for a period of not less than four (4) hours. 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.
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.

1.9 ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

PART 2 - PRODUCTS

2.1 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 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.

2.2 CONTROLLERS

A. Temperature and relative humidity sensor covers shall be stainless steel wire guard type with vandal proof screws. All room relative humidity, 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, and shall be U.L. approved for mounting base in air plenums. 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.

2.3 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.

2.4 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.

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.

2.5 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.

2.6 FIELD INSTALLED CONDENSATE OVERFLOW SWITCHES

A. Condensate overflow switches must be tested to comply with U.L. 508.

B. Interlock condensate overflow switches to shut-down cooling equipment and alarm on

ATC system where overflow condition exists.

2.7 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).

2.8 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:

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.

PART 3 - EXECUTION

3.1 INSTALLATION & SUPERVISION

A. All wiring shall be properly supported and run in a neat and workmanlike manner. All wiring exposed and in equipment rooms shall run parallel to or at right angles to the 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.

C. Verify locations of temperature sensors, relative humidity 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 in accordance with manufacturer’s instructions.

G. Check and verify location of space temperature sensors, relative humidity 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.

H. 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.

I. Install equipment plumb and level.

J. Install all equipment to be accessible for service and maintenance.

3.2 ACCEPTANCE TESTING

A. Sequence Verification

1. The Contractor shall notify the Owner's representative of systems which perform

all specified sequences.

3.3 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, 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, 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.

3.4 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. 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.

3.5 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 heat pumps, the evaporator fans shall be hard wired interlocked with the heat pumps so that if evaporator fan fails, the heat pump shall de-energize.

3.6 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.

3.7 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.

3.8 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 operation with compatible signal generator.
4. Test each system for compliance with sequence of operation.
5. Test hardware interlocks.
6. Test all end switches and verify status is reported on the ATC system.

3.9 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. 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.

5. Stroke and adjust dampers.
6. Provide diagnostic and test instruments for calibration and adjustment of system.
7. 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 temperature, and relative humidity 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.

3.10 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.

3.11 SCHEDULING

A. Submit spreadsheet to Owner indicating occupied/unoccupied times for each item controlled by thermostats. Incorporate all scheduling requirements into sequence of operation.

3.12 STAGING

A. Coordinate staging requirements with equipment being controlled. Where multistage units are scheduled or specified, provide all devices, controllers, wiring to control and sequence all stages.

END OF INSTRUMENTATION & CONTROLS OF HVAC & PLUMBING SYSTEMS

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HVAC AIR DISTRIBUTION
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SECTION 23 30 00 - 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 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

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. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

M. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

N. SMACNA - HVAC Air Duct Leakage Test Manual

O. UL 181 - Factory-Made Air Ducts and Connectors.

P. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

Q. NFPA 70 - National Electrical Code

R. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

1.3 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 Standards.

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.

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.

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.

2.4 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. Water heater intake ductwork shall be PVC.

2.5 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 mesh on one face.

2.6 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. 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.

C. Motor-operated dampers shall be as hereinafter specified under Division 23 Section, “Automatic Temperature Controls”.

D. Duct turning vanes shall be Tuttle & Bailey Ducturns, or approved equal.

E. Furnish and install duct collars and angle iron frames for the installation of ATC dampers.

F. Where volume dampers are installed in exposed finished spaces locate damper handle on top of duct.

G. 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.

H. Where existing air devices do not contain manual volume dampers in the run-out ductwork, install manual volume damper at each existing air device duct runout. Include in Base Bid a minimum of 15 manual volume dampers to be installed in existing duct runouts to existing air devices.

2.7 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.

2.8 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.

2.9 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 air handling units heat pumps 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 insulation lining.

2.10 DUCT ACCESS DOORS

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

B. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

2.11 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.

2.12 DUCT LINING (LOW PRESSURE DUCTWORK)

A. All low pressure supply and return ductwork within 10 feet of air handling 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. (Does not apply to Kitchen Hood Exhaust Fans)]

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.

2.13 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.

2.14 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.

2.15 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 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.

2.16 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.

2.17 DRIP PANS

A. Furnish and install suitable watertight, aluminum drip pans where water or drain piping is routed over electrical switchgear, transformers, computers, elevator machine equipment, dry storage rooms, etc. Each drip pan shall have a 1 inch copper type M drain piped to discharge where shown on drawings; or, if not shown, to discharge over nearest available open drain. Size and arrangement shall be as approved by Engineer. Sides shall be minimum 1.5 inches deep.

B. Drain pans shall be of 16 gauge welded construction. Provide drawings of typical drain pan construction for approval before construction. See Submittals in Division 01 Section, "Product Requirements".

2.18 DUCT SEALANTS AND ADHESIVES

A. All ductwork shall be sealed, including low pressure exhaust systems. Transverse joints and longitudinal seams in duct systems shall be sealed with a duct sealant of the type specified hereinafter in Section 1, 2, or 3, or with a tape sealing system as specified in Section 4. Spiral lockseams are not longitudinal seams and do not require duct sealant. All seams and joints shall require duct sealant suitable for the pressure rating and installation application. All sealants shall exceed 500 hours without becoming brittle under ASTM-D572 test conditions (oxygen bomb), unless specified otherwise. No surface preparation or solvent cleaning shall be necessary to remove light coatings of oil and dust before applying sealant unless specified otherwise. Flanged joints shall be sealed according to Section 5. Construction joints that are not fully welded shall be sealed according to Section 6. Adhesive to secure insulation to metal surfaces shall be that specified in Section 7.

1. Assembly joints to be installed indoors 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.

2.19 AUXILIARY DRIP PANS

A. Furnish and install suitable watertight, aluminum drip pans for all suspended air handling units, heat pumps 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"

2.20 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. All duct supports in janitor's closet areas shall be provided with noncorrosive metal finish such as Galv-Krom or equal.

E. Furnish and install NFPA-approved duct connections where shown and at all connections to fans, air handling units, and similar rotating equipment. Use glass-reinforced neoprene fabric, roll-formed to sheet metal strips or flanges. Support adjacent ductwork to provide sufficient slack in the connection.

F. See NFPA 90A, and latest publication of SMACNA. Prevent direct contact between ductwork and building surfaces or other equipment. The opening in the construction around the duct shall not exceed one-inch average clearance on all sides. Where ducts pass through walls, partitions, floors, ceilings, or roofs, pack and seal the space around

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

G. Coordinate duct installation with the requirements of Division 23 Section, "Vibration Controls for HVAC, Plumbing & Fire Protection Equipment".

H. Install in accordance with manufacturer's instructions.

I. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

J. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

K. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

L. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

M. Use crimp joints, with or without bead, for joining round duct sizes eight (8) inches and smaller with crimp in direction of air flow.

N. Use double nuts and lock washers on threaded rod supports.

O. 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 louvers, and open end ducts with 2 coats of flat black paint.

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, duct detectors, 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 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".

F. 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.

G. Use splitter dampers only where indicated.

H. 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.

I. Check location of all air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangements.

J. 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.

K. 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.

L. Install duct accessories according to applicable details shown in SMACNA's HVAC Duct Construction Standards Metal and Flexible for metal ducts.

M. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

N. Provide test holes at fan inlet and outlet and elsewhere as indicated.

O. Adjust duct accessories for proper settings.

3.3 DUCT LINING INSTALLATION REQUIREMENTS

A. All portions of duct designated to receive duct liner shall be completely covered with duct liner. 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.

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 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.

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.

N. For existing buildings, offset water heater flues/combustion air ducts as required to clear existing structure.

3.5 CLEANING

A. Clean duct system and force air at high velocity through ducts to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

B. Clean duct systems with high power vacuum machines. Protect equipment which may be

harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

C. Ductwork shall be cleaned in accordance with "Duct Cleanliness for New Construction (SMACNA 2000)", and shall achieve a "Basic" cleanliness level.

3.6 DUCTWORK IDENTIFICATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. All ductwork shall be identified with painted background marked with the name of the service with arrows to indicate flow direction. Color Code and System Identification shall comply with ANSI Standards.

C. Marking shall be plain block letters, stenciled on ductwork (above and below ceilings) and shall be located near each branch connection and at least every ten feet on straight runs of ductwork. Where ductwork is aligned adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner as to be easily legible from the floor.

D. Identify ductwork with plastic nameplates or stenciled painting. Identify with air handling unit/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.

END OF HVAC AIR DISTRIBUTION

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COMMON WORK RESULTS FOR ELECTRICAL
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SECTION 26 05 00 - 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 Section affected by Alternates.

1.3 SUMMARY

A. Section Includes:

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

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

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

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

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

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

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

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

1.4 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 010000, *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.

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 outlets, power wiring, etc.

D. Equipment sizes shown on the Drawings are estimated. Before installing any wire or conduit, obtain the exact equipment requirements and install wire, conduit, or other item of the correct size for the equipment actually installed. However, wire and conduit sizes shown on the Drawings shall be taken as a minimum and shall not be reduced without written approval from the Owner.

E. Where variances occur between the Drawings and Specifications or within either document itself, the item or arrangement of better quality, greater quality, or higher cost shall be included in the Contract Price. The Engineer will decide on the item and manner in which the work shall be installed.

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

G. Work not specifically outlined, but reasonably incidental to the completion of the work, shall be included without additional compensation from the Architect, Engineer, or 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. 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.

J. The Owner shall make the application for electrical service and pay for all service charges, as coordinated with the Contractor.

K. The complete set of Architectural, Civil, Structural, 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 another Division of these Specifications. The Contractor shall be responsible for connecting all utilities as shown on the Drawings, to equipment identified as existing.

B. The Contractor shall only submit those manufacturers indicated in the Specification. 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. Alternate manufacturers will not be considered unless the specific item indicates “or as approved equal”. 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.

1.8 ELECTRICAL WORK UNDER OTHER DIVISIONS

A. Mechanical Equipment and Systems

1. In general, power wiring and motor starting equipment for mechanical equipment and systems are furnished and installed under Electrical Division 26.

2. Certain mechanical units are furnished from the factory with starters, contactors, transformers, fuses, wiring, etc., required for fans, pumps, etc. When this equipment is supplied from the factory, the Electrical Contractor must supply power circuit(s) to the unit and a disconnecting means. Coordinate with Mechanical Contractor so that one and only one, set of starters, fuses, switches, etc., is provided and installed.

3. In general, control and interlock equipment for HVAC systems (including associated wiring, conduit, transformers, relays, contacts, etc.) is furnished under Division 23. Division 26 shall install and connect all such equipment as necessary.

4. Controls, wiring, conduit, transformers, etc., for smoke, fire, and motor-operated dampers are provided under Division 23. Division 26 shall install and connect all such equipment.

B. Architectural Equipment: In general, any electrically operated or controlled equipment furnished under architectural divisions shall be supplied with control wiring, transformers, contacts, etc. Provide power circuits and disconnects to such equipment and install all electrical control equipment related thereto.

C. Owner Furnished Equipment: In general, Owner furnished equipment is either provided or wired by the equipment supplier. Provide power circuits to such equipment and make final connections to equipment being provided by the Owner.

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

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. 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.

1.11 SUBMITTALS

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

1.12 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/Engineer, to be in best interest of Owner.

B. 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. Data shall consist of Specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with Contract Documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to Specification sections or paragraphs and Drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The Contractor shall be responsible for corrective action and maintaining

the Specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold Contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

1.13 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. Submit Product Data and Shop Drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable Specification paragraph number and Drawing numer.

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 unacceptable.

Items and Systems

1. Analysis and Coordination Study
2. Basic Electrical Materials
3. Cable – 600 Volt
4. Circuit Breakers
5. Conduit and Surface Raceway
6. Contractor and Subcontractor Qualifications
7. Controllers and Control Devices
8. Equipment Connections
9. Equipment Pads
10. Firestopping
11. Ground Conductors, Rods
12. Identification System
13. Lamps
14. Lighting Control Equipment
15. Light Fixtures

16. Low Voltage Fuses
17. Material and Equipment List
18. Motor Controllers
19. Occupancy and Vacancy Sensors
20. Outlet Boxes
21. Panelboards
22. Receptacles
23. Record and Information Booklet
24. Safety Switches
25. Schedule of Values
26. Sleeves, Hangers, Supports
27. Submittal Schedule
28. Surge Suppression Devices
29. Switchboards
30. Tests and Reports
31. Transformers
32. Wiring Devices
33. Wiring Diagrams

D. Submittals shall include, but not be limited to, the following information: size, type, functional characteristics, compliance with standards in Division 26, required service access which shall be suitable for intended location and use, electrical service connections and requirements, and deviations from Contract Document requirements.

E. Submit for approval any other shop drawings as required by the Architect/Engineer. No item listed above shall be delivered to the site, or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

F. Submit for approval schematic diagrams of each electrical system installed in the building. 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 framed, mounted under glass and hung in each Main Equipment Room. Deliver the tracing or sepia from which the diagrams were reproduced to the Owner.

G. Submittals shall include Riser Diagrams and Schematic Wiring Diagrams, complete conduit and wire requirements, outlet and junction box sizes and power requirements, for the following systems:

1. Fire Alarm System
2. Grounding and Bonding System
3. Lighting Control System(s)
4. Occupancy/Vacancy Sensor Layout

H. 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.

I. 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.

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.

D. *Conduits* include conduit, all fittings, identification, and other accessories relative to such conduit.

E. *Contractor:* The Electrical Contractor and any of his subcontractors, vendors, suppliers, or fabricators.

F. *EPDM*: Ethylene-propylene-diene terpolymer rubber

G. Exposed*:* Not installed underground or *concealed* as defined above.

H. *Finished Spaces*: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

I. *Furnish and install* or *provide*: To supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

J. *Location, Damp*: Locations protected from water and not subject to saturation with water or other liquids, but subject to moderate degrees of moisture. Examples of such locations include interior locations such as basements, crawlspaces, attics, cold-storage rooms, etc.

K. *Location, Dry*: A location not normally subject to dampness or wetness. A dry location may temporarily be subject to dampness or wetness during building construction.

L. *Location, Wet*: Locations subject to saturation with water or other liquids, locations exposed to weather, and installations underground or in concrete slabs or masonry in direct contact with the Earth. Examples of such locations include all exterior locations (including those under canopies, roofed open porches, etc.) commercial kitchens, and vehicle washing areas.

M. *NBR*: Acrylonitrile-butadiene rubber.

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

1.15 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.

1.17 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared six (6) copies of the Operations and Maintenance Manual and deliver these copies of the manual to the Owner. The manual shall be as specified herein. The manual must be approved and will not be accepted as final until so stamped.

B. The manual shall be bound in a three-ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: *Operations and Maintenance Manual –*

Bayard Middle School Phase 1 - Electrical. No sheets larger than 8-1/2 inches x 11 inches shall be used, except sheets that are neatly folded to 8-1/2 inches x 11 inches and used as a pull-out. Provide divider tabs and table of contents for organizing and separating information.

C. Provide the following data in the manual:

1. As first entry, an approved letter indicating the starting/ending time of Contractor's warranty period.

2. Maintenance operation and lubrication instructions on each piece of equipment furnished.

3. Complete catalog data on each piece of electrical equipment furnished including approved Shop Drawing/Submittal with Engineer's Comments (if any).

4. Manufacturer's extended limited warranties on equipment.

5. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.

6. Provide supplier and subcontractor's names, address, and phone number.

7. Catalog data of all equipment, starters, etc. shall include wiring diagrams, parts list and assembly drawing.

8. Access panel charts with index illustrating the location and purpose of access panels.

9. Approved Electrical Certificates.

10. Start-up reports for equipment.

D. Submit Operations and Maintenance Manual prior to anticipated date of Substantial Completion for Engineer review and approval. Substantial Completion requires that Operations and Maintenance Manuals be reviewed and approved.

E. Post one (1) copy of all instructions, lists, charts and diagrams at the equipment mounted under glass or approved plastic cover.

F. Deliver all instruction materials to the Owner prior to the formal instruction period.

G. Upon completion of all work, thoroughly instruct the Owner's representatives in the proper operation and maintenance of all electrical equipment and systems.

H. Instructions shall be done only after completed systems have been put into operation and tested for proper operation and performance.

I. 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.

J. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.

K. Where specified in technical sections, provide longer periods required for specialized equipment.

L. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

M. The Operations and Maintenance Manual shall be available at the time of the instructions, for use by Instructors and Owner personnel.

N. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Engineer.

1.18 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 transformers, panelboards, enclosures, boxes, conduits, mechanical equipment, ductwork, and piping, etc.

2. Electrical Rooms indicating switchboards, panelboards, enclosures, boxes, transformers, conduits, wireways, etc.

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. Prepare, submit, and use scaled layout drawings indicating dimensions, clearances, and actual equipment dimensions. Layout Drawings shall include, but not be limited to the following:

1. Building penetrations.

E. Prepare scaled coordination drawings in accordance with the Specifications. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of power, lighting, and all special system raceways, equipment, and materials. Include the following:

    a. Working space and dedicated space clearances per the NEC.
    b. Clearances for equipment disassembly required for periodic maintenance.
    c. Exterior wall and foundation penetrations.
    d. Fire-rated wall and floor penetrations.
    e. Equipment connections and support details.
    f. Sizes and locations of required concrete bases.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction, including, but not limited to, the following: Major conduits and feeders.

3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

4. The successful Bidder shall be responsible for indicating all raceways described in notes or indicated by home run symbols.

5. The successful Bidder shall check all trades' Drawings, including Civil, Architectural, Structural, Plumbing, and Mechanical, to avoid possible demolition and installation conflicts.

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 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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. Advance Products & Systems, Inc.
b. Bridgeport Fittings, Inc.
c. Calpico, Inc.
d. GS Metals Corporation
e. Metraflex Co.
f. O-Z/Gedney
g. Pipeline Seal and Insulator, Inc.
h. Raco, Inc.

2. Sealing Elements: EPDM, NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Stainless Steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.4 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).

2.5 PLYWOOD BACKBOARDS

A. 4’x8’x 3/4” thick AC grade or better fire-retardant plywood.

B. Backboards shall be painted with a minimum of two coats of flame retardant paint to match adjacent wall color.

2.6 FASTENERS

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

PART 3. EXECUTION

3.1 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 and lighting, including step-down or step-up dry-type transformers as required. Exact requirements for temporary service will be determined by the General Contractor.

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:

1. Lights at each floor in each stair. At least one light outlet per 900 square 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 elevator and lobby, including connections to saws, if required, with ground fault protection.

4. Power for testing and operating of elevators.

5. Temporary lighting for stripping forms for all floors below grade.

6. 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 Contractor shall pay for all energy charges for temporary service. Provide temporary construction power. Remove all temporary power installations and connections after permanent power is established and/or prior to completion of the project.

3.2 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Install equipment with working space and dedicated space in strict accordance with 2008 NEC Article 110.26.

E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

F. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

G. Verify exact electrical service requirements for each piece of equipment receiving electrical connections. Provide proper service for each.

H. Include any and all items required by the National Electrical Code and/or field conditions for the proper connection and installation of each piece of equipment.

I. Right of Way: Give to piping systems installed at a required slope.

J. Coordinate electrical work with architectural items and equipment by others. Typical equipment refers to, but is not limited to, the following:

1. Countertops, Casework and Cabinets.

   a. Do not install outlets, switches, etc., behind casework, cabinets, etc.
   b. Data, phone, and other low voltage system outlets shall be mounted above the counter tops to match power outlets in the same areas.
   c. Coordinate counter top outlets with drilling of casework/counters.
   d. Coordinate surface raceways and outlets above and below counters with approved casework shop drawings to avoid conflicts with sinks and other appurtenances.

2. Kitchen Equipment.

   a. Verify kitchen equipment nameplates and connection requirements prior to rough-in.
   b. Fans and Exhaust Hoods.
   c. Dishwasher Hoods and Fans.

3. Classroom Equipment.

   a. Verify classroom equipment nameplates and connection requirements prior to rough-in.
   b. Exhaust Hoods and Fume Hoods.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (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 079200 *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 *Electrical Firestopping*.

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 mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Cut sleeves to length for mounting flush with both surfaces of walls.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 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*.

3.6 SUPPORTS, HANGERS AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workmanlike manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. Installing Equipment Foundations (Housekeeping Pads):

1. Provide four (4) inch high concrete foundations (housekeeping pads) for all floor-mounted equipment extending a minimum of 6 inches beyond equipment bases for interior equipment and a minimum of 12 inches beyond equipment bases for exterior equipment, unless otherwise noted. 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.

2. Unless otherwise specified, provide all concrete work required in accordance with the requirements of Division 03.

3. Equipment shall be properly aligned. Level and grout equipment where necessary. Support conduit independently of equipment and so as not to cause a strain or thrust.

4. Determine exact location of all equipment, foundations, and supports after Shop Drawings of equipment have been approved.

D. 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.

3.7 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 OSHA 29 CFR 1910 Subpart D and 1910.303(g).

3.8 PAINTING AND FINISHES

A. Provide protective finishes on all materials and equipment. Use coated or corrosion-resistant materials, hardware and fittings throughout the work. Paint bare, untreated ferrous surfaces with rust-inhibiting paint. All exterior components including supports, hangers, nuts, bolts, washers, vibration isolators, etc. shall be stainless steel.

B. Clean surfaces prior to application of insulation, adhesives, coatings, paint, or other finishes.

C. Provide factory-applied finishes where specified. Unless otherwise indicated factory-applied paints shall be baked enamel with proper pretreatment.

D. Protect all finishes and restore any finishes damaged as a result of work under Division 26 to their original condition.

E. The preceding requirements apply to all work, whether exposed or concealed, as defined herein.

F. Remove all construction marking and writing from exposed equipment, ductwork, piping and building surfaces. Do not paint manufacturer's labels or tags.

G. All exterior equipment and conduits shall be painted to match adjacent surface in color as selected by Architect, unless otherwise indicated by the Architect.

H. All exposed conduit, equipment, etc. in finished spaces shall be painted. Colors shall be as selected by the Architect and conform to ANSI Standards.

3.9 COLOR SELECTION

A. Color of finishes shall be as selected by the Architect.

3.10 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.

3.11 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing, or other purposes. Lubricate, adjust, and test all equipment in accordance with manufacturer's instructions. Do not operate equipment unless all proper safety devices or controls are operational. Provide all maintenance and service for equipment that is authorized for operation during construction.

B. Where specified, or otherwise required, provide the services of the manufacturer's factory-trained servicemen or technicians to start up the equipment. Where factory start-up of equipment is not specified, provide field start-up by qualified technician.

C. Submit factory start-up sheets or field start-ups sheets for all equipment prior to the commencement of testing.

D. Do not use electrical systems for temporary services or during construction, unless approved by Owner in writing. Refer to Division 01 Section 015000 *Temporary Facilities and Controls*.

E. Upon completion of work, clean and restore all equipment to new conditions; replace expendable items.

3.12 TESTING AND ADJUSTMENT

A. Perform all tests which are specified or required to demonstrate that the work is installed and operating properly. Where formal tests are required, give proper notices and perform all necessary preliminary tests to assure that the work is complete and ready for final test.

B. Adjust all systems, equipment and controls to operate in a safe, efficient and stable manner.

C. On all circuits, 600 volts or less, provide circuits that are free from ground faults, short circuits and open circuits.

D. Other tests of a specific nature for special equipment shall be as specified under the respective equipment.

E. Submit all test results to the Architect/Engineer for approval.

3.13 WALL AND FLOOR PENETRATIONS

A. All penetrations of partitions, ceilings, roofs and floors by or conduit under Division 26 shall be sleeved, sealed, and caulked airtight for sound and air transfer control. Penetrations of mechanical room partitions, ceilings, and floors shall be as specified in Division 26.

B. All penetrations of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 26 Section, *Electrical Firestoppin*g.

C. Where penetrating through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these Specifications.

D. Provide conduit escutcheons for all exposed conduit penetrations in finished interior spaces and all exposed exterior penetrations. Escutcheons shall match those provided under Division 23.

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.

3.14 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.

3.15 PHASING

A. Refer to Architectural Specifications and Contract Drawings for any required phasing.

B. Maintain building egress and traffic ways at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and Authorities Having Jurisdiction (AHJ).

C. Provide dust barriers/partitions, penetration closures, etc., to ensure safety of building occupants and protection of existing surroundings.

D. The Building shall remain watertight at all times.

E. Refer to phasing plans for additional requirements.

F. Within thirty (30) days of Award of Contract, the Contractor shall submit a minimum of six (6) copies of the proposed Phasing Plan (Drawings and detailed written description) to the Architect for review and approval based on the general and specific requirements indicated on the Drawings and Specifications. The phasing plan shall reflect the work of all trades. The phasing plan shall be updated as often as needed (i.e., major deviations and/or modified sequence of events) and reviewed during each progress meeting so the Owner and Architect can be aware of the areas of construction and progress as it relates to the approved schedule.

G. While work is in progress, except for designated short intervals during which connections are made, continuity of service shall be maintained to all existing systems. Interruptions shall be coordinated with the Owner as to time and duration. The Contractor shall be responsible for any interruptions to service and shall repair any damages to existing systems caused by his operations.

3.16 OUTAGES

A. Provide a minimum of fourteen (14) days' notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.

B. Submit Outage *Request Form*, attached at the end of this Section, to Owner for approval.

3.17 CUTTING AND PATCHING

A. Accomplish all cutting and patching necessary for the installation of work under Division 26. Damage resulting from this work to other work already in place, shall be repaired at Contractor's expense. Where cutting is required, perform work in neat and workmanlike manner. Restore disturbed work to match and blend with existing construction and finish, using materials compatible with the original. Use mechanics skilled in the particular trades required.

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

3.18 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 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, vent assemblies, 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.

3.19 CONCRETE AND MASONRY WORK

A. Furnish and install concrete and masonry work for equipment foundations, supports, pads, and other items required under Division 26. Perform work in accordance with requirements of Division 03 and 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. Installing Outdoor Equipment Foundations:

1. Provide equipment foundations as indicated in Article “Supports, Hangers, and Foundations” in this Section.
2. 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:

   a. Slabs - 3/4 inch
   b. Concrete poured against earth - 3 inches
   c. Other locations - 2 inches

3. Properly align, level, and grout all equipment where necessary.

3.20 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.

3.21 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

5. To provide working space and dedicated space clearances per 2008 NEC Article 110.26.

B. Coordinate installation of required supporting devices 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, Article "Provisions for Access".

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26 Section 260528 *Electrical Firestopping*.

3.22 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. Refer to phasing plans for additional requirements.

E. 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.

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 Authorities Having Jurisdiction (AHJ).

H. Make provisions and include in bid all costs associated with confined entry/space requirements in crawl spaces and all other applicable OSHA regulations.

I. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing 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 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.

3.23 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: (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, OSHA, and MOSHA 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.

END OF COMMON WORK RESULTS FOR ELECTRICAL

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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DIVISION 26 SECTION 26 05 19
LOW-VOLTAGE ELECTRICL POWER CONDUCTORS AND CABLES
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SECTION 26 05 19 - 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. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Indicate procedures and values obtained.

B. Product Data: Provide for each cable assembly type, wire, cables, conductors, and connectors.

C. Factory Test Reports: Indicate procedures and values obtained.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

E. 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 014000, *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. B1: Standard Specification for Hard-Drawn Copper Wire

2. B2: Standard Specification for Medium-Hard-Drawn Copper Wire

3. B3: Standard Specification for Soft or Annealed Copper Wire

4. B8: Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

5. 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. WC3: Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

2. WC5: Thermoplastic-Insulated Wire and Cable for the Transmission and 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
3. UL 854 - Service-Entrance Cables

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, Wire and Cable Packaging.

B. Storage: Store wire and cable in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

C. Handling: Handle wire and cable carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of wires/cables is maintained.

1.6 COORDINATION

A. Coordinate layout and installation of cables with other installations.

B. Revise locations and elevations from those indicated, as required to suit field conditions and as approved by 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. Conductor sizes are based on copper.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2. PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Wires and Cables:

a. American Insulated Wire Corp.; Leviton Manufacturing Co.
b. BICC Brand-Rex Company.
c. Carol Cable Co., Inc.
d. Senator Wire & Cable Company.
e. Southwire Company.
f. Colonial Wire Company.

2. Connectors and Accessories for Wires and Cables:

a. AMP Incorporated.
b. Buchanan.
c. General Signal; O-Z/Gedney Unit.
d. Monogram Company; AFC.
e. NSI Industries, Inc.
f. Square D Company; Anderson.
g. 3M Company; Electrical Products Division.

3. Metal Clad (MC) Cable

a. Alcan Cable
b. Atkore AFC Cable Systems
c. Encore Wire Corporation
d. General Cable
e. Nexans
f. Prysmian Cables and Systems
g. Service Wire Company
h. Southwire Company
i. United Copper Industries

2.2 BUILDING WIRES AND CABLES

A. UL-listed building wires and cables with conductor material, insulation type, cable construction and rating as specified herein.

B. Building wires and cables shall be annealed (soft) copper, 600 volt, Type THHN/THWN (dual-rated) single conductors rated 90°C dry / 75°C wet, with a minimum conductivity of 98 percent at 20°C (68°F), or a maximum resistivity of 1.7 micro-ohms per centimeter.

C. Conductors shall meet or exceed requirements of all applicable ASTM specifications, UL Standard 83, UL Standard 1581, NEMA WC 70, Federal Specification A-A-59544 and shall be RoHS/REACH Compliant.

D. Conductors shall be solid for No. 10 AWG and smaller, and stranded for No. 8 AWG and larger.

E. Building wire and cables shall be color-coded using colors factory impregnated throughout the insulation and jacket. The following color code convention(s) shall be used:

1. 208/120-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. 480/277-Volt, 3-Phase, 4-Wire System:

a.	Phase A:	Brown
b.	Phase B:	Orange
c.	Phase C:	Yellow
d.	Neutral:	Gray
e.	Ground:	Green

F. Rubber insulation material shall comply with NEMA WC 3.

G. Thermoplastic insulation material shall comply with NEMA WC 5.

H. Cross-Linked Polyethylene insulation material shall comply with NEMA WC 7.

I. Ethylene Propylene Rubber insulation material shall comply with NEMA WC 8.

2.3 CONNECTORS AND SPLICES

A. UL-listed, factory-fabricated wiring connectors of size, ampacity rating, material, type, and class for application and service indicated. Comply with Project's installation requirements and as specified in Part 3 Article, "*Wire and Insulation Applications"*.

B. Split Bolt Connectors: Not acceptable.

C. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.

D. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.

E. All wire connectors used in underground or exterior pull boxes shall be gel-filled twist connectors or a connector designed for damp and wet locations.

F. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

G. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic high conductivity copper tubing, internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

H. Heat shrinkable tubing shall meet the requirements of ANSI C119.1-1986 for buried connections to 90 degrees C and shall be material flame-retarded per IEEE 383 *Vertical Tray Flame Test*.

I. 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.

J. Wire Nut Connectors:

1. Wire nuts installed in wet locations, exterior, etc., shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air.

2. Connectors shall be UL listed and appropriately sized according to manufacturer's recommendation for the suitable wire sizes and voltage rating (600 volt minimum).

3. Connector body shall have a color-coded outer shell.

4. Connectors shall be as manufactured by King Technology or approved equal.

2.4 METAL CLAD (MC) CABLE AND CONNECTORS

A. Cable shall meet or exceed the requirements of UL Standard 83, UL Standard 1063, and UL Standard 1569 for Type MC cable, Federal Specification A-A59544 Vertical Cable Tray Flame Test and the National Electrical Code. Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.

B. Cable shall be constructed with soft drawn copper, 600 volt, type THHN/THWN conductors rated 90°C dry/75°C wet, with a green insulated grounding conductor. Only cables with conductor sizes 12 AWG and 10 AWG shall be permitted. Conductors shall be cabled together with a binder tape bearing a print legend that is wrapped around the assembly. An aluminum interlocked armor shall be applied over the assembly. Conductors shall be protected by an anti-short bushing at each termination.

C. Multi-circuit MC cable is not permitted.

D. Straight connectors shall be one-piece spring-steel, set screw design with nylon insulator. Provide ACB series, as manufactured by Crouse-Hinds, or approved equal.

E. 45 and 90 degree connectors shall be die cast zinc, clamp type with insulated throat. Provide ACBXX45 or ACBXX90 series as manufactured by Crouse-Hinds, or approved equal.

F. Cables shall be supported with appropriate hangers; tie wire will not be accepted.

2.5 DROP CORDS

A. Description: Continuous length of cable with locking blade type connector body at lower end as indicated on Drawings. Secure cable at both ends with wire type stainless steel cable grips to prevent transmission of tension directly to conductors or terminal screws.

B. Junction Box: Furnished and installed flush with ceiling anchored to building structure for fastening of upper cord grip.

C. Cable: Type SO 600 volt flexible cord with three #12 stranded wires.

D. Connector Body: Single 120 volt, grounding receptacle of twistlock type that grips on cable insulation and is manufactured for use with wire cable grips. Furnish and install drop cords in length required for a receptacle height of 6 feet 8 inches above the finished floor.

2.6 INSULATING TAPE, PUTTY, RESIN AND SUPPORTS

A. Tape: Provide plastic electrical insulating tape which is flame-retardant, cold and weather-resistant. Tape for use in areas subject to temperatures 30 degrees C to 105 degrees C, or where the tape will be subjected to an oil splash, tape shall have a minimum thickness of 8.5 mils, and shall consist of an oil-resistant acrylic adhesive.

B. Materials: Provide all insulating materials for splices and connections such as glass and synthetic tapes, putties, resins, splice cases, or compositions of the type approved for the particular use, location, voltage and temperature and apply and install in an approved manner, all in accordance with the manufacturer's recommendations.

C. Supports: Provide cable supports of the wedge type which firmly clamp each individual cable and tighten due to the cable weight.

PART 3. EXECUTION

3.1 EXAMINATION

A. Examine raceways and building finishes to receive wires and cables for compliance with requirements for installation tolerances and other conditions affecting performance of wires and cables. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. By beginning work, the Contractor has accepted conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 WIRE AND INSULATION APPLICATIONS

A. No branch circuit wires smaller than #12 AWG shall be used unless otherwise indicated. Conductors shall be continuous from outlet to outlet and from terminal board to point of final connection, and no splice shall be made except within outlet or junction boxes. All conductors shall be of the size indicated. All wires #8 AWG and larger shall be stranded.

B. Control wiring shall not be less than #14 AWG and shall be color coded using colors impregnated into the insulation. All wiring, contacts, and terminal blocks shall be suitably tagged for ease in identification and tracing of circuits. Identification tags shall be engraved fiber or plastic type, subject to acceptance. Wires shall be numbered and coded, using Brady *Quicklabels*, or equal.

1. Wiring shall be tagged at terminations, in pull boxes, junction boxes, outlet boxes, panelboards, handholes, etc.

C. All emergency wiring shall have the same color coding but shall clearly be identified as emergency in all outlets, fixtures, etc. All emergency wiring shall be installed in a dedicated conduit system.

D. Switch leg wire shall be labeled with "*S"* tag.

E. All control wiring shall be color coded with wires of colors different from those used to designate phase wires.

F. Wiring for general 15 and 20 amp branch circuit work shall be as indicated on Drawing E00-01.

G. 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.

H. Joints of #8 AWG and larger in power and lighting circuits shall be of the type indented into the conductor by means of a hand or hydraulic pressure tool. Connectors shall be Burndy *Hy-dent*, T&B *Sta-Kon*, or equivalent. Connectors for control wiring shall be Burndy *Hy-Lug*, or equivalent.

I. All circuits for exterior electric work shall be #10 AWG (minimum) and contain an extra #10 AWG (minimum) copper ground conductor. All exterior wiring shall be installed in conduit as specified above, unless otherwise noted on the Drawings.

J. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

K. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

L. Feeders below Slabs-on-Grade, and Underground: Type RHW-2, single conductors in raceway.

M. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

N. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type MC cable. Homeruns may be type MC cable to the source panelboard in electrical rooms when the remainder of the circuit is type MC.

O. Branch Circuits below Slabs-on-Grade, and Underground: Type RHW-2, single conductors in raceway. Branch circuits may only be installed below slab on grade when required to reach floor boxes. Floor boxes on second and third floors are to be from a fire rated poke-through from floor below.

P. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.4 INSTALLATION

A. Install wires and cables as indicated, according to manufacturer's written instructions and NECA's Standard of Installation.

B. Remove existing wires from raceway before pulling in new wires and cables.

C. Pull Conductors: Use a UL-listed and manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway. Completely and thoroughly swab conduit system before installing conductors.

E. Install exposed cables, parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 26 Section, Common Work Results for Electrical and Division 26 Section, Hangers and Supports.

G. Seal around cables penetrating fire-rated elements according to Division 26 Section 260528 Electrical Firestopping.

H. Identify wires and cables according to Division 26 Section, Electrical Identification.

I. Conductors installed in parallel shall be of equal lengths.

J. Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet.

K. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

L. The Contractor shall provide suitable installation equipment to prevent cutting and abrasion of conductor insulation. The Contractor shall use suitable cable guides, pulleys, and protective sleeving to prevent damage to cable during installation. Ropes used for pulling of wire and cable shall be made of polyethylene or other suitable non-metallic material. Pulling lines shall be attached to cable by means of either woven basket grips or pulling types attached directly to the conductors. Wire pulling lubricants, if used, shall conform to UL requirements applicable to the various insulations and raceway materials. The lubricants shall be certified by the manufacturer to be non-injurious to such insulation and materials.

M. Each feeder cable shall be labeled at terminals and at all accessible points in equipment and in pull boxes. Each control wire shall be labeled at both ends. Labels shall be self-sticking wire markers.

N. Riser cables shall have cable supports as required by Code.

O. For rubber and plastic-covered wire and cable, pulling compound Ideal Yellow 77 may be used.

P. Terminal lugs for wires #8 AWG and larger shall be T&B 54,000 Series or Burndy HY-Dent, compression type, unless noted otherwise. One-hole lugs for #4/0 AWG and smaller. Two-hole lugs for all sizes #250 kcmil AWG and larger.

Q. Install wires and cables using braided rope larger than the cable being pulled to keep twists to a minimum.

R. 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.

S. Coordinate cable and wire installation work with electrical raceway and equipment installation work, as necessary for proper interface.

T. Conductors installed in runs within 6 inches of heating pipes or equipment shall be type AVA.

U. No conductors shall be drawn into conduit until all work, which may cause cable damage, is completed.

V. All wiring in fluorescent fixture channels, over boilers and breechings, in Kitchen hoods, and in other high ambient temperature areas, shall be of types required by NEC.

W. During installation, do not deform cable by improper bending, stretching, twisting, kinking, or pinching, nor do any other abusive handling. Any failure to observe these instructions will be detected and corrected during the demonstrations following completion of the installation. All cable runs shall contain S loops or other means to accommodate expansion or contraction as required. Cable bends will have a radius not less than the value recommended by the cable manufacturer. Cable connected to electronic equipment in the system shall be tagged to show its function and the location of its other end. All labels shall be of durable material and securely fastened to the cable.

X. Wiring of different system voltages shall not be mixed at pull boxes enclosures, surface metal raceway, wiretrough, etc., unless a barrier (separator) is provided between the differing systems.

3.5 CONNECTIONS

A. Conductor Splices: Keep to minimum.

B. Install splices and taps that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.

C. Use splice and tap connectors compatible with conductor material.

D. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

F. Wire splices and taps shall be adequate to carry full current rating of wire.

G. Splices and taps in wires up to #8 AWG shall be made with Scotch-lok or T&B PT Series or Ideal Wing Nut insulated electrical connectors. Wire nuts installed in wet location boxes shall be silicon gel-filled. For wires #8 AWG and larger, use copper solderless connectors covered with insulating molded body and then wrapped with electrical tape. Use twist-on wire connectors for connecting lighting fixtures and small motor leads up to #8 AWG wire.

H. Conductors shall be continuous from outlet to outlet, and no splices shall be made except within outlet or junction boxes. Junction boxes may be utilized where required. Wire connectors of insulating material or solderless pressure connections, properly taped, shall be utilized for all splices in wiring.

I. Splices in branch circuits and feeders shall be made where indicated or as required for the installation. All splices shall be accessible and made in enclosure approved for that purpose.

J. For splices in branch circuits and feeders, provide connectors as follows;

1. Wire Sizes #12 AWG to #10 AWG: Provide Ideal Model 74B or 76B or equivalent by T&B.

2. Wire Sizes #8 AWG and Larger: Provide Ideal Model Series AGP and GT or equivalent by Burndy, O-Z, or T&B. All splices shall be enclosed in insulating molded thermoplastic, rubber, or rubber-like covers or shall be wrapped with Bishop No. 111 or equivalent insulating tape in accordance with the Manufacturer's directions.

K. Thoroughly clean wiring prior to installing lugs or connectors.

3.6 IDENTIFICATION

A. Interface with Other Work:

1. Identify wire and cable using Thomas and Betts Type WM vinyl markers.

2. Identify each phase and neutral conductor with its circuit number or other designation indicated on the Drawings in all junction, pull, terminal boxes, and cabinets.

B. Provide identification tags on each conductor entering panel, switch, junction box, and pull box to identify conductor.

C. Comply with the requirements of Division 26 Section, Electrical Identification.

D. Feeder Identification: Securely fasten nonferrous identifying tags or pressure-sensitive labels to all cables, feeders, and power circuits in pull boxes, handholes, panelboards, and at termination of cables.

1. Tags or labels shall be stamped or printed to correspond with markings on Contract Drawings or marked so that feeder or cable may be readily identified.

2. If suspended type tags are provided, they shall be attached by approximately 55-pound test monofilament line or slip-free plastic cable lacing units.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

B. Testing: On installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.3.2. Certify compliance with test parameters.

C. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

D. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

E. Verify continuity of each branch circuit conductor.

F. Tests: Feeder circuit insulation shall be tested after installation, and before connection to fixtures and appliance.

1. Tests shall be performed with a 1,000-volt Megger insulation tester, and conductors shall test free from short-circuits and grounds.

2. Conductors shall be tested phase-to-phase and phase-to-ground.

3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Owner's Representative.

4. Actual test readings shall be recorded.

5. Submit all test reports to the Architect/Engineer for approval.

G. Demonstration: Subsequent to wire and cable hook-ups, energize circuit and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF LOW-VOLTAGE ELECTRICL POWER CONDUCTORS AND CABLES

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GROUNDING AND BONDING
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SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Bond each separately-derived system neutral to nearest grounding system.

B. Bond together system neutrals; service equipment enclosures; exposed non-current carrying metal parts of electrical equipment; metal raceway systems; grounding conductor in raceways; receptacle ground connectors; and plumbing systems.

1.3 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. Qualification data for firms and persons specified in *Quality Assurance* Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

D. Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

1.4 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.

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.

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. Heary Brothers Lightning Protection Co.
3. Ideal Industries, Inc.
4. ILSCO.
5. O-Z/Gedney Co.
6. Raco, Inc.
7. Thomas & Betts, Electrical.

2.2 GROUNDING AND BONDING PRODUCTS

A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.3 WIRE AND CABLE GROUNDING CONDUCTORS

A. Comply with Division 26Section 260519, *Conductors and Cables*. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.

B. Equipment Grounding Conductors: Insulated with green color insulation, size as indicated on the Drawings, or as required by 2017 National Electrical Code (NEC) Table 250-122, whichever is larger.

C. Grounding-Electrode Conductors: Stranded cable. Size as indicated on the Drawings, in the Specifications, or as required by 2017 National Electrical Code (NEC) Table 250-66, whichever is larger.

D. Bare Copper Conductors: Conform to the following:

1. Solid Conductors: ASTM B 3.
2. Assembly of Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.

2.4 MISCELLANEOUS CONDUCTORS

A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section, minimum size ¼-inch x 2-inch.

B. Braided Bonding Jumpers: Copper tape, braided No. 30 AWG 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 ally material. Bolts, nuts, washers and lockwashers shall be made of silicon bronze and supplied as a part of the connector body and shall be of the two-bolt type.

2. Split bolt connector types are NOT allowed 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 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.

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.

2. Computer Outlet Circuits: Install separate equipment grounding conductor in branch circuit runs from computer area power panels or power-distribution units.

3. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

4. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and above, including air cleaners and heaters. Bond conductor to each unit and to air duct.

B. Separately Derived Systems: Where NEC requires grounding, ground according to NEC Article 250.26.

3.2 INSTALLATION

A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

B. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

C. Grounding shall satisfy requirements of the applicable publications. All exposed noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in nonmetallic raceways, and grounded conductors of the wiring system shall be grounded.

D. 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.

E. Ground buses and neutral buses in all distribution panelboards, switchboards, 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.

F. 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.

G. 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.

H. 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.

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.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections. 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 No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

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. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

F. 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.

END OF GROUNDING AND BONDING

DIVISON 26 SECTION 26 05 28
ELECTRICAL FIRESTOPPING
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SECTION 26 05 28 - ELECTRICAL FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Through-penetration firestopping in fire rated construction.

2. Through-penetration smoke-stopping in smoke partitions.

B. Related items: Raceway seals and manufactured electrical devices: Refer to Division 26 Section, “Raceways and Boxes”.

1.3 REFERENCES

A. Underwriters Laboratories

1. UL Fire Resistance Directory

a. Through-penetration firestop devices (XHCR)
b. Fire resistance rating (BXUV)
c. Through-penetration firestop systems (XHEZ)
d. Fill, void, or cavity material (XHHW)

B. American Society for Testing and Materials Standards: ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.4 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

B. Barriers: Time-rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

E. System: Specific products and applications classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

F. Sleeve: Metal fabrication or pipe section extended through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other Sections and may or may not be required.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

1. Fire-rated construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption.

2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption.

1.6 SUBMITTALS

A. Submit in accordance with Division 01, unless otherwise indicated.

B. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.

2. Manufacturer's installation instructions.

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: Statement of qualifications.

E. Applicators' qualifications statement: List past projects indicating required experience.

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.

2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.9 PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.

2. Furnish forced air ventilation during installation if required by manufacturer.

3. Keep flammable materials away from sparks or flame.

4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.

1.10 GUARANTEE

A. Submit copies of written guarantee agreeing to repair or replace joint sealers which fall in joint adhesion, extrusion resistance, migration resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be two years from date of substantial completion unless otherwise noted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Hilti.

2. 3M

3. Nelson.

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Systems of devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrate type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.

1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

2. Acceptable manufacturers and products.

a. Those listed in the UL Fire Resistance directory for the UL System involved and as further defined in the “System and Applications Schedule” in Part 3 of this Section.
b. All firestopping products must be from a single manufacturer.

2.3 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 ACESSORIES

A. Fill, void or cavity materials: As classified under category XHHW in the UL Fire Resistance Directory.

B. Forming materials: As classified under category XHKU in the UL Fire Resistance Directory.

C. Sleeves: Minimum 24 MSG galvanized steel, 12-inch diameter or smaller steel pipe. Sleeve shall project ½-inch from each surface of the floor/wall. Size as recommended by firestop manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.

2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

A. Install penetration seal materials in accordance with printed instructions of the UL Fire Resistance Directory and in accordance with manufacturer's instruction.

B. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

C. Protect materials from damage on surfaces subject to traffic.

D. When large openings are created in walls or floors to permit installation of conduits, cable tray, or other items, close unused portions of opening with firestopping materials tested for the application.

E. Install smoke stopping as specified for firestopping.

F. Provide sleeves the full thickness of the assembly being penetrated and cut sleeves to a length of 1-inch more than the over-all thickness of the penetration, or as recommended by the firestop manufacturer.

3.4 FIELD QUALITY CONTROL

A. Examine penetration sealed areas to ensure proper installation before concealing or enclosing areas.

B. Keep areas of work accessible until inspection by applicable code authorities.

C. Perform under this section patching and repairing of firestopping caused by cutting or penetration by other trades.

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+	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
	CAJ1091 CP 25N/S,CP 25S/L, CP 25WB+ CAJ1092 CP 25WB+ CAJ1112 FS-195+ CAJ1160 CP 25S/L, CP 25N/S CAJ1175 CP 25WB+ CAJ1176 CP 25WB+ CAJ1188 2000+ CBJ1020 CS-195+, FS-195+ CBJ1021 CS-195+, MPS-2+ CBJ1031 2001 CBJ1032 2001 FA1002 CP 25WB+ WJ1010 CP 25WB+ WJ1023 2001		
Non-Metallic	CAJ2001 FS-195+, 1-inch& 2-inch WIDE, PPD'S CAJ2002 FS-195+ CAJ2003 CS-195+, FS-195+ CAJ2005 FS-195+ CAJ2006 FS-195+ CAJ2013 FS-195+ CAJ2019 2000, 2000+, 2003 CAJ2027 FS-195+, CP 25N/S, CP 25S/L, CP 25WB+ CAJ2028 FS-195, MPS-2+ CAJ2029 FS-195+, PPD'S CAJ2030 CS-195+, FS-195+ CAJ2040 FS-195+, CP 25WB+ CAJ2044 FS-195+, CP 25N/S, CP 25S/L CP 25 WB+ CAJ2090 FS-195+ CAJ2177 FS-195+, PPD'S FA2001 FS-195+, PPD'S FS2002 CS-195+, FS-195+, MPS-2+, PPD'S FA2011 FS-195+ WJ2012 FS-195+ 1-inch WIDE	WL2002 FS-195+, PPD'S WL2003 FS-195+ WL2004 FS-195+ WL2005 FS-195+ 4' WIDE WL2006 FS-195+ WL2013 FS-195+ WL2031 CS-195+, FS-195+ WL2032 CS-195+, FS-195+ WL2033 FS-195+ WL2073 FS-195+ 1-inch WIDE	FC2002 FS-195+, PPD'S FC2007 FS-195+, PPD'S FC2008 FS-195+ FC2009 FS-195+, PPD'S FC2024 FS-195+ FC2026 FS-195+ FC2028 FS-195+, 1' & 2-inch WIDE, PPD'S
Insulated Cable	CAJ3001 CP 25N/S, CP 25S/L CAJ3005 CS 195+, FS-195+ CAJ3007 2001 CAJ3009 2000, 2000+, 2003 CAJ3010 2000, 2000+, 2003 CAJ3011 2001 CAJ3014 FD 150 CAJ3015 FD 150 CAJ3021 MPS-2+ CAJ3029 2000, 2000+, 2003 CAJ3030 CP 25WB+ CAJ3031 CP 25N/S, CP 25S/L CAJ3041 2000, 2000+, 2003 CAJ3044 CS-195+, FS-195+ CAJ3058 FS-195+, MPS-2+ CAJ3071 CP 25N/S, CP 25S/L	WL3001 CP 25, MPS-2+ WL3008 2000+ WL3009 2000+ WL3015 CP 25WB+, CP 25N/S WL3022 2000+ WL3030 FS-195+ WL3031 MPS-2+ WL3032 CP 25WB+ WL3041 2000+ WL3051 CP 25N/S WL3056 CP25N/S WL3062 CP 25WB+	FC3001 CP 25S/L, CP 25N/S FC3002 2000+ FC3003 2000, 2000+, 20003 FC3007 CP 25WB+, MPS-2+ FC3008 FS-195+

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
	CAJ3074 CP 25N/S, CP 25S/L CAJ3075 2001 CAJ3080 CP 25WB+ CBJ3016 CS-195+, FS-195+ CBJ3017 CS-195+, MPS-2+ FA3001 CP 25WB+ FB3004 CS-195+, MP WJ3015 2001 WJ3016 2001		
Mixed Penetrating Items Combos	CAJ8001 CS-195+ FS-195+ CAJ8003 2000, 2000+, 20003 CAJ8004 2000, 2000+, 20003 CAJ8006 2001 CAJ8013 FS-195+, CP 25 CBJ8004 CS-195, FS-195+ CBJ8005 CS-195+, MPS-2+ CBJ8008 2001 FA8001 FS-195+, CP 25WB+	WL8002 CS-195+, FS-195+	

* Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF ELECTRICAL FIRESTOPPING

DIVISION 26 SECTION 26 05 29
HANGERS AND SUPPORTS
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SECTION 26 05 29 - HANGERS AND SUPPORTS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 26 Sections apply to this Section:

1. "Common Work Results for Electrical" for general installation requirements.

2. "Electrical Firestopping" for requirements for firestopping at sleeves through walls and floors that are fire barriers.

1.2 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. Provide equipment supports consisting of platforms, curbs, concrete pads, gratings, cradles, structural members, hangers, rods, racks, and incidental materials.

C. Provide all labor, supervision, and fabrication. Design and construct supporting structures of strength to safely withstand stresses to which they may be subjected and to properly distribute the load and impact over building areas. Provide all engineering and fabrication as required for installation of support system.

D. Provide hangers, clamps, anchors, inserts, supports, supplementary steel framing, and hardware of the proper size and load capacity to support electrical equipment and raceways, whether indicated on the drawings or not.

1.3 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 01 Specification Sections.

B. Product data for each type of product specified.

C. Submit for review, shop/assembly drawings and layout drawings of curbs and equipment supports for major items of equipment.

D. Submit structural calculations for approval. Calculations include stress and deflection analysis. Submit design criteria and selection calculation.

E. Supporting devices and fastening methods shall be subject to the review and approval of 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.

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.

2. All Strut Support System components must be supplied by a single manufacturer.

F. Standards:

1. Work shall meet the requirements of the following standards:

a. Federal, State and Local Codes.
b. American Iron and Steel Institute (AISI) Specification for the Design of Cold-Formed Steel Structural Members - August 19, 1986 Edition, December 11, 1989 Addendum.
c. American Society for Testing and Materials (ASTM).
d. Underwriters Laboratories (UL).
e. National Electrical Code (NEC).

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All material is to be delivered to the work site in original factory packaging to avoid damage to the finish.

B. Upon delivery to the work site, all components shall be protected from the elements by a shelter or other covering.

1.6 GUARANTEE

A. Separate guarantees shall be issued from the erector and manufacturer, valid for a period of one year against any defects that may arise from the installation or manufacture of the Strut Support System components.

PART 2. PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Slotted Metal Angle and U-Channel Systems:

a. American Electric, Kindorf
b. Alstrut
c. Unistrut Diversified Products
d. Power-Strut
e. Thomas & Betts

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion-resistance using approved alternative treatment, finish, or inherent material characteristic. All products shall be hot-dip galvanized.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Fasteners: Types, materials, and construction features, as follows:

1. Expansion Anchors - Carbon steel wedge or sleeve type.

2. Toggle Bolts - All steel springhead type.

3. Power-Driven Threaded Studs - Heat-treated steel, designed specifically for the intended application.

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: Sixteen-gauge channels with 9/16-inch-diameter holes at a minimum of eight inches on center in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacturer.

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.

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 (non-seismic zones).

F. Existing Concrete: Expansion anchor fasteners.

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. Installation shall be accomplished by a fully trained manufacturer-authorized installer.

B. Set Strut System components into final position true to line, level and plumb, in accordance with approved Shop Drawings.

C. Anchor material firmly in place. Tighten all connections to their recommended torques.

D. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

E. Coordinate with the building structural system and with other electrical installation.

F. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.

2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a

safety allowance of less than 200 pounds, provide additional strength until there is a minimum of 200 pounds safety allowance in the strength of each support.

3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers.

5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.

6. Space supports for raceways in accordance with Table I of this Section. Space supports for raceway types not covered by the above in accordance with NEC.

7. Support exposed and concealed raceway within one foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminations are not made with chase nipples or threadless box connectors.

8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminations.

G. 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.

H. 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.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including, but not limited to conduits, raceways, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.

2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.

4. Concrete (Existing): Double-plated expander type anchors. Phillips, Hilti, or approved equivalent. Loads shall not exceed 1/4 of tested pullout (or shear) strength.

5. Precast Concrete Plank: Drill hole through plank; bolt hanger rod to 4" x 4" x 1/8" steel plate on top of plank.

J. 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.

K. 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.

L. General Supporting Installations:

1. Provide appropriate concrete anchors for hanger rods. Rods shall be screwed into or extended through frame construction (with washer and nut). Supports shall secure conduit in place, and shall prevent vibration, provide for expansion and contraction and shall make neat appearance. Strap hangers or chains are not permitted.

2. Electrical raceways (conduit and EMT) 1-1/2-inches and smaller shall be secured with 1-hole malleable iron straps or brackets to walls. Trapeze supports shall be used for groups or parallel raceways with raceways secured to trapeze with approved clamps. Individual runs of raceways 2-inches and larger shall be supported by Clevis type hangers.

3. Provide all steel supports including roof curbs for all equipment provided under this Section.

4. Electrical raceway supports to be spaced on the following maximum centers, unless otherwise required by the NEC:

   a. 3/4-inch to 1-inch conduit - 8 feet
   b. 1-1/4-inch and larger conduit - 10 feet

5. Provide additional hangers or steel members to distribute the load among two or more structural members when required or directed.

6. Drilling of new concrete slabs will not be permitted. Anchors and inserts shall be cast in the concrete slabs.

M. 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.

N. Hangers and Supports:

1. Provide hangers, angles, channels, and other supports required by field conditions to install items of electrical equipment. Design of supports and methods of fastening to building structure shall be acceptable to the Owner.

2. Use of power-actuated fasteners and devices is permitted in the vertical surfaces of the building only with the following requirements.

   a. For fastening conduits 1-1/2-inch and smaller and lighting fixtures 50 lbs or less.
   b. Load capacity per manufacturers' recommendations.
   c. Fasteners shall be located in the thickest part of the slab.
   d. Devices shall comply with OSHA requirements.

3. Use of lead shield expansion anchors is not permitted.

4. No electrical items shall rest on, or depend for support on suspended ceiling media (tiles, lath, plaster, splines, etc.).

5. In suspended ceilings, support conduits directly from structural slabs, decks (or framing members). Do not support conduits on ceiling suspension members.

6. Support 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, 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. Hangers and supports shall be hot dipped galvanized, unless noted otherwise.

14. Equipment shall not be held in place by its own dead weight. Provide base anchor fasteners in each case.

15. 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.

16. Vertical conduits shall be supported by heavy wrought iron clamps or collars anchored to construction at each floor.

O. 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.

P. Table I: Spacing For Raceway Supports

TABLE I: SPACING FOR RACEWAY SUPPORTS				
Raceway Size (Inches)	No. of Conductors in Run	Location	RNC & IMC (Ft.)	EMT (Ft.)
		HORIZONTAL RUNS		
1/2, 3/4	1 or 2	Flat ceiling or wall.	5	5
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7
1/2, 3/4	3 or more	Any location.	7	7
1/2 - 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
Up to 2	---	Shaftway.	14	10
2-1/2	---	Shaftway.	16	10
3 & larger	---	Shaftway.	20	10

Any	---	Concealed.	10	10
Abbreviations:	EMT	Electrical Metallic Tubing		
	IMC	Intermediate Metallic Conduit		
	RNC	Rigid Nonmetallic Conduit		
	RGS	Rigid Galvanized Steel		

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 HANGERS AND SUPPORTS

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DIVISION 26 SECTION 26 05 33
RACEWAYS AND BOXES
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END OF SECTION 18

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SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1. Raceways include the following:

a. EMT.
b. FMC.
c. IMC.
d. LFMC.
e. PVC.
f. RGS.
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.

B. Related Sections include the following:

1. Division 26 Section 260528, Electrical Firestopping for requirements for firestopping at penetrations through walls and floors that are fire barriers.

2. Division 26 Section 260529, Hangers and Supports for raceways and box supports.

3. Division 26 Section 262726, Wiring Devices for devices installed in boxes.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FMC: Flexible Metal Conduit.

C. IMC: Intermediate Metal Conduit.

D. LFMC: Liquidtight Flexible Metal Conduit.

E. PVC: Rigid Polyvinyl Chloride Conduit.

F. RGS: Rigid Galvanized Steel Conduit.

G. RMC: Rigid Metal Conduit.

H. RNC: Rigid Nonmetallic Conduit.

1.4 SUBMITTALS

A. Product Data: For raceways, boxes, wireways, 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 installation of outlet boxes, mounting heights, orientation, and locations of outlets.

E. Coordinate mounting heights and locations of outlet boxes thoroughly with approved casework shop drawings.

1.7 PROJECT RECORD DOCUMENTS

A. Accurately record routing of all concealed conduits. Record actual routing of all exposed conduits/larger than 1 inch. Indicate actual locations and mounting heights of outlet boxes, pull and junction boxes, branch circuits, arrangements, etc.

PART 2. PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Metal Conduit and Tubing:

a. Allied Tube & Conduit Corporation.
b. Anamet, Inc.; Anaconda Metal Hose.
c. AFC/Monogram Company.
d. Carol Cable Co., Inc.
e. Cole-Flex Corp.
f. Electri-Flex Co.
g. Flexcon, Inc.; Coleman Cable Systems, Inc.
h. Grinnell Co.; Allied Tube and Conduit Div.
i. Monogram Co.; AFC.
j. Spiraduct, Inc.
k. Triangle PWC, Inc.
l. Wheatland Tube Co.

2. Nonmetallic Conduit and Tubing:

a. Anamet, Inc.; Anaconda Metal Hose.
b. 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 Corp.

3. Conduit Bodies and Fittings:

a. American Electric; Construction Materials Group.
b. Crouse-Hinds; Div. of Cooper Industries.
c. Emerson Electric Co.; Appleton Electric Co.
d. Hubbell, Inc.; Killark Electric Manufacturing Co.
e. Lamson & Sessions; Carlon Electrical Products.
f. O-Z/Gedney; Unit of General Signal.
g. Scott Fetzer Co.; Adalet-PLM.
h. Spring City Electrical Manufacturing Co.
i. Thomas & Betts Corporation.

4. Metal Wireways:

a. Hoffman Engineering Co.
b. Keystone/Rees, Inc.
c. Square D Co.

5. Nonmetallic Wireways:

a. Hoffman Engineering Co.
b. Lamson & Sessions; Carlon Electrical Products.
c. Wiremold Co.
d. Hubbell

6. Boxes, Enclosures, and Cabinets:

a. American Electric; FL Industries.
b. Butler Manufacturing Co.; Walker Division.
c. Crouse-Hinds; Div. of Cooper Industries.
d. Electric Panelboard Co., Inc.
e. Erickson Electrical Equipment Co.
f. Hoffman Engineering Co.; Federal-Hoffman, Inc.
g. Hubbell Inc.; Killark Electric Manufacturing Co.
h. Hubbell Inc.; Raco, Inc.
i. Lamson & Sessions; Carlon Electrical Products.
j. O-Z/Gedney; Unit of General Signal.
k. Parker Electrical Manufacturing Co.
l. Robroy Industries, Inc.; Electrical Division.
m. Scott Fetzer Co.; Adalet-PLM.
n. Spring City Electrical Manufacturing Co.

o. Thomas & Betts Corp.
p. Woodhead Industries, Inc.; Daniel Woodhead Co.

2.2 METAL CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit: ANSI C80.1 and UL 6.

B. IMC: ANSI C80.6.

C. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

D. Plastic-Coated IMC and Fittings: NEMA RN 1.

E. EMT and Fittings: ANSI C80.3, galvanized tubing.

1. Fittings: Compression type, NEMA FB1.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings: NEMA FB 1; compatible with conduit/tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. PVC: NEMA TC 2, Schedule 40 or 80.

B. PVC Fittings: NEMA TC 3; match to conduit or conduit/tubing type and material.

2.4 METAL WIREWAYS

A. Material: Sheet metal sized and shaped as indicated.

B. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

D. Wireway Covers: Screw-cover type.

E. Finish: Manufacturer's standard enamel finish.

2.5 OUTLET AND DEVICE BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized flat-rolled sheet steel.

B. Cast-Metal Boxes: NEMA FB 1, Type FD, cast box, deep type, with gasketed cover, and threaded hubs.

C. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including corrosion-resistant screws, mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes which are compatible with outlet boxes being used and fulfilling requirements of individual wiring situations.

D. Nonmetallic: NEMA OS2.

2.6 PULL AND JUNCTION BOXES

A. Small Sheet Metal Boxes: NEMA OS 1.

B. Sheet metal boxes over 12" in any dimension shall comply with the requirements of Article "Enclosures and Cabinets" of this Section.

C. Boxes for Outdoor and Wet Locations: Flat flanged, surface-mounted, UL listed as raintight, galvanized cast iron box and cover with neoprene gasket and stainless steel cover screws.

D. Boxes for Buried Flush Grade Locations: NEMA 250, Type 6, flat flanged, UL listed as watertight, galvanized cast iron, aluminum or PVC box.

1. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.

2. Cover Legend: "Electric" or "Communications" as appropriate.

2.7 BOX EXTENSIONS

A. Prohibited on new construction.

2.8 ENCLOSURES AND CABINETS

A. Hinged-Cover Enclosures: NEMA 250, Type 1 in dry locations, and Type 4 in wet or damp locations, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

B. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards.

Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

2.9 EXPANSION / DEFLECTION FITTINGS

A. Provide an expansion/deflection fitting in each concealed or exposed electrical run crossing a building expansion joint. Fittings shall be complete with bronze end couplings, neoprene sleeves, tinned copper braid integral bonding jumper and stainless steel bands. Expansion/deflection fittings shall be suitable for the size and type of conduit run they connect. Bonding jumper shall comply with NEC and UL requirements.

B. Expansion/deflection fitting shall accommodate the following movements without collapsing or fracturing the conduit and damaging the wires it contains:

1. Axial expansion or contraction up to 3/4-inch.

2. Angular misalignment of the axes of the conduits up to 30 degrees in all directions.

3. Parallel misalignment of the axes of the conduits up to 3/4-inch in all directions.

C. Expansion/Deflection fitting shall be OZ/Gedney Type "DX" or approved equal by Crouse Hinds (Type XD).

2.10 BUSHINGS

A. Bushings for 1-inch conduit and smaller shall be self-extinguishing thermoplastic type - 150°C temperature rating.

B. Bushings for 1-1/4" conduit and larger shall be malleable iron body with 150 degrees C insulating ring. Insulating material shall be locked in place and non-removable.

PART 3. EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of raceway installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 RACEWAY REQUIREMENTS

A. Conduit Application Schedule:

Application	Conduit Type	Remarks

In or under concrete slab	RGS	
Exposed exterior locations.	RGS	Use threaded or rain-tight fittings.
Wet interior locations.	RGS	Use threaded or rain-tight fittings.
Exposed dry interior locations up to 7'-0" AFF where subject to physical damage.	RGS	
Exposed dry interior locations above 7'-0" AFF and up to 7'-0" where not subject to physical damage.	EMT	
Exterior Underground	RNC (Sched. 40 PVC)	RGS Elbows/Sweeps
Equipment connections in dry interior locations.	FMC (e.g. Greenfield)	Short lengths only (maximum 6 feet).
Equipment connections in wet interior locations.	LFMC (e.g. Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings.
Equipment connections in exterior locations.	LFMC (e.g Sealtite)	Short lengths only (maximum 6 feet). Use threaded or rain-tight fittings.
Concealed in dry wall construction.	EMT	
Concealed above suspended ceilings.	EMT	
Concealed in masonry walls.	EMT	

1. Provide Flexible Metal Conduit (FMC), e.g. Greenfield, in short lengths (maximum 6 feet) for the connection of lighting fixtures, dry type transformers and any vibrating equipment. The flexible connections to recessed fixtures and equipment shall be sufficient slack to permit removal of fixture.

2. Provide Liquidtight Flexible Metal Conduit (LFMC), e.g. Sealtite, in short lengths (maximum 6 feet) for the connection of exterior equipment, motors and equipment in damp or wet locations as defined in Division 26 Section 260500, Common Work Results for Electrical.

3. Aluminum conduit is prohibited.

4. For exposed rooftop applications and where indicated on the drawings, Rigid Non-metallic Conduit may be used as permitted in Article 347 of the NEC, with or without concrete encasement. Where rigid non-metallic conduit is exposed, it shall be Schedule 40 PVC, with all provisions for thermal expansion/contraction as recommended by the Manufacturer.

5. PVC conduits for electric and telephone services shall be encased in 3 in. concrete envelope. Conduits shall be rigid same as above and beyond 5 feet of the building shall be non-metallic PVC equal to Carlon Type EB encased in concrete.

6. Rigid Polyvinyl Chloride (PVC) Conduit may be used underground and under slabs except where rigid metal conduit is required.

B. Fittings:

1. All fittings to match conduit material and to be suitable for the purpose intended. Join conduit with fittings designed and approved for the purpose and make joints tight.

2. Provide UL listed compound filled sealing fittings for NEC-required locations, for conduits passing from interior to exterior, and at the interface of widely different space temperatures such as refrigeration or cold storage rooms where conduits pass from warm locations to cool locations, such as the boundaries of air conditioned spaces and non-conditioned air spaces. For concealed conduits, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

3. Provide expansion fittings with bonding jumpers where conduits cross expansion joints or where otherwise required to compensate for thermal expansion and contraction. Provide expansion fittings in each straight uninterrupted run of surface-mounted conduit, both horizontal and vertical, in excess of 200 feet. Distance between fittings shall not exceed 200 linear feet. The Contractor shall refer to the Architectural Drawings for expansion joint locations.

4. Fasten rigid steel conduit with threaded galvanized steel fittings, double locknuts, and insulated bushings. Insulated bushings shall be OZ/Gedney type "B", or equal.

5. Fasten EMT conduit with "Concretight" or "Raintight" compression fittings made from galvanized steel or malleable iron. Fittings using set screw or indentations as a means of attachment or made from cast "white metal" are prohibited. All connectors shall have insulated throats.

6. Fasten liquid-tight conduit with fittings incorporating a threaded ferrule, nylon sealing ring, and steel or malleable iron compression nut and body. Furnish Crouse Hinds metallic liquid-tight fittings, or equal.

7. Fasten Flexible Metallic Conduit (FMC) with Thomas & Betts (T&B) "Tite-Bite" insulated connectors, or equal.

8. Watertight fittings shall use a copper base anti-corrosive conductive compound. Provide watertight fittings in conduits exposed to weather, in wet locations, in underground locations, and in slabs.

C. Box Locations:

1. Electrical boxes shall accommodate wire pulling, splices, taps, equipment connections and Code compliance.

2. Coordinate access doors as required to provide access to boxes in hard ceilings and similar inaccessible areas.

3. Provide cast box (with threaded hubs) in exterior enclosures, high traffic areas (surface installations), and as specified by Owner.

D. Outlet Boxes:

1. Outlet boxes for concealed work shall be zinc-coated or cadmium-plated sheet steel boxes suitable for the service and type outlet.

2. Boxes and conduit fittings for exterior locations, all damp or wet locations, and exposed locations subject to damage shall be NEMA 4 cast-aluminum, cast steel or cast iron type with threaded hubs for conduit entrance and gasketed cover plates.

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 unplastered brick or block walls shall be provided with deep square-cut device covers. They shall be set so that the brick or block can be cut and fitted closely to the cover opening and so that the standard wall plate will cover the joint between the brick or block and the box.

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. Provide knockout closures for unused openings.

12. Provide blank coverplates for all unused boxes.

13. For multiple device installations, provide multi-gang boxes. Sectional boxes are not permitted. Provide barrier separation of different voltage conductors in the same box.

14. Thoroughly coordinate mounting heights of boxes with casework and backsplash heights.

15. 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.

16. Provide back supports for boxes in metal stud walls.

E. Junction and Pull Boxes:

1. Junction and pull boxes shall be furnished and installed as shown or where required to facilitate pulling of wires or cables. Such boxes shall be installed in accessible locations. All boxes for concealed work shall be constructed of 12 gauge USS galvanized sheet steel minimum, unless otherwise specified or indicated and provided with mounting brackets and flat screw covers secured in position by round head brass or stainless steel 300 grade machine screws. Boxes for exterior work shall be cast aluminum or galvanized cast iron type with threaded hubs unless otherwise directed. Gasketed cover plates shall be furnished for outdoor installation. Provide barrier (separators) where different system voltage share the same box.

2. Wherever possible, locate pull and junction boxes above accessible ceilings in finished areas.

3. Pull or junction boxes shall be supported independently of conduit.

4. In flush grade outdoor applications, unit shall be adequately supported against settling or tipping. Where heavy traffic or poor soil compaction exists, cast box in a concrete base which provides 6" of cover around and under the box.

3.3 INSTALLATION

A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.

B. Furnish and install a separate and independent raceway system as shown on the Drawings for each of the various wiring systems including, but not limited to, the following:

Control Wiring
Emergency
Fire Alarm System
Lighting
Optional Standby
Power

1. All raceway systems shall be completely wired as specified herein, shown on drawings and/or required for satisfactory operation of the various systems.

2. Raceways, generally, shall be concealed conduit as specified herein. Where wiring troughs are required or used to facilitate the wiring installation, they shall be equal to Square D Company's Square-Duct and fittings, with hinged cover arranged for total removal, all finished in baked enamel and all components U/L listed. The gutters shall be of ample size to accommodate conductors therein and as required by the NEC.

3. Support all conduit not embedded in concrete or masonry such that strain is not transmitted to outlet boxes and pull/junction boxes, etc. Supports to be sufficiently rigid to prevent distortion of conduits during wire pulling.

C. Minimum Raceway Size: 3/4-inch trade size (DN21), 1-inch trade size for exterior underground work.

D. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.

E. Electrical Metallic Tubing (EMT) shall be used for the following unless otherwise indicated:

1. Branch circuits for lighting, receptacles, and power concealed in:

a. Dry wall construction.
b. Suspended ceilings.
c. Masonry walls.

2. Exposed in equipment room areas as needed to serve fixed equipment.

F. Rigid Galvanized Steel Conduit (RGS) shall be used for the following, unless otherwise indicated:

1. Branch circuits and feeders for lighting, receptacle and power, installed exposed in areas subject to physical damage.

G. ATC (Automatic Temperature Control) and Fire Alarm system wiring shall be installed in raceways within partitions, terminated 8" above ceiling.

H. Wiring above ceiling shall be plenum rated cable, where required by Code.

I. Wiring installed concealed above hard ceilings and exposed in areas with no ceilings shall be installed in conduit.

J. 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.

K. 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.

L. 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.

M. Install raceways level and square and at proper elevations. Provide adequate headroom.

N. Complete raceway installation before starting conductor installation.

O. Support raceways as specified in Division 26 Section "Hangers and Supports". Arrange supports to prevent misalignment during wiring installation.

P. 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.

Q. 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.

R. 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.

S. 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.

T. Run concealed raceways, with a minimum of bends, in the shortest practical distance considering the type of building construction and obstructions, unless otherwise indicated.

U. Conduits shall not be installed in elevated concrete floor slabs so that composite action between the slab and beams is not affected.

V. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

W. Run parallel or banked raceways together, on common supports where practical.

X. 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.

Y. 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.

Z. Tighten set screws of threadless fittings with suitable tools.

AA. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of the pull wire.

BB. Lubricants for pulling wires shall be approved for use with the types of wire and conduit installed.

CC. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

DD. Use conduit hubs or sealing lock nuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

EE. 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.

FF. Avoid moisture traps; provide junction box with drain fittings at low points in conduit system.

GG. Die-cast fittings of pot metal will not be accepted.

HH. Conduits shall be free of any burrs, foreign objects, and water prior to conduit installation.

II. Conduit placed against concrete or masonry above ground shall be fastened to the concrete or masonry with pipe straps or one screw clamp attached to the concrete by means of expansion screw anchors and screws. "Caddy Clip" type hangers or straps will be permitted only in non-exposed areas and restricted to ½ " to 3/4" conduit.

JJ. 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.

KK. Rigid conduit or Electrical Metallic Tubing (EMT) shall not be strapped or fastened to equipment subject to vibration or mounted on shock-absorbing bases.

LL. Conduit shall be installed in such manner as to insure against the collection of trapped condensation, and runs of conduit shall be without traps wherever possible. Drill 1/8" diameter weep holes where necessary.

MM. 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.

NN. Provide wall flanges and gasketing on conduits entering fan housings to minimize air leakage at points of penetration of housing.

OO. Conduit risers shall be rigidly supported on the building structure, using appropriate supports only.

PP. In equipment spaces, such as fan rooms, plenums, etc., conduits and outlets may be exposed, but shall avoid interference with ventilating ducts, piping, etc.

QQ. 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.

RR. 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.

SS. 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.

TT. Screws for all exposed work shall be stainless steel, unless otherwise noted.

UU. Cadmium-plated steel screws may be used for interior dry locations only.

VV. No running threads shall be cut or used.

3.4 FLEXIBLE CONNECTIONS

A. Provide Flexible Metal Conduit (FMC), e.g. Greenfield, in short lengths (maximum 6 feet) for the final connection of lighting fixtures, dry type transformers and vibrating equipment in dry interior locations. The flexible connections to recessed fixtures and 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 260500, *Common Work Results for Electrical*.

C. 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.

D. Flexible connections shall be sized per the Contract Drawings, or as required in accordance with Code; the more stringent requirement shall apply.

3.5 INSTALLATION OF TERMINATIONS

A. Where raceways are terminated with lock nuts and bushings, align the raceway to enter squarely, and install the lock nuts with dished part against the box. Where terminations cannot be made secure with one lock nut, use two lock nuts, one inside and one outside of the box.

B. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

C. Open ends shall be capped with approved manufactured conduit seals as soon as installed and kept capped until ready to pull in conductors.

D. Where conductors No. 10 AWG or larger enter a raceway, cabinet, pull box, and junction box, the conductors shall be protected by an insulated bushing providing a smoothly rounded surface.

E. Double lock nuts shall be used at termination of rigid conduit in knock-out openings.

F. Ends of conduits shall be equipped with insulating bushings for 1" and smaller, and insulated metallic bushings for 1-1/4" and larger. Ends of conduit shall be temporarily capped prior to installation and during construction to exclude foreign material.

3.6 INSTALLATION OF BOXES

A. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors.

B. Provide junction boxes, pull boxes, cable support boxes, and wireways as required for proper installation of the electrical work. Covers shall be accessible. Small junction boxes shall be similar to outlet boxes. Provide barriers (separators) where different system voltage wires share the same box.

C. Pull boxes, cable support boxes, and large junction boxes for indoor use shall be made of Code gauge steel or no less than 12 gauge. Covers shall be held in place with stainless 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 or brass.

E. Pull boxes shall be installed at all necessary points to prevent injury to the insulation or other damage that might result from pulling resistance or for other reasons necessary for proper installation. Pull box locations shall be approved by the Owner's representative prior to installation.

F. Where boxes are used in connection with exposed conduit, plain covers attached to the box with a suitable number of countersunk flat head machine screws shall be used.

G. Pull boxes with barriers shall have a single cover plate and the barriers shall be of the same gauge as the pull box.

H. Exposed pull boxes will not be permitted in finished spaces.

I. Location of pull boxes shall be coordinated with piping, ductwork, and other equipment so as to permit sufficient clearance for maintenance and access.

J. Pull boxes recessed in walls or partitions shall be provided with flanged type covers.

K. Outlet boxes and covers shall be sheet steel knockout type, zinc-coated, or cadmium-plated and shall be of proper Code size for the number of wires of conduits passing through or terminating therein, but in no case shall any box be less than 4" square, or boxes at end of a run and containing a single device may be of the "handy box" type. Covers for flush outlets shall finish flush with plaster or other finished surface. Approved factory-made knockout seals shall be used in all boxes where knockouts are not intact. Boxes in concrete shall be a type which will allow the placing of conduit without displacing the reinforcing bars. Additional pull boxes shall be installed as required to facilitate pulling of wires.

L. Outlet boxes for lighting fixtures shall be equipped with fixture supporting devices.

M. Outlet boxes for switches shall be of the gang type.

N. Each circuit in each pullbox shall be marked with a tag guide denoting panels to which they connect.

O. Boxes shall be separated to prevent sound transmission. Back-to-back boxes shall not be used.

P. Outlet boxes shall be provided with suitable plaster rings and covers or plates.

Q. Unused knockout holes shall remain closed and those opened by error shall be closed with snap-in blanks.

R. Outlet boxes shall not be smaller than required by Code for the number and size of wires to be installed.

S. Outlet boxes installed in plenum ceilings shall be in accordance with applicable codes.

T. Outlet boxes shall be installed true and plumb so that the covers or plates will be level and at uniform elevations for the types of outlets contained.

U. Outlet boxes for switches at doorways shall be located at the strike side of the door as finally hung.

V. Outlet box locations as indicated shall be considered to be approximate only. Determine exact locations from architectural details or from field instructions and coordinate outlet box locations with the work of other trades.

W. Install junction and pull boxes to be accessible.

X. Locations of junction and pull boxes requiring access panels shall be reviewed by the Owner's Representative.

3.7 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to Manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

C. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

D. Steel conduit: Conduit that shows corrosion within the guarantee period shall be replaced.

3.8 CLEANING

A. On completion of installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

B. After conduits and accessories have been installed, and concreting operations completed, conduit runs shall be satisfactorily cleared of obstructions and foreign matter. Defects which might damage cable upon installation shall be corrected. Where new conduits installed are connected to new conduits installed by others and where new conduits installed are connected to existing conduits, the entire run to the nearest box or other termination point shall be cleaned.

3.9 PAINTING AND FINISHES

A. All exterior equipment and conduits shall be painted to match adjacent surface in color as selected by Architect.

B. 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.

C. Boxes for fire alarm cabling and devices shall be red, except for finished locations, where they shall be painted to match adjacent surfaces.

END OF RACEWAYS AND BOXES

DIVISION 26 SECTION 26 05 43
UNDERGROUND DUCTBANKS
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SECTION 26 05 43 - UNDERGROUND DUCTBANKS

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. Sections of other Divisions in this Specification which relate to excavation and concrete construction.

1.2 SUMMARY

A. This Section includes complete concrete ductbank construction and direct burial materials and methods for outside power 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.

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 or shall do work for which no detailed Specifications are set forth, the materials or manufactured articles shall be 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 ducts and manholes 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

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. Maintain continued access to parking areas, roads, abutting properties, and other facilities which the construction will cross.

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 test in 28 days - See Division 03, Section Cast-*in-Place Concrete*.

   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. per Division 03, Section 033000, Cast-in-Place Concrete.

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 prior to pour.

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, 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: Steel grounding bushings shall be grounded to the manhole or junction box ground. On steel conduit with end bells, provide an Appleton Catalog No. XJB Series or equal bonding fitting with bonding strap. Connect bonding strap to ground wire in manhole or junction box.

I. Drainage Assembly: All ducts shall drain to an open end - preferably to a manhole. Or away from the building.

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.

C. Warning Tapes:

1. Refer to Division 26 Section, “Electrical Identification” for product requirements.

2. Bury marker tape 12-inches below grade above every ductbank and buried conduit.

2.4 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

2.5 PAINTING

A. General: All exposed conduit shall be primed and painted to match existing building exteriors.

1. First coat: Zinc Duct - Zinc oxide primer house and trim paint.

2. Second Coat: Type and color to match existing building walls and/or trim where applicable.

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 ducts and handholes for compliance with installation tolerances and other conditions affecting performance of the underground ducts and manholes. 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 follows: 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.

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, "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 from manhole to manhole and from manhole to building shall be completely excavated and graded before any duct is laid in that section.

E. Provide underground detectable warning tape 12-inches below finish grade over all ductbanks.

F. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated compaction equipment.

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 manholes or both ways from high points between manholes 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.

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. Place temporary bituminous pavement when required by the sequence of operations.

O. On completion of distribution systems construction, replace pavements, sidewalks, curbs and gutters.

P. 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 will 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. Where drawings indicate spare conduits under existing roadways, walks, and other similar paved areas, all ends of conduits shall be capped five feet beyond the pavement and adequately protected from mechanical damage. The ends of these conduits shall be marked by the placement of concrete monuments. Minimum size shall be 6 inches in diameter by 18 inches long set flush in ground with "S/C" indented in top to signify spare conduit.

C. Conduit Protection at Penetrations: Galvanized conduits which penetrate concrete shall be PVC-coated and shall extend at least 2 inches within the concrete to the first coupling or fitting outside the concrete.

D. Provide all cutting and patching necessary for the installation of the ductbank work. Any damage done to the work already in place by reason of this work shall be repaired at the Contractor's expense by a qualified mechanic experienced in such work. Patching shall be uniform in appearance and shall match with the surrounding surface.

E. Patching shall be done in accordance with the requirements of Division 02 for the appropriate disturbed surface materials.

F. 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 existing building wall or utility hole penetration, install heavy wall galvanized steel conduit within the concrete envelope to provide protection against vertical shearing.

B. Core drill all existing walls and footings, and waterproof per Division 26 using an assembly of rubber links of mechanical seal of the proper size for the pipe and tighten in place, in accordance with the manufacturer's instruction, after the new conduit is installed.

C. 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.

D. Pitch conduit properly for drainage to manhole or pull box and to prevent low pockets or irregular dips between conduit ends. Minimum pitch to be 4 inches per 100 feet.

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.

I. Provide flush bell ends on duct at buildings. When entering a new building the bell ends for PVC shall be a pre-manufactured system (system as manufactured by Formex or equal) with conduit seals and provisions for roughing into the concrete.

J. Provide insulated, grounding bushings on duct ends in equipment enclosure.

K. Plug or cap empty conduits. Provide standard manufactured plugs.

L. Seal all spare ducts and conduits, at all new and existing building entrances and at outdoor terminations at equipment pedestals with a suitable compound to prevent the entrance of moisture and gases.

M. 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.

N. Clear conduit by rod and pull an approved test mandrel from structure to structure or from structure to the conduit termination.

O. Leave nylon or polyester pull line in each conduit, tagged to identify the conduit's point of origin, contents and final destination.

P. 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.

Q. 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.

1. Install top of duct bank minimum 30 inches below finished grade.

2. Terminate conduit in end bell at manhole entries.

3. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank.

R. 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 telephone conduit.
    b. Two (2) inches between conduits containing cables operating at not over 600 volts.
    c. Six (6) inches between a telephone conduit and any power conduit in the same envelope.
    d. One and a half (1-1/2) inches between conduits containing cables operating at over 600 volts.
    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 manholes, 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 test at 28 days. Concrete for ductwork shall be Class B, 470 lb. (5 sacks) of Portland cement per cubic yard.

B. Supervise the placement of concrete in the ductbank.

C. Complete entire section of conduit from utility pole to 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 utility to manhole 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.

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 bank at least 30 inches (750 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 manholes shall be poured in one continuous operation. Where more than one pour is necessary, each pour shall terminate in a vertical plane, 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 sealing compound and plugs to withstand at least 15 psi (1.03 Mpa) hydrostatic pressure.

Q. 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.

R. 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 for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 50 feet (15 m) 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 lacing 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 shall be installed at the time the 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 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. Insulated Steam: 24-inches.

2. Un-insulated Steam: 48-inches.

3. All others: 18-inches.

3.8 DIRECT BURIED CONDUIT

A. Provide where indicated direct-buried electrical circuits utilizing either PVC Schedule 40 or PVC-coated rigid galvanized steel conduit, as indicated. Conduit shall be as specified in Division 26 Section, “Raceways and Boxes”. Burial depth shall be as follows:

1. Below paved roads (PVC and RGS): 30-inches below bottom of paving.

2. Under non-vehicle concrete (PVC and RGS): 24-inches below bottom of paving.

3. Other areas (PVC): 24-inches.

4. Other areas (RGS): 24-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 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 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.

3.10 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 UNDERGROUND DUCTBANKS

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DIVISION 26 SECTION 26 05 53
ELECTRICAL IDENTIFICAITON
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SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

B. This section includes labeling of all terminations and related subsystems; including, but not limited to, nameplates, stenciling, wire and cable markers, labeling and identification of cables, equipment and other products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels. Provide a schedule of nameplates and stenciling.

C. Samples: Prior to installation, submit samples for each type of label and sign to illustrate color, lettering style, and graphic features of identification products. These samples shall include examples of the lettering to be used. Samples shall be mounted on 8-1/2-inch x 11-inch sheets annotated, explaining their proposed use.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with ANSI A13.1 and NFPA 70 for color-coding.

D. Comply with applicable EIA/TIA Standards.

E. Comply with OSHA Standards.

1.5 DEFINITIONS

A. Emergency systems include, but are not limited to, generator circuits and systems, fire alarm systems, exit sign circuits, emergency lighting circuits, etc.

PART 2 - PRODUCTS

2.1 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.

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 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm 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.

F. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch- (0.4-mm-) thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.

G. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

H. Aluminum-Faced, Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch (0.05 mm) thick, laminated with moisture-resistant acrylic adhesive, punched for fasteners, and preprinted with legends to suit each application.

I. Brass or Aluminum Tags: 2 by 2 by 0.05-inch (51 by 51 by 1.3-mm) metal tags with stamped legend, punched for fastener.

2.2 NAMEPLATES AND SIGNS

A. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

B. Engraved Plastic Nameplates and Signs: Engraving stock, melamine 3-layer plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes. Use colors prescribed by ANSI A13.1, NFPA 70 and these specifications.

1. Engraved legend with white letters on black background.

2. Emergency system nameplates shall have an engraved legend with white letters on red background, or as required by the local authority having jurisdiction.

C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting. Backed with adhesive material formulated for the type of surface and intended use.

D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for the application. 1/4-inch (6.4-mm) grommets in corners for mounting.

E. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 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., 11,847 volts, 480 volts, 208 volts), each switch, switchboard, junction box, equipment, etc., on each system must be labeled for voltage in addition to other requirements listed herein.

2. All branch circuit panelboards must be identified with the same designation used in the circuit directory in the Main Switchboard, and in Distribution Panelboards.

3. Before attaching labels, clean all surfaces with the label manufacturer's recommended cleaning agent.

4. Install all labels firmly, as recommended by the label manufacturer.

5. Labels attached to receptacle and switch faceplates shall be installed plumb and neatly on all equipment.

6. Install nameplates parallel to equipment lines.

7. Secure nameplates to equipment fronts using screws or rivets. Secure nameplate to inside of recessed panelboards in finished locations.

8. Embossed tape will not be permitted for any application.

9. Labels: All labels shall be permanent and be machine-generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.

10. Label size shall be appropriate for the conductor and cable size(s) and outlet faceplate layout. All labels to be used shall be self-laminating, white/transparent vinyl and be wrapped around the cable sheath. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminated over the full extent of the printed area of the label.

B. Panelboard Directories:

1. Panelboards shall be equipped with equipment nameplates as specified in paragraph “Equipment Identifications Labels” in Part 3 of this Section.

2. Panelboards shall have an accurate typed index indicating exactly what each added branch serves.

3. The Contractor shall provide up to date directories in new and existing panelboards, indicating all deletions and additions, and to note the date of all changes on the directory.

4. The directory shall reflect the exact circuit designations. Directories indicating the reference room numbers on the contract drawings or in the panelboard schedule shall not be acceptable.

5. If at anytime after occupancy the directory is found to be incorrect due to negligence by the installer, then the Contractor shall trace out circuits, and correct the directory at no additional cost to the Owner.

C. Miscellaneous Identification:

1. Individual circuit breakers, switches, and motor starters in panelboards and switchboards, and in motor control centers: 1/4-inch (6 mm); identify circuit and load served, including location.

2. Individual circuit breakers, enclosed switches, and motor starters: 1/4-inch (6 mm); identify load served.

3. Junction boxes: 1/2-inch (13 mm); identify system source(s) and load(s) served.

D. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

E. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

F. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

G. Self-Adhesive Identification Products: Clean surfaces before applying.

H. Install painted identification according to manufacturer's written instructions and as follows:

1. Clean surfaces of dust, loose material, and oily films before painting.

2. Prime surfaces using type of primer specified for surface.

3. Apply one intermediate and one finish coat of enamel.

I. Color Code Banding and Painting of Raceways, Boxes, and Cables: Band all exposed and concealed accessible raceways, pull boxes, and junction boxes of the systems listed below:

1. Bands: Pre-tensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.

2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

3. Junction boxes, pull boxes, and their covers shall be distinctively painted to identify their service.

4. Apply the following colors to the systems listed below:

a. Fire Alarm System: Red.
b. Fire-Suppression Supervisory and Control System: Red and yellow.
c. Combined Fire Alarm and Security System: Red and blue.
d. Security System: Blue.
e. CCTV System: Green and yellow.
f. Mechanical and Electrical Supervisory System: Green and blue.
g. Telecommunication System: Green.
h. CATV System: Violet.
i. Computer Data: Blue.
j. 120/208 V (or 120/240 V) Power and Lighting System: Yellow.
k. 480/277 V Power and Lighting System: Black.
l. Standby/Emergency Power System: Orange.
m. Any other system, with system type (such as Sound System) marked on covers in black letters with white covers.

J. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover. Install label on inside face of door or cover in finished spaces.

K. Circuit Identification Labels on Boxes: Install labels externally.

1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.

2. Concealed Boxes: Plasticized card-stock tags.

3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.

L. 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.

M. Secondary Service, Feeder, and Branch-Circuit Conductors: Color-code throughout the secondary electrical system. Refer to Division 26 Section 260519, *Conductors and Cables* for additional requirements.

N. Power-Circuit and Control Wire Identification: Metal tags or aluminum, wraparound marker bands for each conductor, cables, feeders, and power circuits in vaults, panelboard gutters, outlet boxes, junction boxes, pullboxes, junction boxes, manholes, switchboard rooms, and at load connections. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

1. Legend: 1/4-inch- (6.4-mm-) steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.

2. Tag Fasteners: Nylon cable ties.

3. Band Fasteners: Integral ears.

O. 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.

P. 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.

Q. Equipment Identification Labels: Engraved plastic laminate with white lettering on black background. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless

units are specified with their own self-explanatory identification. Unless otherwise noted, labels/nameplates shall identify equipment designation(s), voltage rating, and source (including source locations). Labels for disconnect switches, motor starters, etc…, shall indicate the designation of the load served as the "equipment designation". In general, labels requiring one or two lines of text shall be 1-1/2 inches high. Labels requiring three lines of text shall be 2 inches high. The first line of text, which shall indicate equipment designation/load served, shall utilize 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 labeling examples. Apply labels to each unit of the following categories of equipment using mechanical fasteners:

1. Panelboards.
2. Switchboards.
3. Transformers.
4. Disconnect Switches.
5. Enclosed Circuit Breakers.
6. Motor Starters.
7. Push-Button Stations.
8. Contactors.
9. Electrical Cabinets and Enclosures.
10. Control Devices.
11. Fire Alarm Master Station or Control Panel.
12. Security-Monitoring Master Station or Control Panel.
13. Access Doors and Panels for Concealed Electrical Items.

R. 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 number followed by feeder voltage.
   c. At each end of the above series of markers provide a pipe banding tape around the conduit. Refer to paragraph "Color Code Banding and Painting

of Section 260533, Raceways, Boxes, and Cables, in part 3 of this Section for banding requirements.

S. Communication Conduit and Cables:

1. Cables shall be identified with Brady B-500 vinyl cloth markers or equivalent by L.E.M., Stranco, or Panduit wire markers. Conduit shall be identified with Brady Vinyl Cloth B-500 pipe markers or equivalent. Systems shall be identified as follows:

   a. Each cable shall be identified at each point of entrance to or exit from a conduit or enclosure and at 50-foot intervals in the tray. All identification at 50-foot intervals shall be at the same location in the tray. Each cable shall be identified at control panels, junction boxes, and terminal boards.
   b. Conduit shall be identified exiting an enclosure or panel at junction or pull boxes, and at each side of penetrations of walls, partitions, or floors, within 1-foot of penetration, to identify service type, i.e. "TELEPHONE", "DATA", "CATV", etc...

T. Fire Alarm: Junction box covers shall be painted red and labeled "Fire Alarm" per NFPA 72. Wiring color code shall be as follows:

1.	Red	-	Smoke Detector - Common.
2.	Black	-	Smoke Detector - Power.
3.	Yellow	-	Smoke Detector - Alarm.
4.	Orange	-	Heat Detector - Alarm.
5.	Pink	-	Flow Switch.
6.	Tan	-	Valve Tamper Switch.
7.	Purple	-	Bells.
8.	Grey	-	Audio/Visual Devices.
9.	Light Blue	-	nual Stations.

U. 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.

V. Surfaces shall be cleaned and painted, if specified, before applying markings.

W. Place markings so that they are visible from the floor.

X. Protect finished identification to ensure that markings are clear and legible when project is turned over to the Owner.

END OF ELECTRICAL IDENTIFICATION

DIVISION 26 SECTION 26 09 23
LIGHTING CONTROL DEVICES
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SECTION 26 09 23 - 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. Provide lighting controls that can operate as standalone local room network(s) and have the capability to expand to a central building wide network. The building wide network shall provide control, monitoring, adjustment and scheduling functionality. The system shall be PC based with software and historical data storage. The system shall support third party integration with the building management system through BACnet/IP.

B. This Section includes the following lighting control devices:

1. Time switches.
2. Photoelectric switches.
3. Daylight-harvesting controls.
4. Indoor occupancy/vacancy sensors.
5. Low voltage switches.
6. Lighting contactors.
7. Emergency shunt relays.

C. Related Sections include the following:

1. Division 26 Section 262726, Wiring Devices for snap switches.

2. Section 260943 “Network Lighting Controls”.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coverage Plans: Provide full scale plans showing locations and coverage patterns for all occupancy/vacancy sensors.

C. Location Plans: Provide full scale plans showing locations and coverage patterns for all devices.

D. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

2. Include diagrams for power, signal, and control wiring.

3. Include riser diagrams showing all devices and wiring.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

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 SUBSTITUTIONS

A. The lighting control specification and lighting control details represent the basis of design. Acceptable manufacturers must meet the criteria listed in the system requirements as well as intent demonstrated through control details. Compliant systems are required to achieve the design intent and are not required to have all the parts and pieces listed.

B. Manufacturers not listed in the list of Acceptable Manufacturers must submit for approval within 10 days prior to bid.

C. Acceptable Manufacturers

1. Basis of Design

a. Acuity Brand Controls; nLight.

2. Alternative Manufacturers

a. Wattstopper; Digital Lighting Management
b. Hubbell NX
c. Eaton; Room Controller System

1.7 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide a wired digital networked lighting control system as indicated on the drawings. The system shall include, but not be limited to, occupancy/vacancy sensor(s), photo sensor(s), digital room controller(s), digital switches, and all interconnecting wiring required for a complete operational system. The Basis-of-Design System is the Acuity Brand Controls; nLight.

2.2 TIME SWITCHES

A. Basis-of-Design product: Subject to compliance with requirements, provide Acuity or a comparable product by one of the following:

1. Wattstopper.
2. Leviton Manufacturing Company, Inc.
3. Pass & Seymour.
4. Cooper Industries, Inc.
5. Intermatic, Inc.

B. Digital Time Switches: Wall switch style, electroluminescent back-lit LCD display shows timer countdown, time-out adjustments from 5 minutes to 12 hours, compatible with electronic ballasts; UL listed, five-year warranty.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

A. 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. Acuity.
2. Cooper Industries.
3. Intermatic, Inc.
4. NSi Industries, LLC; TORK Products.
5. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.

3. Time Delay: 15-second minimum, to prevent false operation.

4. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.

5. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.4 LIGHTING CONTACTORS

A. Basis of Design Product: Subject to compliance with requirements, provide ASCO; 918 series with solid-state control module for 2 wire control with number of poles and ratings as indicated on the drawing, or a comparable product by one of the following:

1. Square D; Schneider Electric.

2. Allen-Bradley/Rockwell Automation.

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status.

2. Control: On-off operation.

2.5 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Basis-of-Design Product: Subject to compliance with requirements, provide nLight nCm ADCX RJB or comparable product by one of the following:

1. Wattstopper DLM
2. Hubbell NX
3. Eaton

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with a hand held digital configuration tool or a PC with appropriate software.

a. Initial setup tool: a hand held digital configuration tool. Sensor adjustments may also be made using configuration pushbuttons on the sensors.
b. USB interface and PC software: capability to program, read, store, modify and document device and system configuration.

C. Ceiling-Mounted Dimming Controls: Solid-state, digital light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye in order to automatically dim a lighting zone.

D. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operating Ambient Conditions: Dry interior conditions, 32 to 104 deg F (0 to 40 deg C).

3. Sensor Output: Digitally communicates with room controller to dim loads based on lighting conditions. Sensor is powered from the room controller.

E. Light-Level Sensor Set-Point Adjustment Range: 10 to 200 fc (108 to 2152 lux)

2.6 INDOOR OCCUPANCY/VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide nLight nCM PDT RJB, nWV PDT, or comparable product by one of the following:

1. Wattstopper DLM
2. Hubbell NX

3. Eaton

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state digital indoor occupancy/vacancy sensors with a separate controller unit.

1. Systems programming is done with a hand held digital configuration tool or a PC with appropriate software.

a. Initial setup tool: a hand held digital configuration tool. Sensor adjustments may also be made using configuration pushbuttons on the sensors.
b. USB interface and PC software: capability to program, read, store, modify and document device and system configuration.

2. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Operation:

a. Occupancy Sensor: Automatic-on when coverage area is occupied, and automatic-off when unoccupied.
b. Vacancy Sensor: Manual-on when coverage area is occupied, and automatic-off when unoccupied.
c. Time Delay for turning lights off adjustable over a minimum range of 1 to 30 minutes in 1-minute increments. Default setting: 20 minutes.

4. Sensor Output: Digitally communicates with room controller to turn loads on and off based on occupancy. Sensor is powered from the room controller.

5. Mounting:

a. Sensor: Suitable for mounting, ceiling mounting and corner mounting.
b. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind removable cover.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

2. Detection Coverage (Standard Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3. Detection Coverage Large Room): Detect occupancy anywhere in a circular area of 2000 sq.ft. (186 sq.m) when mounted on a 96-inch-(2440-mm) high ceiling.

D. Ultrasonic/Microphonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

2. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (Corridor): Detect occupancy anywhere within 48 feet (18.0 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 12 feet (3.7 m).

4. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

5. Detection Coverage (corner mount): Detect occupancy anywhere within a 30 foot (9145 mm) radius when corner mounted at ceiling or on wall at 120-inches (3058 mm) above the finished floor. Provide stem mount as required to maintain manufacturer's recommended mounting height.

2.7 SWITCHBOX-MOUNTED OCCUPANCY/VACANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sensor Switch WSX, WSX-ZP, WSX-D (to match function indicated on the drawings) or comparable product by one of the following:

1. Wattstopper DLM
2. Hubbell NX
3. Eaton

B. General Description: Wall-mounting, solid-state units suitable for mounting in a single-gang switchbox

1. Operation:

    a. Occupancy Sensor: Automatic-on when coverage area is occupied, and automatic-off when unoccupied.
    b. Vacancy Sensor: Manual-on when coverage area is occupied, and automatic-off when unoccupied.
    c. Time Delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes in 1-minute increments. Default setting: 15 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.

3. Mounting:

    a. Sensor: Suitable for mounting in a standard outlet box.
    b. Time-Delay and Sensitivity Adjustments: Recessed and concealed.

4. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

5. Bypass Switch: Override the on function in case of sensor failure.

6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

C. Dual-Technology Type: Wall mounting; detect occupancy by using a combination of PIR and ultrasonic or microphonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch (150 mm) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12-inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12-inches/s (305 mm/s).

3. Detection Coverage: (Standard Room): Detect occupancy anywhere within a 15 foot radius (4572 mm) when wall mounted at 48-inches (1220 mm) above finished floor.

2.8 LOW VOLTAGE SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide nLight PODM, or comparable product by one of the following:

1. Wattstopper DLM
2. Hubbell NX

3. Eaton

B. General Description: Low-voltage, momentary pushbutton switches in 1, 2, 3, 4, 5, and 8 button configuration with the following features.

1. Two-way infrared (IR) transceiver for use with personal, and configuration remote controls.

2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.

3. Configuration LED on each switch that blinks to indicate data transmission.

4. Load/Scene Status LED on each switch button with the following characteristics:

a. Bi-level LED
b. Dim locator level indicates power to switch
c. Bright status level indicates that load or scene is active

5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

C. Two RJ-45 ports for connection to local network.

D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology local network. No additional configuration will be required to achieve multi-way switching.

E. The following switch attributes may be changed or selected using a wireless configuration tool:

1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).

2. Individual button function may be configured to Toggle, On only, or Off only.

3. Individual scenes may be locked to prevent unauthorized change.

4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.

5. Ramp rate may be adjusted for each dimmer switch.

6. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.

2.9 DIGITAL ROOM CONTROLLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide nLight nPP16 or comparable product by one of the following:

1. Wattstopper DLM
2. Hubbell NX
3. Eaton

B. Description: Self configuring, digitally addressable one, two or three relay controllers with 0-10 volt control for drivers and single relay application-specific plug load controllers (if applicable) Room controllers shall be provided to match room lighting load and control requirements and have the following features:

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.

2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.

3. Device Status LEDs to indicate:

   a. Data transmission.
   b. Device has power.
   c. Status for each load.
   d. Configuration status.

4. Quick installation features including:

   a. Standard junction box mounting.
   b. Quick low voltage connections using standard RJ-45 patch

5. Plenum rated.

6. Manual override and LED indication for each load.

7. Dual voltage (120/277 VAC, 60 Hz)

8. Zero cross circuitry for each load.

9. Controllers shall be equipped for fail-safe operation and shall be evaluated for this purpose.

10. Controllers shall be activated by activation of the building fire alarm system.

11. Controllers shall be equipped for activation by the building security system.

C. On/Off/Dimming enhanced room controllers shall include:

1. Real time current monitoring.

2. One, two or three relay configuration.

3. Efficient 250 mA switching power supply.

4. Four RJ-45 local network ports.

5. One 0-10 volt analog output per relay for control of compatible LED drivers.

6. Optional Network Bridge for BACnet MS/TP communications (LMRC-3xx).

7. The following dimming attributes may be changed or selected using a wireless configuration tool:

    a. Establish preset level for each load from 0-100%.
    b. Set high and low trim for each load.
    c. Set lamp burn in time for each load up to 100 hours.
    d. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.
    e. One relay configuration only.
    f. Automatic-ON/OFF configuration.

2.10 CONFIGURATION TOOL

A. Basis-of-Design Product: Subject to compliance with requirements, provide nLight, or comparable products by one of the following:

1. Wattstopper DLM
2. Hubbell NX
3. Eaton

B. A configuration tool facilitates customization of local networks, and is used to set up open loop daylighting sensors. A wireless configuration tool features infrared communications, while PC software connects to each local network via a USB interface.

Features and functionality of the wireless configuration tool shall include:

1. Two-way infrared (IR) communication with IR-enabled devices within a range of approximately 30 feet.

2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.

3. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.

4. Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.

5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting.

6. Adjust or fine-tune daylighting settings established during auto-commissioning, and input light level data to complete commissioning of open loop daylighting controls.

2.11 EMERGENCY SHUNT RELAY

A. Basis-of-Design Product: Subject to compliance with requirements, provide Bodine or comparable product by one of the following:

1. Lighting Control and Design, Inc.
2. Nine Twenty Four.

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 1008 and/or UL 924.

1. Coil Rating: 120 / 277 V.

2.12 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section, Low-Voltage Electrical Power Conductors and Cables.

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 24 AWG. Comply with requirements in Division 26 Section 260519, Low-Voltage Electrical Power Conductors and Cables.

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section 260519, Low-Voltage Electrical Power Conductors *and Cables*."

PART 3 - EXECUTION

3.1 PRE-INSTALLATION MEETING

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Owner's representative, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:

1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.

2. Review the specifications for low voltage control wiring and termination.

3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.

4. Discuss requirements for integration with other trades.

C. Inspect and make notes to job conditions prior to installation:

1. Record minutes of the conference and provide copies to all parties present.

2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.

3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Owner’s representative.

3.2 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section 260519, Low-Voltage Electrical Power Conductors and Cables. Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section 260553, *Electrical Identification*.

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

C. Prepare test and inspection reports.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section 017900, *Demonstration and Training*.

END OF LIGHTING CONTROL DEVICES

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DIVISON 26 SECTION 26 09 43
NETWORK LIGHTING CONTROLS
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SECTION 26 09 43 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. Provide all Labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete system for the control of lighting and other equipment as indicated on the plans, detailed in the manufacturer submittal, and as further defined herein. Contractor is solely responsible to verify quantity, installation locations and wiring requirements for this project. Specific manufacturer's catalog numbers, when listed in this section are for reference only. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product availability.

B. The system shall include but not be limited to the following list: Pre-wired, microprocessor controlled relay or dimming panels with latching relays controlled via switches, photocells, occupancy sensors, time based control, building automation systems, thermostats, and other control devices.

1.3 SUBMITTALS

A. Shop Drawings: Submit drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, occupancy sensors, photocells and other interfaces. Shop drawings shall indicate location of each device. Plans are diagrammatical. Electrical Contractor shall verify all lighting control material requirements from approved shop drawings. "Cut Sheet" submittal not acceptable.

B. Product Data: Submit for approval manufacturer's data for each type of product. Include construction details, descriptions, dimensions, and conductors and cables. Submit a complete bill of materials with part numbers, description and voltage specifications.

C. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component. Submittals that show typical riser diagrams are not acceptable.

1. Show installation details for all devices including interconnection diagrams showing all field installed wiring.

2. Include diagrams for power, signal and control wiring.

D. Coverage Plans: Show locations and coverage patterns for all occupancy sensors.

E. Programming Forms: Submit programming forms with complete information describing the operation of the network lighting control system and all other information necessary to show proper operation of the system.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

B. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation and maintenance manuals.

1.6 SUBSTITUTIONS

A. The lighting control specification and lighting control details represent the basis of design. Acceptable manufacturers must meet the criteria listed in the system requirements as well as intent demonstrated through control details. Compliant systems are required to achieve the design intent.

B. Manufacturers not listed in the list of Acceptable Manufacturers must submit for approval within ten (10) days prior to bid.

C. Acceptable Manufacturers

D. Basis of Design

1. Acuity Brand Controls; nLight.

2. Alternative Manufacturers

a. Wattstopper; Digital Lighting Management.
b. Hubbell NX
c. Eaton; Room Controller System.

PART 2 - PRODUCTS

2.1 GENERAL SYSTEM REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon wired networkable intelligent lighting control devices, standalone lighting control zones using distributed intelligence, and system backbone for remote, time based and global operation between control zones.
2. The system shall be capable of providing individually addressable switching and dimming control of the following: control zones to include multiple switch legs or circuits, relays and dimming outputs from centralized panels and networked luminaires. System shall be capable of integrating indoor and outdoor lighting controls.

3. Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through software.

4. System shall be capable of 'out of box' sequence of operation for each control zone. Standard Sequence is:

    a. All switches control all power packs in a zone.
    b. All occupancy sensors automatically control all power packs in the control zone with a default time out.

B. Wired Network Control Zone Characteristics

1. Following proper installation and provisions of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming. The 'out of box' default sequence of operation is intended to provide typical sequence of operation so as to minimize the system start up and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone address.

C. System Integration Capabilities

1. The system shall be capable of interface with third party building management systems to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.

2.2 DISTRIBUTED SYSTEM POWER, SWITCHING AND DIMMING CONTROLS

A. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage class 2 power to the rest of the system.

B. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.

C. Power packs shall accept 120 or 277 volt VAC and shall be plenum rated.

D. Devices shall be UL listed for load and load types as specified on the plans.

2.3 WIRED NETWORK RELAY AND DIMMING PANEL

A. Relays and dimming panels shall be capable of providing the required amount of relay capacity indicated as 4-relay, 8-relay, or 16-relay, as required per panel schedules shown on drawings, with an equal number of individually 0-10v dimming outputs.

B. Standard relays used shall have the following required properties:

1. Configurable in the field to operate with normally closed or normally open behavior.

2. Provide visual status of current state and manual override control of each relay.

3. Be individually programmable.

C. 0-10 VDC dimming outputs shall support a minimum of 100 mA sink current per output.

D. Panel shall be UL924 listed for control of emergency lighting circuits.

E. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays in the panels.

2.4 WIRED NETWORKED WALL SWITCHES, DIMMERS, SCENE CONTROLLERS

A. Wall switches & dimmers shall support the following device options:

1. Number of control zones: 1, 2 or 4.

2. Control Types Supported: On / Off or On / Off / Dimming.

B. Scene controllers shall support the following device options:

1. Number of Scenes: 1, 2 or 4.

2. Control Types Supported:

a. On / Off or On / Off / Dimming
b. Preset Level Scene Type
c. Reprogrammed or other devices within daisy-chained zone so as to implement user selected lighting scene.
d. Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones.

2.5 WIRED NETWORKED OCCUPANCY AND PHOTOSENSORS

A. Sensors shall utilize passive infrared (PIR) or dual technology (microphonic/ultrasonic plus passive infrared) to detect both the major (walking) and minor (hand) motion as defined by NEMA WD-7 standards.

B. Sensing technologies that are acoustically passive, meaning they do not transmit sound waves to any frequency, do not require commissioning. Ultrasonic based sensing technologies may require commissioning or sensitivity adjustment due to the active nature of their technology, if factory required.

C. Sensor coverage shall be coordinated with the floor plans. Sensors shall be available in standard and extended range, as well as being available with option for High Bay mounting.

D. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.

E. Sensor mounting type shall match project design requirements as shown on the plans.

1. Sensors shall have optional features for photosensor/daylight override, dimming control and low temperature/high humidity operations.

F. The system shall support the following types of photocell-based control:

1. On / Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.

2. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level

consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

2.6 WIRED NETWORKED AUXILIARY INPUT / OUTPUT (I/O) DEVICES

A. Auxiliary Input / Output Devices shall be specified as an input or output device with the following options:

1. Contact closure input

a. Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.

2. 0-10v analog input

a. Input shall be programmable to function as a daylight sensor.

3. RS-232/RS-485 digital input

a. Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.

4. 0-10v dimming control output, capable of sinking a minimum of 20 mA of current

a. Output shall be programmable to support all standard sequence of operations supported by system.

2.7 WIRED NETWORKED WALL SWITCH SENSORS

A. Wall switches sensors shall support the following device options:

1. User input control types supported: On / Off or On / Off / Dimming.

2. Occupancy Sensing Technology: PIR or Dual Technology.

3. Daylight Sensing Option: Inhibit Photosensor.

2.8 SYSTEM CONTROLLER

A. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.

B. System Controller shall perform the following functions:

1. Facilitation of global network communication between different areas and control zones.

2. Time-Based control of downstream wired and wireless network device.

3. Linking to an Ethernet network.

4. Integration with Building Management System (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.

5. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.

C. System Controller shall not require a dedicated PC or a dedicated cloud connection.

D. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.

E. Devices shall have a standard and astronomical internal time clock.

F. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 wired connection.

G. System Controllers shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.

1. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the expansion I/O modules.

2. BACnet/MSTOP shall support 9600 to 115200 baud.

3. System Controllers shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building (B-BC) with outlined enhanced features.

4. System controllers must support BACnet/IP Broadcast Management Device (BBMS) and Foreign Device Registration (FDR).

H. Controllers shall be equipped for fail safe operation and shall be evaluated for this purpose.

I. Controllers shall be activated by activation of the building fire alarm system.

J. Controllers shall be equipped for activation by the building security system.

2.9 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.

2. Management interface must be compatible with industry-standard web browser clients.

3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall be capable of providing a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud based server.

C. Visualization Interfaces

1. System shall be capable of providing an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. System shall have option for a portable handheld application interface for standalone control zones.

2. Programming capabilities through the application shall include, but not be limited to, the following:

a. Switch/occupancy/photosensor group configuration.
b. Manual/automatic on modes.
c. Turn-on dim level.
d. Occupancy sensor time delays.
e. Dual technology occupancy sensors sensitivity.
f. Photosensor calibration adjustment and auto-setpoint.
g. Trim level settings.

E. Demand Response Client Interface

1. System shall be capable of receiving a signal from the Utility or through a BAS control sequence and initiating load shed in response.

a. One full test of the Demand Response plan shall be performed and reports shall be included in the operations and maintenance manual.

PART 3 - EXECUTION

3.1 CONTRACTOR RESPONSIBILITY

A. Contractor shall provide the proper quantities and types of sensors for complete coverage of the areas to be controlled.

B. Contractor shall properly install, wire, test and adjust sensors according to manufacturer instructions.

C. Contractor shall be responsible for a complete operational system as specified.

D. Contractor shall warrant all equipment and installation for a period of two (2) years from date of substantial completion. Contractor shall make any necessary adjustments to the system at no charge to the Owner during the warranty period.

E. Contractor/Regional Sales Manager shall provide training to the Owner's representative in the use, operation, adjustment and maintenance of the equipment.

F. Contractor shall set the sensors time delays per owner's instruction.

3.2 SYSTEM START UP AND COMMISSIONING

A. To facilitate start-up, all devices daisy-chained together shall automatically be grouped together into a functional lighting control zone.

B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.

D. All system devices shall be capable of being given user defined names.

E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

F. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.

END OF NETWORK LIGHTING CONTROLS

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DIVISION 26 SECTION 26 27 26
WIRING DEVICES
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SECTION 26 27 26 - 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 and associated device plates.
2. GFCI receptacles.
3. Locking receptacles.
4. Tamper-Resistant receptacles.
5. Weather-Resistant receptacles.
6. Toggle switches.
7. Wall-box dimmer switches.
8. Pendant cord connector devices.
9. Cord and plug sets.
10. Emergency pushbuttons.
11. Floor service outlets, poke-through assemblies, and multioutlet assemblies.

B. Related sections include the following:

1. Section 260923 – Lighting Control Devices

1.3 DEFINITIONS

A. EMI: Electromagnetic Interference.

B. GFCI: Ground-Fault Circuit Interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-Frequency Interference.

E. UTP: Unshielded Twisted Pair.

F. TR: Tamper-Resistant.

G. WR: Weather-Resistant.

1.4 SUBMITTALS

A. Product Data: For each product specified, indicating configurations, finishes, dimensions, and manufacturer's instructions.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. 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. WD2: Semiconductor Dimmers for Incandescent Lamps
   c. WD5: Special Purpose Wiring Devices
   d. WD6: Wiring Devices - Dimensional Requirements.

4. National Fire protection Association (NFPA): Comply with NFPA 70, National Electrical Code, as applicable to construction and installation of electrical wiring devices.

5. Underwriters Laboratories, Inc. (UL): Provide wiring devices which are UL listed and comply with the requirements of:

   a. 20: General-Use Snap Switches.
   b. 498: Attachments, Plugs and Receptacles
   c. 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

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Wiring Devices:

a. Hubbell, Inc.; Wiring Devices Div.
b. Pass & Seymour/Legrand; Wiring Devices Div.
c. Leviton Manufacturing Co., Inc.
d. Cooper Wiring Devices

2. Multioutlet Assemblies:

a. Airey-Thompson Co.
b. Wiremold.
c. Hubbell Inc. Wiring Devices
d. American Electric

3. Emergency Pushbuttons

a. Safety Technology International, Inc. (STI)

2.2 STRAIGHT BLADE RECEPTACLES

A. General Requirements

1. Straight blade receptacles shall have the following basic features:

a. Tamper-Resistant.
b. One-piece brass mounting strap with integral ground for low resistance of fault currents.
c. Auto-ground clip to assure positive ground.

d. Impact-resistant nylon/thermoplastic face and base housing.
e. #10 large head brass terminal and ground screws.

B. Duplex Convenience Receptacles

1. Duplex convenience receptacles shall be extra heavy-duty, specification grade, 20A, 125V.

2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498 and Federal Specification W-C-596.

3. Hubbell HBL5362, or approved equal by acceptable manufacturer.

C. Single Convenience Receptacles

1. Single convenience receptacles shall be extra heavy-duty, specification grade, 20A, 125V.

2. Comply with NEMA WD-1, NEMA WD-6 configuration 5-20R, UL 498 and Federal Specification W-C-596.

3. Hubbell HBL5361, or approved equal by acceptable manufacturer.

D. 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.

E. Controlled/Switched Receptacle

1. Controlled/Switched Receptacles shall be 125 V, 20 A and comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

2. Hubbell; BR20* or approved equal by acceptable manufacturer.

3. Provide with controlled receptacle marking with custom engraving/pad printing on device plate device with the words “Controlled Receptacle.”

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. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
f. Auto-ground clip to assure positive ground.
g. Impact-resistant nylon/thermoplastic face and base housing.
h. #10 large head brass terminal and ground screws.

B. Duplex GFCI Receptacles

1. Duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V.

2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.

3. Hubbell BR20*, or approved equal by acceptable manufacturer.

C. Weather-Resistant Duplex GFCI Receptacles

1. Weather-resistant duplex GFCI receptacles shall be extra heavy-duty, specification grade, 20A, 125V with the following features:

a. "WR" marking on face as required by UL Standard.
b. UV-resistant nylon face for longer life under adverse environmental conditions.

2. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498 and Federal Specification W-C-596.

3. Hubbell GFTR20, or approved equal by acceptable manufacturer.

2.4 LOCKING RECEPTACLES

A. Single Convenience Receptacles

1. Single convenience 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. 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, 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), or approved equal by acceptable manufacturer.

C. Pilot Lighted Switches

1. Pilot lighted switches shall be quiet-type, extra heavy-duty, industrial grade, 120/277V, 20A with the following features:

a. Red lighted toggle, lit when switch is "on".

2. Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.

3. Hubbell PS1221PL (single-pole), HBL1222PL (two-pole), HBL1223PL (three-way), or approved equal by acceptable manufacturer.

D. Key (Locking) Switches

1. Key (locking) switches shall be quiet-type, extra heavy-duty, industrial grade, 120/277V, 20A with the following features:

a. Furnished with key for locking switch.

2. Comply with NEMA WD 1, UL 20 and Federal Specification W-S-896.

3. Hubbell HBL1221L (single-pole), HBL1222L (two-pole), HBL1223L (three-way), HBL1224L (four-way), or approved equal by acceptable manufacturer.

2.6 WALL-BOX DIMMER SWITCHES

A. General Requirements

1. Wall-box dimmer switches shall have the following basic features:

a. Modular, full-wave, solid-state units with audible frequency and EMI/RFI suppression filters.

b. Single-pole or three-way switching.
c. Comply with UL 1742.

2. Wall-box dimmer switches shall be sized by the Contractor to serve the load indicated on the Contract Drawings.

2.7 WALL-BOX TIMER SWITCHES

A. 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 ongitude.
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:

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. RT24.

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: Ivory.

2. Wiring Devices connected to Computer Power System: Gray.

3. Wiring Devices connected to Emergency Power System: Red.

4. 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 Finished Spaces: 0.04-inch thick, Type 430 satin finished stainless steel.

2. Material for Unfinished Spaces: Galvanized steel.

3. Color: Matches wiring device, except as otherwise indicated. To match existing device plates.

4. Plate-Securing Screws: Metal with heads colored to match plate finish.

B. Material for Damp Locations: Heavy-duty die-cast zinc/aluminum construction listed and labeled for use in "wet locations." All components shall have baked-on electrostatic, polyester, power paint finish for superior corrosion resistance. Covers for receptacles shall be equipped with one or more lift cover(s) equipped with stainless steel springs. Covers for toggle switches shall be equipped with actuating levers and shall mount directly over the switch. Covers for receptacles shall comply with 2011 NEC Article 406.9(A). Covers for switches shall comply with 2011 NEC Article 404.4.

1. Duplex Receptacle, 2 Self-Closing Lids – Pass & Seymour Model No. CA8GH or approved equal

2. GFCI Receptacle, 1 Self-Closing Lid – Pass & Seymour Model No. CA26GH (Horizontal) and Pass & Seymour Model No. CA26GV (Vertical), or approved equal.

3. Toggle Switch – Pass & Seymour Model No. CA1GL or approved equal.

4. Toggle switch, lockable cover – Crouse-Hinds Model No. DS185, or approved equal.

C. Material for Wet Locations: Heavy-duty die-cast zinc/aluminum construction with gasketed, hinged lockable lid, designed to be weatherproof while the device is in use, and listed and labeled for use in “wet locations.” All components shall have baked-on electrostatic, polyester, power paint finish for superior corrosion resistance. Covers for receptacles shall be self-closing per UL514C42.3, be equipped with stainless steel springs, and shall have a

cam action latch for secure closure. Covers for toggle switches shall be equipped with actuating levers and shall mount directly over the switch. Covers for receptacles shall comply with 2011 NEC Article 406.9(B). Covers for switches shall comply with 2011 NEC Article 404.4.

1. Duplex/GFCI Receptacle - Pass & Seymour Model No. WIUCAST1 or approved equal.

2. Toggle switch – Pass & Seymour Model No. CA1GL, or approved equal.

3. Toggle switch, lockable cover – Crouse-Hinds Model No. DS185, or approved equal.

D. Device plates for receptacles on emergency circuits shall be a red finish.

E. Provide jumbo size plates for outlets installed in masonry walls.

2.10 PROTECTIVE WIRE GUARDS

A. Provide protective wireguards over devices subject to physical damage. All devices installed in mechanical and electrical rooms and on the exterior of the building 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. Clocks
3. Bells
4. Fire Alarm Pull Stations
5. Thermostats
6. Smoke/Heat Detectors
7. Speakers
8. Fire Alarm Audio/Visual Devices (Strobe, Horn, etc…)
9. Exit Signs
10. Emergency Lights
11. Telephones
12. Data Outlets
13. Security Devices/Motion Detectors
14. Wiring Devices
15. Emergency Shut-Off Stations
16. Other Devices as required by Owner

C. Guard shall be fabricated from ¼-inch (9-gauge) cold-rolled steel rods, welded together with mounting tabs. Guard 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. 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.

2.11 PENDANT CORD/CONNECTOR DEVICES

A. Description: Matching, locking type, plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, Heavy-Duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.12 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.

2.13 EMERGENCY PUSHBUTTONS

A. General:

1. Emergency pushbuttons shall be Stopper Station with Bopper Stopper cover, as manufactured by Safety Technology International, Inc. (STI), or approved equal.

B. 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. Standard switch shall include one N.O. and one N.C. contact.

4. Switch shall hold up to three (3) sets of isolated contacts.

C. 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.

3. Pushbutton shall be provided with stainless steel backplate and matching polycarbonate spacer (as required), both having a 5VA flammability rating.

D. 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. "Emergency Power Off"
   b. "Water Heater Shut-Down"
   c. "Emergency Utilities Off" (used when shutting off multiple utilities, i.e. power, air, water, and/or gas)

E. 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.
   f. Lifetime guarantee against breakage of polycarbonate from normal use.

F. 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.

G. 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.

2.14 FLOOR SERVICE FITTING

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 6 jacks for UTP cable.

2.15 MULTIOUTLET ASSEMBLIES

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. Hubbell Incorporated; Wiring Device-Kellems.

2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles. Provide in lengths indicated on the Drawings, with wiring devices in quantities and spacing indicated. Provide suitable device plates and standard receptacle plates. Provide complete with all fittings and accessories required for a complete system.

C. Raceway material: Metal with manufacturer's standard finish. Provide power and telecommunications wiring to all devices indicated as multioutlet assemblies. Feed locations and wiring runs shall be configured such that 40 percent full capacities are not exceeded.

D. Raceways shall be provided with full length divider for separation of power and communications devices of and wiring.

E. Devices shall be type and color as previously specified. Label, circuit number on inside of plate of each power device.

2.16 FLOOR BOXES

A. Available Products: Subject to compliance with requirements, products may be incorporated into the Work to include, but not be limited to, the following:

1. Wiremold Company (The).

2. Hubbell, Incorporated.

B. Provide floor boxes as detailed on the Drawings, complete with fittings, devices, covers, etc. Floor boxes shall be cast iron for slab-on-grade applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

1. Verify that outlet boxes are installed at proper height.

2. Verify that wall openings are neatly cut and will be completely covered by wall plates.

3. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

C. By beginning Work, accepts conditions and assume responsibility for correcting unsuitable conditions encountered at no additional cost to the Owner.

3.2 INSTALLATION

A. Install devices and assemblies plumb, level, and secure.

B. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top or as required by the local Authority Having Jurisdiction. Exception: Mount exterior GFCI weatherproof duplex receptacles horizontally with grounding terminals on the left, or as required by the local Authority Having Jurisdiction. Group adjacent switches under single, multi-gang wall plates.

F. Protect devices and assemblies during painting.

G. Emergency shut-down toggle switches for boilers shall be provided at all means of egress from rooms in which boilers are installed. Boiler shut-down switches shall be clearly identified and shall be equipped with illuminated red toggle.

H. Receptacles on emergency circuits shall be clearly identified, with a circuit label indicating panelboard and circuit number.

I. 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 2014 NEC Article 406.9(A) and 406.9(B).

J. 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 2017 NEC Article 210.8(B).

1. Bathrooms/Toilet Rooms
2. Kitchens
3. Rooftops
4. Outdoors
5. Within six (6) feet (1.8m) of sinks, plumbing fixtures and water piping.
6. Indoor wet locations.

K. 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.

L. Switches shall be located as indicated on the drawings, arranged singular or in gangs within 18" of the door jam on the strike side of the door openings. Verify the door swings with the Architectural Drawings prior to rough-in.

M. Install life safety system switches separate from the normal power switches. Do not include in the multiple gang configuration.

N. Switch and receptacle combinations shall be as above in a 2-gang box where both are of the same voltage. Provide separate boxes where different voltages are present.

O. All switches in Mechanical Rooms, Electrical Rooms and other such places shall be a lighted handle, single-pole light switch(es) as required.

P. Install receptacles with ground pole in position top unless otherwise required by local authority having jurisdiction.

3.3 IDENTIFICATION

A. Comply with Division 26 Section 260553, *Electrical Identification*.

1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate. Light switches shall be labeled as to lights controlled and with circuit number and panel identification.

2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes. Protect label from damage during construction. Replace all damaged and unclear labels.

3. Mark all conductors with the panel and circuit number serving the device at the device.

4. Mark the panel and circuit number serving the device on the back side of the device plate with a permanent marking system, machine-generated, that does not show through the front of the plate.

3.4 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity, continuity, short circuits, and ground continuity. Operate each device at least six times.

B. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

C. Replace damaged or defective components.

3.6 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF WIRING DEVICES

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DIVISION 26 SECTION 26 28 13
FUSES
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SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Fuses.
2. Spare Fuse Cabinet.

B. The Electrical Contractor shall provide a complete set of fuses for all fusible equipment on the project as indicated on the Contract Documents. Final test and inspections shall be made prior to energizing the equipment.

1.3 PERFORMANCE REQUIREMENTS

A. Select fuses to provide appropriate levels of short circuit and overcurrent protection for components such as wire, cable, bus structures, and other equipment. Provide system to ensure that component damage is within acceptable levels during a fault.

B. Select fuses to coordinate with time-current characteristics of other overcurrent protective elements, such as other fuses, circuit breakers, and protective relays. Provide system to ensure that device closest to fault operates.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for each fuse type specified. Include the following:

1. Descriptive data and time-current curves.

2. Let-through current curves for fuses with current-limiting characteristics

3. Coordination charts and tables and related data.

C. Field test reports indicating and interpreting test results.

D. Maintenance data for tripping devices to include in the Operation and Maintenance Manual specified in Division 01.

E. Record the equipment nameplate rating and actual fuse rating and location of fuses on the record drawings.

F. Provide a complete short circuit coordination study report as required to select fuses to protect equipment.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from one source and by a single manufacturer.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.

1. The terms Listed and Labeled as defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

3. Comply with National Electrical Manufacturer's Association NEMA FU-1 Low Voltage Cartridge Fuses.

4. Comply with IEC269.

5. Comply with CANENA Standard 248.

6. Comply with UL 198.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Spare Fuses: Furnish quantity equal to 20 percent of each 600 ampere and small fuse type and size installed, but not less than one (1) set of three (3) of each type and size. (Provide three (3) of each 601 Ampere and larger fuse type and size installed.)

2. Fuse Pullers: Furnish two (2) fuse pullers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fuses that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries Inc. Bussmann Div.
2. Eagle Electric Mfg, Co. Inc.
3. Ferraz Corp
4. General Electric Co; Wiring Devices Div.
5. Gould Shawmut.
6. Tracor, Inc; Littelfuse, Inc. Subsidiary

B. All fuses shall be of the same manufacturer to assure coordination.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU-1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

2.3 SPARE FUSE CABINET

A. Cabinet: Wall mounted, 0.05 inch (1.27) mm) thick steel unit with full length, recessed piano-hinged door with key coded cam lock and pull, and circuit voltage.

1. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.

2. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.

3. Finish: Gray, baked enamel.

4. Identification: Provide engraved nameplate to read “SPARE FUSES” in 1/2-inch letters on door. Refer to Division 26 Section, “Electrical Identification” for nameplate requirements.

5. Fuse Pullers: For each size fuse.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Main Service: Class L, fast acting, 600 Volt, 601-6000 Amp, and 300 kA interrupting rating.

B. Main Feeders: Class J, time delay, 600Volt, 0-600 Amp, and 300 kA interrupting rating.

C. Motor Branch Circuits: Class RK1, time delay, 250 Volt Class J Time Delay 600 Volt, 0-600 Amp, and 300 kA interrupting rating. Time delay fuses shall hold 500% of rated current for a minimum of 10 seconds.

D. Other Branch Circuits: Class RK1, non-time delay, 250 Volt, Class J Time Delay 600 Volt, 0-600 Amp, and 300 kA interrupting rating.

E. Provide fuses of type and rating recommended by equipment manufacturer for packaged and/or specialized equipment.

F. Motor, transformer, feeder, and main service protection - 250 Volts or less:

1. Six hundred (600) ampere and less in interrupter switches, Class RK1, dual elements, time delay, 300 kA interrupting rating.

2. Four hundred (400) to six hundred (600) ampere in bolted pressure switches, Class J, 300 kA interrupting rating.

G. Motor, transformer, feeder, and main service protection - 600 volts or less; 600 ampere and less - Class RK-1, dual element, time delay, 300 kA interrupting rating.

H. Six hundred (600) ampere to six thousand (6000) ampere fuses used for protection of services, mains and feeders, Class L, current-limiting, time delay, 300 kA interrupting rating, rms symmetrical. Fuses shall be time delay and shall hold 500 percent of rated current for a minimum of four (4) seconds, clear 20 times rated current in 0.01 second or less, UL listed.

I. Six hundred ampere or less, installed ahead of breaker: Class RK1, time delay.

J. Six hundred ampere or less, for general power circuits: Class J, time-delay, dual element, 300 kA interrupting rating. Time-delay fuses shall hold 500 percent of rated current for a minimum of 10 seconds and shall be UL listed.

K. Fuse sizes for motor protection shall be chosen from fuse manufacturers published data and recommendations.

L. Control circuits and lighting: Class CC, current limiting rejection type, rated 0-30 amperes, 600 volts, and 200- kA interrupting rating.

M. Motor Circuits: All individual motor circuits with full-load ampere ratings (FLA) of 480 amperes or less shall be protected by Dual-Element Time-Delay Fuses. The following guidelines apply for motors protected by properly sized overload relays: Fuses for motors with a marked service factor not less than 1.15 shall be installed in ratings of 125% of motor full-load current (or next size larger if 125 percent does not correspond to a fuse size), except where high ambient temperatures prevail, or where the motor drives a heavy revolving part which cannot be brought up to full speed quickly, such as large fans. Under such conditions, the fuses may be 150 percent to 175 percent of the motor full-load current. For all other motors, (such as 1.0 service factor motors) fuses shall be sized in ratings of 115 percent of the motor full load current (or next size larger if 115 percent does not correspond to a fuse size) except as noted above. The following guidelines apply where fuses are used as the only overload protection for the motor:

1. For motors with a 1.15 service factor or more, fuses should be sized at 125 percent of motor full-load current (or next size smaller if 125 percent does not correspond to a fuse size).

2. For all other motors, fuses should be sized at 115 percent of motor full-load current (or next size smaller, if 115 percent does not correspond to a fuse size.

N. Motor Controllers: NEMA and IEC Style motor controllers shall be protected from short-circuits by Dual-Element Time-Delay fuses in order to provide testing agency-witnessed Type 2 coordination for the controller. This provides no damage protection for the controller, under low and high level fault conditions, as required by IEC Publication 947-4. For IEC style controller, the fuses shall be installed in ratings to coordinate with the overload relays, such that the relay/fuse curves cross over at 7-10 times the IEC contactor current rating.

O. Panelboards: The manufacturer shall supply equipment utilizing fully-rated and listed components. This equipment shall be tested, listed, and labeled for the available short-circuit current.

3.3 INSTALLATION

A. Fuses shall not be installed until equipment is ready to be energized. This measure prevents fuse damage during shipment of the equipment from the manufacturer to the job site, or from water that may contact the fuse before the equipment is installed. Final tests and inspections shall be made prior to energizing the equipment. This shall include a thorough cleaning, tightening, and review of all electrical connections and inspection of all grounding conductors. All fuses shall be furnished and installed by the electrical contractor.

All fuses shall be of the same manufacturer.Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

B. Install spare fuse cabinet where indicated.

C. Provide fuse clips as required.

3.4 IDENTIFICATION

A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF FUSES

DIVISION 26 SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS
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SECTION 26 28 16 - ENCLOSED SWITCHES AND 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.

1.2 SUMMARY

A. This Section includes individually mounted switches and circuit breakers.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 26 Section 262726, *Wiring Devices* for attachment plugs and receptacles, and snap switches used for disconnect switches.

2. Division 26 Section262813, *Fuses* for fuses in fusible disconnect switches.

C. Provide method of disconnection at all appliances, motors, equipment, etc., as required to comply with NEC (including Article 422-C, and Article 440-D).

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

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 disconnect switches, circuit breakers, and accessories specified in this Section.

C. Product Data for 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.

D. Coordination charts and tables and related data.

E. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

G. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

H. Field quality-control reports.

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

I. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 01.

J. Submit a schedule of equipment to indicate ratings of disconnects, fuses, circuit breakers, and other electrical characteristics for each item of equipment.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: In addition to the requirements specified in Division 01 Section 014000, *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 (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.

5. Replacement circuit breakers shall be obtained from the original manufacturer through an authorized factory distributor, complete with full factory warranty.

6. Original manufacturer product data shall be submitted for review.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D; a brand of Schneider Electric or comparable product by one of the following. No other manufacturers are acceptable.

1. ABB-GE Electrification Equipment

2. Eaton Corp.; Cutler-Hammer.

3. Siemens Energy & Automation, Inc.

2.2 DISCONNECT SWITCHES

A. Enclosed, Nonfusible Switch: Heavy duty, NEMA KS 1, Type HD, horsepower rated with lockable handle in the OFF position. Switch shall be provided with an override screw to permit opening front cover with switch in ON position.

B. Enclosed, Fusible Switch, 800 A and Smaller: Heavy duty, NEMA KS 1, Type HD, horsepower rated, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable in the OFF position, with 2 padlocks, and interlocked with cover in CLOSED position. Switch shall be provided with an override screw to permit opening front cover with switch in ON position. Minimum fault current rating shall be 200,000 symmetrical rms amperes.

C. Characteristics: Size, number of poles and ratings as indicated and to match load being served.

D. Enclosure: NEMA KS 1, Type 1, with gray baked enamel finish, unless otherwise specified or required to meet environmental conditions of installed location. Enclosure shall be rated for 200,000 rms symmetrical amperes short circuit current.

1. Outdoor Locations: Type 3R, with top-hinged, attached with removable screws.

2. Kitchen Areas: Type 4X, stainless steel, attached by molded hinges and Type 316 stainless steel hinge pins.

3. Other Wet or Damp Indoor Locations: Type 4.

E. Accessories

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit (fusible switches only): Provides rejection of other fuse types when Class R fuses are specified.

4. Auxiliary Contact Kit (where indicated on drawings or required for proper operation): One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

5. Hookstick Handle: Allows use of a hookstick to operate the handle.

6. Lugs: Compression type, suitable for number, size, and conductor material.

7. Service-Rated Switches (where indicated on drawings or required for proper oeration): Labeled for use as service equipment.

2.3 ENCLOSED CIRCUIT BREAKERS

A. Enclosed, Molded-Case Circuit Breaker: 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, 200 A and Larger: Trip units interchangeable within frame size.

E. Circuit Breakers, 400 A and Larger: Field-adjustable, short-time and continuous-current settings.

F. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

G. Shunt Trip: Where indicated. Provide voltage rating as required.

H. Accessories:

1. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.

2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

3. Shunt Trip (where indicated on drawings or required for proper operation): Trip coil energized from separate circuit, with coil-clearing contact.

4. Auxiliary Contacts (where indicated on drawings or required for proper operation): One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

5. Accessory Control Power Voltage (where indicated on drawings or required for proper operation): Remote mounted and powered; 120-V ac.

I. Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.

1. Outdoor Locations: Type 3R.

2. Kitchen Areas: Type 4X, stainless steel.

3. Other Wet or Damp Indoor Locations: Type 4.

J. Provide full capacity neutral lug or 200 full capacity neutral for non-linear loads and equipment grounding lug and isolated ground lug where isolated grounding is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install disconnect switches and circuit breakers in locations generally as indicated, according to manufacturer's written instructions. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install disconnect switches and circuit breakers level and plumb. Provide mounting brackets, wall bracing, and accessories as required.

C. Install wiring between disconnect switches, circuit breakers, control, and indication devices.

D. Connect disconnect switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

E. Identify each disconnect switch and circuit breaker according to requirements specified in Division 26 Section 260553, *Electrical Identification*. All switches shall be provided with laminated plastic labels which clearly identify the equipment served.

1. Each disconnect means shall be legibly marked as required by Code (including all disconnect units for motors, appliances, feeders, and branch(es).

F. Provide fuses for all fusible safety switches as indicated and required by the load being served. Coordinate fusing of disconnects with mechanical equipment electrical characteristics.

G. Provide disconnect switches for all equipment as indicated and as required by the NEC. Where disconnect switches are specified and furnished with mechanical equipment, install one only. Coordinate devices furnished for mechanical equipment with Division 23 Drawings and Specifications.

H. Weatherproof switches shall be provided for all locations exposed to the elements whether called for or not.

I. Switches and circuit breakers shall be labeled for service entrance use, if so required, where used for service entrance whether called for or not.

J. 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.

K. Install circuit and motor disconnect switches unit 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 FIELD QUALITY CONTROL

A. Testing Agency: Provide the services of a qualified independent testing agency to perform specified field quality-control testing.

B. Testing: After installing disconnect switches and breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers.

2. Certify compliance with test parameters.

C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.3 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573, Short Circuit Analysis*, Coordination Study, & Arc Flash Hazard Analysis*.

3.4 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 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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DIVISION 26 SECTION 26 29 13
MOTOR CONTROLLERS
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SECTION 26 29 13 - MOTOR CONTROLLERS

PART 1. GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes AC motor-control devices rated 600 V and less that are supplied as enclosed units.

B. Related Sections include the following:

1. Division 26 Section 260500, *Common Work Results for Electrical* for Mechanical - Electrical coordination requirements.
2. Division 23 Section 230600, *Heating, Ventilating and Air Conditioning Equipment* for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. N.C.: Normally closed.

C. N.O.: Normally open.

D. OCPD: Overcurrent protective device.

1.4 SUBMITTALS

A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

D. Qualification Data for Field Testing Agency: Certificates, signed by Contractor, certifying that agency complies with requirements specified in Quality Assurance Article below.

E. Submit a schedule of equipment to indicate motor controller ratings, sizes, and other electrical characteristics for each item of equipment.

F. Load Current and Overload Relay Heater List: Compiled and submitted by Contractor. Arrange to demonstrate selection of heaters to suit actual motor nameplate full load currents.

G. Wiring Diagrams: For power, signal, and control wiring.

H. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section 017823, Operation *and Maintenance Data*, include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.

2. Manufacturer's written instructions for setting field-adjustable overload relays.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 50 miles (80 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. 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.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

1.8 COORDINATION

A. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

C. The horsepower rating of all starters shall be checked against actual motor to be controlled, before installation and correct size overload elements shall be provided in all starters based on nameplate and manufacturer’s recommendation.

D. Provide all control devices and wiring, where not provided under Division 23, required for all equipment.

E. Motors and controllers shall be provided for voltage and current characteristics as indicated. In the event that equipment provided is of different electrical characteristics than the ones specified, any increase in electrical feeders, conduits, circuit breakers, etc., including increase of labor cost shall be the responsibility of the Contractor.

F. Provide branch circuits for all motors to the starting equipment and then to the motors, complete with all control wiring for automatic and remote control where required or noted. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with Liquid-Tight Flexible Metal Conduit (LFMC), Seal-tight "UA", or approved equal.

G. All conduits and wiring required for control work from the holding coil circuit of the starter, including the furnishing and installation of control devices such as auxiliary contacts, control relays, time delay relays, pilot lights, selector switches, alternators, etc., shall be provided and installed by other trades unless otherwise indicated.

H. Power Branch Circuits: Wire sizes for branch circuits not specifically called for on drawings or in Specifications shall be based on 125 percent of the full load current of the motor unless the voltage drop of motor branch circuits exceeds 1-1/2 percent from the distribution panel to the motor; in which case, voltage drop shall govern wire sizes. A power factor of 80 percent shall be used for motors in such calculations.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

PART 2. PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D; a brand of Schneider Electric or comparable product by one of the following. No other manufacturers are acceptable.

1. ABB-GE Electrification Equipment

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.

B. All motor controllers shall be NEMA type controllers. IEC type controllers shall NOT be acceptable.

2.2 MANUAL MOTOR CONTROLLERS

A. Description: NEMA ICS 2, AC general-purpose Class A manually-operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit. Manual motor controllers shall be equipped with red pilot light, hand-off-automatic selector switch and toggle operator. Provide size and number of poles as required for a complete installation of the equipment being connected.

B. Thermal Overload Units:

C. 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.

D. Enclosure: ANSI/NEMA ICS 6; Type 1 for interior use and Type 4X stainless steel or cast iron for damp or wet locations. Provide flush-mounted enclosures for units located in finished areas. Provide handle guard with locking provisions in the "off" position on all enclosures.

E. Furnish Square D, Class 2510 Type F, or approved equal.

2.3 MANUAL MOTOR SWITCHES

A. Description: NEMA ICS 2, AC general-purpose Class A manually-operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit. Manual motor switches shall be equipped with red pilot light and toggle operator. Provide size and number of poles as required for a complete installation of the equipment being connected.

B. Enclosure: ANSI/NEMA ICS 6; Type 1 for interior use and Type 4X stainless steel or cast iron for damp or wet locations. Provide flush-mounted enclosures for units located in finished areas. Provide handle guard with locking provisions in the "off" position on all enclosures.

C. Furnish Square D, Class 2510 Type K, or approved equal.

2.4 MAGNETIC MOTOR CONTROLLERS

A. Description: NEMA ICS 2, AC general-purpose Class A full-voltage, horsepower-rated, non-reversing, across-the-line magnetic controller for induction motors.

B. Control Circuit: Coordinate with Automatic Temperature Control Contractor; obtained from integral control power transformer.

C. Coil: Encapsulated type.

D. Poles: As indicated.

E. Size: NEMA size 1, unless otherwise indicated.

F. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.

G. Wiring: Straight-through wiring with all terminals clearly marked.

H. Overload Relay: NEMA ICS. Provide with sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for motor duty cycle.

1. Melting Alloy: One-piece thermal unit construction. Thermal units shall be interchangeable. Overload relay control circuit contact shall be replaceable. Thermal units shall be required for starter to operate.

2. Outputs: Provide normally closed (N.C.) auxiliary contact.

3. Reset: Unit shall offer both manual reset and remote reset using an external module.

I. Options and Features:

1. Control Power Transformers: Include a control power transformer with adequate capacity to operate connected pilot light, indicating and control devices, plus 100 percent spare capacity. Provide fused secondary protection and bond un-fused leg of secondary to enclosure.

2. Auxiliary Contacts: Provide one normally open (N.O.) and one normally closed (N.C.) auxiliary contact in each starter in addition to the standard normally open (N.O.) sealing contact.

3. Push-Buttons: Momentary push buttons with a factory-applied hasp arranged so a padlock can be used to lock the push-button in depressed position with control circuit open.

4. Cover Mounted Indicating Lights: White "Power Available" and green "Running" LED type indicating lights. "Power Available" indicating light shall be connected at the load side of the fused secondary terminals of the control power transformer. "Running" indicating light shall be connected through one

normally open (N.O.) auxiliary control contact. Indicating lights connected to the start button or across the load side of starters will not be acceptable. Indicating lights shall be equipped with individual legend plates supplied by the manufacturer.

5. Pilot Device Contacts: NEMA ICS 2, Form "Z".

6. Selector Switches: Rotary type, Hand-Off-Automatic (H-O-A) selector switch. All switch positions shall be maintained contact.

7. Auxiliary Relays: Provide factory-installed phase failure and reverse phase relay.

J. Enclosure: Enclosure: ANSI/NEMA ICS 6; Type 1 for interior use and Type 4X stainless steel for damp or wet locations.

K. Furnish Square D, Class 8536 Type S, or approved equal.

2.5 COMBINATION MAGNETIC MOTOR CONTROLLER

A. Description: Combine magnetic motor controllers with either disconnect, circuit breaker or motor circuit protector disconnect (as indicated on the drawings) in common enclosure.

1. Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A full-voltage, non-reversing, across-the-line magnetic controller for induction motors rated in horsepower.

2. Motor Circuit Protectors: NEMA AB 1 circuit breakers with integral instantaneous magnetic trip in each pole. Circuit breaker shall have a color-coded externally operated handle. Operating handle shall give positive visual indication of "on/off" with red and black color-coding.

B. Control Circuit: Coordinate with Automatic Temperature Control Contractor; obtained from integral control power transformer.

C. Coil: Encapsulated type.

D. Poles: As indicated.

E. Size: NEMA size 1, unless otherwise indicated.

F. Contacts: Totally enclosed, double-break, silver-cadmium-oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.

G. Wiring: Straight-through wiring with all terminals clearly marked.

H. Overload Relay: NEMA ICS. Provide with sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for motor duty cycle.

1. Melting Alloy: One-piece thermal unit construction. Thermal units shall be interchangeable. Overload relay control circuit contact shall be replaceable. Thermal units shall be required for starter to operate.

2. Outputs: Provide normally closed (N.C.) auxiliary contact.

3. Reset: Unit shall offer both manual reset and remote reset using an external module.

I. Options and Features:

1. Control Power Transformers: Include a control power transformer with adequate capacity to operate connected pilot light, indicating and control devices, plus 100 percent spare capacity. Provide fused secondary protection and bond un-fused leg of secondary to enclosure.

2. Auxiliary Contacts: Provide one normally open (N.O.) and one normally closed (N.C.) auxiliary contact in each starter in addition to the standard normally open (N.O.) sealing contact.

3. Push-Buttons: Momentary push buttons with a factory-applied hasp arranged so a padlock can be used to lock the push-button in depressed position with control circuit open.

4. Cover Mounted Indicating Lights: White "Power Available" and green "Running" LED type indicating lights. "Power Available" indicating light shall be connected at the load side of the fused secondary terminals of the control power transformer. "Running" indicating light shall be connected through one normally open (N.O.) auxiliary control contact. Indicating lights connected to the start button or across the load side of starters will not be acceptable. Indicating lights shall be equipped with individual legend plates supplied by the manufacturer.

5. Pilot Device Contacts: NEMA ICS 2, Form "Z".

6. Selector Switches: Rotary type, Hand-Off-Automatic (H-O-A) selector switch. All switch positions shall be maintained contact.

7. Auxiliary Relays: Provide factory-installed phase failure and reverse phase relay.

J. Enclosure: Enclosure: ANSI/NEMA ICS 6; Type 1 for interior use and Type 4X stainless steel for damp or wet locations.

K. Furnish Square D, Class 8539 Type S, or approved equal.

2.6 ENCLOSURES

A. Description: All motor controllers shall be mounted in enclosures. Flush or surface-mounted cabinets as indicated. NEMA 250, *Enclosures for Electrical Equipment*, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.

2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.

3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X.

PART 3. EXECUTION

3.1 APPLICATIONS

A. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

C. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.

D. Hand-Off-Automatic Selector Switches: In covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment.

E. Provide heaters and fuses correlated with full load nameplate current of motors provided. Set overload devices to suit motor provided.

3.2 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pretesting and adjustment of solid-state controllers.

C. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

D. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Division 26 Section 260500, Common Work Results for Electrical.

E. Install freestanding equipment on concrete housekeeping bases conforming to Division 03 Section 033000, Cast-in-Place Concrete.

F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

G. Install power factor correction capacitors. Connect to the line side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

H. Install fuses in control circuits if not factory installed. Comply with requirements in Division 26 Section 262813, Fuses.

I. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

J. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify motor-control components and control wiring according to Division 26 Section 260553, *Electrical Identification*.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved nameplate.

3. Label each enclosure-mounted control and pilot device

3.4 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.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing.

B. Testing: After installing motor controllers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Sections 7.5, 7.6, and 7.16. Certify compliance with test parameters.

2. Remove and replace malfunctioning units with new units, and retest.

C. Reports: Prepare written reports certified by testing organization of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

D. Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

E. Schedule visual and mechanical inspections and electrical tests with at least one week’s advance notification.

F. Pretesting: On completing installation of the system, perform the following preparations for tests:

1. Make insulation resistance test of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by the manufacturer.

2. Make continuity tests of circuits.

3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in the original Contract Documents.

4. Provide manufacturer's instructions for installation and testing of motor control devices to test personnel.

G. Visual and mechanical inspection: Include the following inspections and related work.

1. Motor-Control Device Ratings and Settings: Verify that ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective-device ratings and settings where differences are found. Use accepted revised ratings or settings to make the final system adjustments. Prepare and submit the load current and overload relay heater list.

2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current project drawings.

3. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instructions.

4. Check tightness of electrical connections of devices with calibrated torque wrench. Use Manufacturer's recommended torque values.

5. Clean devices using Manufacturer's approved methods and materials.

6. Verify proper fuse types and ratings in fusible devices.

H. Electrical Tests: Perform the following in accordance with manufacturer's instructions:

1. Insulation resistance test of motor control devices conducting parts to the extent permitted by the manufacturer's instructions. Insulation resistance less than 100 megohms is not acceptable.

2. Use primary current injection to check performance characteristics of motor-circuit protectors and for overload relays of controllers for motors 15 horsepower and larger. Trip characteristics not within manufacturer's published time-current tolerances are not acceptable.

3. Make adjustments for final settings of adjustable-trip devices.

4. Test auxiliary protective features such as loss of phase, phase unbalance and undervoltage to verify operation.

5. Check for improper voltages at terminals in controllers that have external control wiring when controller disconnect is opened. Any voltage over 30V is unacceptable.

I. Correct deficiencies and retest motor control devices. Verify by the system tests that specified requirements are met.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally, using methods and materials recommended by manufacturer.

3.8 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to demonstrate solid-state and variable- speed controllers and train Owner's maintenance personnel.

1. Conduct a minimum of four (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 seven (7) days' advance notice.

END OF MOTOR CONTROLLERS

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LIGHTNING PROTECTION FOR STRUCTURES
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SECTION 26 41 13 - LIGHTNING PROTECTION FOR STRUCTURES

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 lightning protection for structures, structure elements and building site components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.

2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2. PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I copper unless otherwise indicated.

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. East Coast Lightning Equipment Inc.
b. ERICO International Corporation.
c. Heary Bros. Lightning Protection Co. Inc.
d. Independent Protection Co.
e. Thompson Lightning Protection, Inc.

2. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.

3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Down Conductors: Copper.

E. Ground Rods: Copper-clad steel, 3/4-inch (19 mm) in diameter by 10 feet (3 m) long.

PART 3. EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.

2. Down conductors.

3. Interior conductors.

4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches (600 mm) from building foundation.

2. Bond ground terminals to the ground loop.

3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.

H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Division 26 Section "Basic Electrical Materials and Methods."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF LIGHTNING PROTECTION FOR STRUCTURES

DIVISION 26 SECTION 26 43 13
SURGE PROTECTIVE DEVICES
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SECTION 26 43 13 - SURGE PROTECTIVE 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. Description: This section describes the materials and installation requirements for stand-alone Surge Protective Devices (SPDs) for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

1.3 REFERENCES:

A. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.

B. ANSI/EEE C62.45 - IEEE Recommended Practice on Surge Suppressor Testing.

C. FIPS Pub 94 (1983) - Guide on Electrical Power for ADP Installation.

D. National Electrical Code - Article 285

E. National Fire Protection Association - NFPA-20, NFPA-70, NFPA-75, NFPA-78.

F. NEMA LS-1 Low Voltage Surge Protection Devices.

G. NEMA 250 - Enclosures for Electrical Equipment.

H. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.

I. UL 1283 - Electromagnetic Interference Filters.

J. UL 1449, Third Edition - Surge Protective Devices.

1.4 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated. Indicate overcurrent protection requirements.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

C. Maintenance Data: For surge protective devices to include in the maintenance manuals specified in Division 01.

D. Warranties: Special warranties as specified in this Section.

E. The submittals shall include:

1. UL 1449, Fourth Edition Listing documentation verifying:

a. Short Circuit Current Rating (SCCR)
b. Voltage Protection Ratings (VPRs) for all modes
c. Maximum Continuous Operating Voltage (MCOV) rating
d. I-nominal (I-n) rating
e. Type 1 Device listing

2. VPR, MCOV, I-n and Type 1 information is posted at www.UL.com, under Certifications. SCCRs are posted in manufacturer's UL documents.
3. ULStandard 1283 Listing, documentation.
4. UL data and visual inspection take precedence over manufacturer's published documentation.

F. Submittals shall include shop drawings including the following:

1. Manufacturer's installation instruction manual and line drawings detailing dimensions and weights of enclosure.
2. Internal wiring diagram illustrating all modes of protection in each type of SPD required.
3. Wiring diagram showing all field connections and manufacturer's recommended wire and circuit breaker sizes.

G. Upon request, an encapsulated but complete SPD shall be presented for visual inspection. MOV type & quantity shall reflect kA ratings on product data sheets, verification of diagnostic monitoring, thermal & overcurrent protection, etc.

1.5 QUALITY ASSURANCE

A. Listing and Labeling: Provide electrically operated equipment specified in this Section that is 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.
3. Comply with NFPA-70.

1.6 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the contract Documents and shall be in addition to, and run concurrent with, other warranties made under requirements of the Contract Documents.

B. Special Warranty: A written warranty, executed by manufacturer, agreeing to repair or replace components of Surge Protective Devices that fail in materials or workmanship within the specified warranty period.

1. Warranty Period: Five (5) years (minimum) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following listed manufacturers provide units of acceptable quality. Verify that the proposed units meet the specified requirements.

1. Advanced Protection Technologies, Inc.
2. EFI Electronics Corporation.
3. Liebert Corporation.
4. Current Technology, Inc.
5. LEA Dynatech, Inc.
6. Square-D Co.

2.2 SURGE PROTECTIVE DEVICES

A. 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 NEC 285.6.

B. SPD shall be UL labeled as Type 1 (verifiable at UL.com), intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal over-temperature controls. SPDs relying upon external or supplementary installed safety disconnects do not meet the intent of this specification.

C. SPD shall be UL labeled with 20kA I-nominal (I-n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.

D. Suppression components shall be heavy duty 'large block' MOVs, each exceeding 30mm diameter.

E. Minimum surge current capability (single pulse rated) per phase shall be:

Distribution Panelboards & MCC:	200kA
Branch Panelboards:	100kA

F. SPD shall provide surge current paths for all modes of protection: L-N, L-G, L-L and N-G for Wye systems; L-L, L-G in Delta and impedance grounded Wye systems.

G. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120	700V	700V	1200V	700V
480Y/277	1200V	1200V	1800V	1200V

(Mode VPRs verifiable at UL.com. Numerically lower is allowed/preferred; old-style Suppressed Voltage Ratings (SVRs) shall not be submitted, nor evaluated due to outdated less-strenuous testing)

H. UL 1449 Listed Maximum Continuous Operating Voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation (%)	MCOV
208Y/120	25%	150V
480Y/277	15%	320V

I. SPD shall include a serviceable, replaceable module (excluding Branch).

J. SPD shall have UL 1283 EMI/RFI filtering with minimum attenuation of -50dB at 100kHz.

K. SPD shall include visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED. SPD shall include an audible alarm with on/off silence function and diagnostic test function (excluding branch).

L. SPD shall be provided with the following options:

1. One (1) set of NO/NC dry contacts
2. Surge event counter with back-up power source
3. Integral disconnect switch

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

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.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Before energizing electrical circuitry, verify that the unit voltage and connecting equipment voltage is the same.
3. Inspect anchorage, alignment, grounding, and clearances.
4. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

B. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SURGE PROTECTIVE DEVICES

DIVISION 26 SECTION 26 51 00
LIGHTING
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SECTION 26 51 00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Exterior building mounted fixtures.

B. Related Sections:

1. Division 26 Section 260923, Lighting Control Devices for automatic control of lighting, including time switches, photoelectric relays, multipole lighting relays and contactors.

2. Division 26 Section 262726, *Wiring Devices* for snap switches and wall switches.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LED: Light-emitting diode.

D. LER: Luminaire efficacy rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting fixture, including ballast housing if provided.

G. THD: Total harmonic distortion.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.

2. Emergency lighting units including battery and charger.

3. Driver, THD, input power, input voltage, power factor, connector type, starting temperature.

4. Energy-efficiency data.

5. Life, output (delivered lumens) CCT, and CRI color rendition fidelity (Rf) and gamut (Rg) per IES TM-30.

6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:

1. Lamps and ballasts, installed.
2. Cords and plugs.
3. Pendant support system.

D. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

B. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

4. LED Modules (light engine and driver): Furnish at least (1) of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.9 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

2. Warranty Period for d Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for Drivers: Manufacturer’s standard form in which driver manufacturer agrees to repair or replace drivers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Drivers: Ten years from date of Substantial Completion.

2. Special Warranty for LED luminaires: Manufacturer’s standard form, made out to Owner and signed by lamp manufacturer agreeing to replace LED modules and drivers that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

3. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Lighting Fixture Schedules where titles below are column or row headings that introduce lists, the following requirements apply to product selection.

1. Basis of Design Product: The design of each item of luminaire and its support is based on the first product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type.
b. CCT and CRI for all luminaires.

2.3 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

C. Self-Luminous Signs: Using strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Provide with universal bracket for flush-ceiling, wall, or end mounting.

2.4 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, nickel metal hydride type.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.

7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.5 LED LUMINAIRES

A. A LED luminaire consists of LED light engine and driver, heat-sink, fixture housing, and optic assembly where applicable.

1. Temperature: Minimum starting temperature of -30 deg C (-22 deg F), minimum 40 deg C (104 deg F) ambient temperature rating.

2. Life and Lumen Maintenance: Plus 50,000 hours rated life at greater than 70% lumen maintenance.

3. CRI and CCT: 3500 deg K (+/- 275 K) CCT and greater than 80 CRI.

4. Transient Voltage Protection: Rated to withstand 2.5 kV of transient line surge.

5. Photometric Data and Test Reports: Comply with IESNA LM-79-08, IESNA LM-80-08, and ANSI C78.377-08.

6. Radio Frequency Interference: Comply with CAP 106B Telecommunications (Control of Interference) Regulations.

7. Luminaires and components thereof shall comply with UL 8750 Standard of Safety.

8. Five-year warranty on luminaire including LED light engine and driver.

9. Power Factor: 90 percent minimum.

10. Total Harmonic Distortion Rating: Less than 20 percent.

11. RoHS compliant.

12. Sound Rating: Class A.

13. Overload, short circuit, and thermal protection.

14. LED luminaires must be listed with the Design Lights Consortium or Energy Star Qualified Products list.

15. Comply with UL 1598-08 NMX-J-307/1-ANCE/C22.2 NO.250.0-08, *Luminaires, LEDs.*

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with 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 (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm.

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 GENERAL:

A. Comply with NECA/IESNA 500-2006 “Standard for Installing Indoor Commercial Lighting systems” for all interior fixtures.

B. Comply with NECA/IESNA 501-2006 “Standard for Installing Exterior Lighting Systems” for all exterior fixtures.

3.2 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.

2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of

luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Drivers: Distance between the driver and fixture shall not exceed that recommended by driver manufacturer. Verify, with driver manufacturers, maximum distance between driver and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling Solid #12AWG safety wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install 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.

4. Install at least one independent support wire from structure to a tab on lighting fixture. Wire shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting 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. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 26 Section 260519, *Low-Voltage Electrical Power Conductors and Cables.*

3.3 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 26 Section 260553, *Electrical Identification*.

3.4 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 STARTUP SERVICE

A. Burn-in all LEDs that require specific aging period to operate properly, prior to occupancy by Owner.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF LIGHTING

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DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM
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SECTION 28 31 11 – 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.

1.2 SUMMARY

A. This specification provides the requirements for the installation, programming and configuration of An extension of the existing complete and operational Addressable Intelligent Fire Alarm System Network. The system shall include, but not be limited to: Fire Alarm Control Panel(s), Automatic and Manually Activated Voice Evacuation Alarm Subsystem, Automatic and Manually activated alarm Initiating and Indicating Peripheral Devices and Appliances, conduit, wire and accessories required to furnish a complete and operational Fire Alarm System. System shall include, but not be limited to, the following:

1. Existing fire-alarm control unit.
2. System smoke detectors.
3. Existing Remote Annunciator.
4. Addressable interface device.

B. The system shall include all wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, alarm initiating devices, alarm indicating devices, and control equipment, and all other accessories and miscellaneous items required for an operating system.

C. All related work specified in other sections shall be properly coordinated with the fire alarm equipment.

1.3 REFERENCES

A. The system, equipment, installation, and operation shall comply with the current provisions of the following standards and publications:

1. National Electric Code, Article 70.
2. National Fire Protection Association Standards:

   a. NFPA72 National Fire Alarm Code
   b. NFPA 90A Air Conditioning & Ventilation Systems
   c. NFPA101 Life Safety Code

3. Local and State Building Codes.
4. Local Authorities Having Jurisdiction.

5. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

    a. UL 864/UOJZ, APOU - Control Units for Fire Protective Signaling Systems.
    b. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
    c. UL 268A - Smoke Detectors for Duct Applications.
    d. UL 217 - Smoke Detectors Single Station.
    e. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
    f. UL 228 - Door Holders for Fire Protective Signaling Systems.
    g. UL 464 - Audible Signaling Appliances.
    h. UL 1638 - Visual Signaling Appliances.
    i. UL 38 - Manually Activated Signaling Boxes.
    j. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems.
    k. UL 1971 - Standard for Signaling Devices for the Hearing Impaired.
    l. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
    m. UL 1711 - Amplifiers for Fire Protective Signaling Systems.
    n. UL Electrical Construction Materials Directory.
    o. UL Fire Protection Equipment Directory.

6. Americans with Disabilities Act (ADA)
7. International Standards Organization (ISO)

    a. ISO-9000
    b. ISO-9001

8. Factory Mutual Approval Guide.
9. State of Maryland Fire Prevention Code.
10. American Insurance Association Fire Protection Code (Article 14).
11. Maryland Occupational Safety & Health Act.
12. International Building Code (IBC).

1.4 DEFINITIONS

A. FACP: Fire Alarm Control Panel.

B. HLI: High Level Interface.

C. NICET: National Institute for Certification in Engineering Technologies.

1.5 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.

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. Detail assembly and support requirements.
4. Include voltage drop calculations for notification-appliance circuits.
5. Include battery-size calculations.
6. Include input/output matrix.
7. 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.
8. Include performance parameters and installation details for each detector.
9. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
10. 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. Locate detectors according to manufacturer's written recommendations.

11. 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 Architect.

    a. Secure permits and approvals prior to installation.
    b. Prior to commencement and after completion of work, notify Authorities Having Jurisdiction.
    c. Submit letter of approval for installation before requesting acceptance of system.

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.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.7 WARRANTY

A. For materials and workmanship for a period of two years from final system acceptance.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

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:
1. Equipment tested.
2. Frequency of testing of installed components.
3. Frequency of inspection of installed components.
4. Requirements and recommendations related to results of maintenance.
5. 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. A total of two copies shall be provided; one read only type and one writeable type.
3. Device address list.
4. Printout of software application and graphic screens.
5. All passcode information required to make alternations to the Fire Alarm Control Panel.

1.9 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. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
   2. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.11 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.12 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: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as one system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. 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 EXISTING FIRE-ALARM CONTROL UNIT

A. The existing Fire Alarm Control Panel shall remain. Refer to Fire Alarm Riser Diagram on Drawings for existing manufacturer and model numbers. Provide modifications and additions as required to accommodate new and relocated devices indicated, including but not limited to, additional power supplies and battery capacity.

2.3 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. 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.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Multiple levels of detection sensitivity for each sensor.
    b. 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.
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: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.4 PROJECTED BEAM SMOKE DETECTORS

A. Projected Beam Light Source and Receiver: Designed to accommodate small angular movements and continue to operate and not cause nuisance alarms.

B. Detector Address: Accessible from fire-alarm control unit and able to identify the detector's location within the system and its sensitivity setting.

C. 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 average value.
4. Present sensitivity selected.
5. Sensor range (normal, dirty, etc.).

D. 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.

2.5 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.

2.6 EXISTING REMOTE ANNUNCIATOR

A. Description: Existing 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. Provide all programming and configuration are required for extension of system.

2.7 ADDRESSABLE INTERFACE DEVICE

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.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts. Provide for all sprinkler flow and tamper switches, and as required.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown, etc.

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. Operate solenoids for use in sprinkler service.
3. Mute sound system(s).
4. Unlock security doors.

2.8 REMOTE TEST/INDICATING STATION

A. Provide keyed test switch with LED indicating light for each duct detector. Located 12" below accessible ceiling.

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 PREPARATION

A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document 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 in accordance with requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of fire-alarm service.

C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 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 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 building.
2. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to new points. New components must be capable of merging with existing configuration without degrading 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. 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.

E. 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.

F. 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.

G. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.4 PATHWAYS

A. Pathways above recessed ceilings and in non-accessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.5 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 "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 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. Supervisory connections at valve supervisory switches.
3. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
4. Data communication circuits for connection to building management system.

C. Each addressable analog loop shall be circuited as shown on the drawings but device loading is not to exceed 80% of loop capacity in order to leave space for future devices.

D. Where it is necessary to interface conventional initiating devices, provide intelligent input modules to supervise Class B zone wiring.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.7 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.

3.8 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

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 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.

3.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 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.

3.10 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.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

SECTION 31 20 00

EARTH MOVING

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. Preparing subgrades for all aspects of construction shown on the plans.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
4. Subbase course for concrete walks pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
8. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for recording pre-excavation and earth moving progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Division 14 Section "Hydraulic Elevators" and "Hydraulic Freight Elevators" for excavating well hole to accommodate elevator-cylinder assembly.
5. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.
6. Division 31 Section "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
7. Division 31 Section "Dewatering" for lowering and disposing of ground water during construction.

8. Division 31 Section "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
9. Division 31 Section "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
10. Division 32 Section "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
11. Division 32 Section "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
12. Division 33 Section "Sub-drainage".

C. Delaware Department of Transportation (DelDOT) Standard Specifications.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

G. Fill: Soil materials used to raise existing grades.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.

3. Base Course aggregate
4. Drainage Course aggregate.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Pre-excavation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify Miss Utility (1-800-282-8555) for area where Project is located before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 31 Section "Site Clearing are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

1. All on-site borrow, subbase material, base course and drainage course shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters meeting Mirafi 140N or approved equal.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters meeting Mirafi 600X or approved equal.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
6. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. All excavation shall be as shown on the plans and in accordance with the DelDOT Standard Specifications and the DNREC Sediment and Erosion Control Handbook.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.8 SUBGRADE INSPECTION

A. Notify Architect/Engineer/Construction Manager when excavations have reached required subgrade.

B. If Architect/Engineer/Construction Manager determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly as shown on the plans and in accordance with the DelDOT Specifications.

3.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section Cast-in-Place Concrete.

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place and compact fill as shown on the plans and in accordance with the DelDOT Standard Specifications.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.17 SUBSURFACE DRAINAGE

A. Sub-drainage Pipe: Specified in Division 33 Section "Sub-drainage."

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place as shown on the plans and in accordance with the DelDOT Standard Specifications.

3.19 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

3.20 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft or less of paved area or building slab, but in no case fewer than three tests.
2. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained.

3.21 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.22 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 32 12 16

ASPHALT PAVING

PART 1 - **GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Pavement-marking paint.

B. Related Sections:

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

C. Delaware Department of Transportation (DelDOT) Standard Specifications.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Erosion and Sediment Control Handbook.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: See DelDOT Standard Specifications.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: For each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Material Certificates: For each paving material, from manufacturer.

D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by DelDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of DelDOT for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review condition of subgrade and preparatory work.
c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: See DelDOT Standard Specifications

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: All aggregates for asphalt paving are in accordance with the DelDOT Standard Specifications.

2.2 ASPHALT MATERIALS

A. All asphalt materials are in accordance with the DelDOT Standard Specifications.

B.

2.3 AUXILIARY MATERIALS

A. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

B. Joint Sealant: Per the DelDOT Standard Specifications.

C. Pavement-Marking Paint: As shown on the project plans and in accordance with the DelDOT Standard Specifications.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by DelDOT and in accordance with the DelDOT Standard Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving in accordance with the DelDOT Standard Specifications.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Prime Coat: In accordance with the DelDOT Standard Specifications.

C. Tack Coat: Apply uniformly to surfaces of existing pavement in accordance with the DelDOT Standard Specifications.

3.5 PAVING GEOTEXTILE INSTALLATION

A. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

3.6 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted in accordance with the DelDOT Standard Specifications.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers in accordance with the DelDOT Standard Specifications.

B. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

C. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

D. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the tolerances found in the DelDOT Standard Specifications.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the tolerances found in the DelDOT Standard Specifications.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 14 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

1. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

C. In-Place Density: In accordance with the DelDOT Standard Specifications.

3.12 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an DNREC approved landfill.

END OF SECTION 32 12 16

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SECTION 32 13 13

CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Walks.
   2. Concrete Pavement
   3. Concrete Pads
   4. Concrete Curb

B. Related Sections:

   1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
   2. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

C. Delaware Department of Transportation (DelDOT) Standard Specifications.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Other Action Submittals:

1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.
8. Aggregates and sand materials.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with the DelDOT Standard Specifications.

B. Testing Agency Qualifications: 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.

C. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:
   a. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Concrete paving subcontractor.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces in accordance with the DelDOT Standard Specifications.

B. Form-Release Agent: In accordance with the DelDOT Standard Specifications

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets as shown on the plans and in accordance with the DelDOT Specifications.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
   a. Portland Cement: Per the DelDOT Standard Specifications.

B. Normal-Weight Aggregates: Per the DelDOT Standard Specifications.

C. Water: Per the DelDOT Standard Specifications.

D. Air-Entraining Admixture: Per the DelDOT Standard Specifications.

2.4 CURING MATERIALS: All curing shall be in accordance with the DelDOT Standard Specifications.

2.5 RELATED MATERIALS

A. Joint Fillers: In accordance with the DelDOT Standard Specifications.

2.6 CONCRETE MIXTURES

A. All concrete shall be Type “B” (3,000 PSI) in accordance with the DelDOT Standard Specifications.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete in accordance with the DelDOT Standard Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: In accordance with the DelDOT Standard Specifications.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet for paving and 20 feet for sidewalks and curbing unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness at 25-foot intervals for paving and 5-feet for sidewalks.

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

A. Placement of concrete shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

3.7 FLOAT FINISHING

A. Float finishing shall be in accordance with the DelDOT Standard Specifications.

3.8 CONCRETE PROTECTION AND CURING

A. Concrete protection and curing shall be in accordance with the DelDOT Standard Specifications.

3.9 PAVING TOLERANCES

A. Paving tolerances shall be in accordance with the DelDOT Standard Specifications.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: In accordance with the DelDOT Standard Specifications.
2. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
3. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if 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.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Concrete paving will be considered defective if it does not pass tests and inspections.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 1814
SUBGRADE AND STONE AGGREGATE DRAINAGE LAYER

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. General conditions, special conditions, and Section "Scope of Work" are a part of and govern this section.

B. Excavation and subgrade compaction, see Section 312000, Earth Moving.

C. Field perimeter curb, see Section 321313, Concrete Paving.

D. Field Retaining Walls, see Section 321313, Concrete Paving.

E. Site storm drainage, see Section 334100, Storm Utility Drainage Piping.

F. Elastomeric layer pad, see Section 321800, Shock Pads.

G. Pre-fabricated Shock Pad, see section 321800, Shock Pads.

1.2 SCOPE OF WORK

A. Furnish and install a new vertically-drained stone base layer utilizing a stable subgrade, aggregate drainage layer and drainage network.

B. The design requirements contained in this subsection cover the general minimum considerations in geometric layout and materials. For specific requirements referencing technical testing societies, organizations, associations, etc. see the subsection on Technical Requirements.

C. The work of this Section includes, but is not necessarily to be limited to:

1. Engineering layout.
2. Erosion and sediment controls.

3. Excavation and grading.
4. Removal of excess earth and topsoil from the site.
5. Construction of a stable subgrade.
6. Construction of the permeable aggregate base layer and underdrain system.
7. Verification of drainage (permeability).
8. Verification of finished surface slope and planarity.
9. Cleanup.
10. Guarantee.
11. Maintenance.

1.3 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have been actively and directly engaged in constructing stadium athletic fields for a period of five (5) years or more, and provide proof of ten (10) or more sports field installations completed by them within the last three (5) years, five of which must be synthetic turf fields.

B. In addition, the Owner may make such investigations as he deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work specified herein.

1.4 WORK BY OTHERS

A. This Contractor shall afford other Contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate his work with theirs.

B. Where any part of the Contractor's work depends for proper execution or results upon the work of any other separate Contractor, the Contractor shall inspect and promptly report to the Architect any apparent discrepancies or defects in such work that render it unsuitable for such proper execution and results. Failure of the Contractor to inspect and report shall constitute an acceptance of the other Contractor's work as fit and

proper to receive his work, except as to defects which may develop in the other separate Contractor's work after the execution of the Contractor's work.

C. Should the Contractor cause damage to the work or property of any separate Contractor on the project, the Contractor shall, upon due notice, settle with such other Contractor by agreement or arbitration.

1.5 CONDITIONS

A. All the conditions, shown and/or specified, and the incidental conditions in or about the project site and structure, shall be considered mandatory parts of the Contract Documents.

1.6 SUBCONTRACTORS

A. The Contractor shall furnish, within five (5) days after notification, a list of subcontractors he proposes to employ in the work. The approval of subcontractors shall be a condition precedent to award of the contract. All subcontractors shall be subject to the approval of the Architect and/or the Owner.

1.8 MATERIAL SAMPLES AND INSPECTIONS

A. Submit samples of all dry materials and labels of liquids or wettable powders to be used in construction ten (10) days or more before beginning work.

1.9 ENGINEERING LAYOUT

A. The Contractor shall employ a registered engineer, landscape architect or surveyor to lay out all lines, grades and construction staking. Periodically throughout this project, the Architect may request the Contractor to verify the required construction elevations.

1.10 SITE PREPARATION - GENERAL

A. Keep excavation, stored materials, and other areas, free from excess rain or subsurface water at all times.

B. Excess material excavated, including suitable fill material and topsoil shall be removed.

C. Any piping, conduits or wiring encountered that are not required to be removed or otherwise encountered shall be temporarily supported and maintained until permanent support has been restored.

D. Utilize Geotechnical Consultant or Site Engineer for on-site work, inspecting during entire excavation, subgrade stabilization, underdrain system and porous aggregate base layer construction, utilizing a competent Testing Laboratory to evaluate soil conditions and drainage properties. Submit test results, as required, indicating compliance.

E. Backfill and compact around structures, walls, trenches and where concrete curbs are installed.

F. Rutting in the subgrade created by offloading and placement of the aggregate material shall be thoroughly repaired, by filling with competent material and compacting and rolling, in accordance with procedures specified herein.

G. Utilizing laser-guided equipment perform rough and precision grading in areas required, to the lines and grades required for the permeable aggregate base, and in accordance with recommended tolerances.

H. Keep excavations and the remainder of site free from dirt and debris at all times during the progress of the work, and in accordance with other applicable sections of the specifications.

1.11 CONSTRUCTION OF PERMEABLE AGGREGATE BASE LAYER, AND UNDERDRAIN SYSTEM

A. EXCAVATION

1. The site shall be excavated to a depth that the subgrade becomes stable. Topsoil shall be stripped and removed from the site. All other excavated soil shall be removed from the site.

2. When the proper sub-grade elevation is established, the entire area shall be proof-rolled with a ten ton (static weight) smooth-wheeled roller, to delineate localized loose, or soft zones. All such material shall be undercut to competent material.

3. The Site/Geotechnical Engineer will determine whether the materials in the excavated areas are suitable for use as backfill. All unsuitable material shall be removed and all new materials shall be approved before use.

4. The sub-grade shall be constructed using the approved backfill material.
   This material shall be placed in lifts not greater than 6" (15.24 cm) in depth. Each lift (layer) shall be compacted separately. The moisture in the soil, at the time of compaction, shall be uniformly distributed and should be within 90 and 120 percent range of the optimum. Within these limits, the Site Engineer will determine the proper moisture level to be used.

5. The backfill material in the first layer shall be rolled until the course has been uniformly compacted to over 95 percent of the maximum dry density. The second and succeeding courses shall be placed and mixed and then compacted as specified in the first course.

6. The finished surface of the sub-grade shall have a finished grade as shown. Sub-grade shall be established to within the tolerance of +0.0' or -0.02' of the design sub-grade elevation.

7. Excavate collector trenches, width and depth as required for the collector drain plus 6 inches on each side of the pipe. Trenches shall be excavated and sloped for drainage. The trenches shall be excavated with the indicated percent slope starting from the high point of the drainage system extending toward the storm drain connection points.

8. All loose debris shall be removed from the tops, edges and inside trenches. The trenches shall then be compacted by tamping or other approved means to 95 percent of the maximum dry density.

B. UNDERDRAIN SYSTEM

1. GEOTEXTILE

Verify that surface elevations of finished sub-grade conform to elevations shown on drawings prior to under drain system construction and that the sub-grade surface is uniform and free of depressions, voids, and irregularities. Provide nonwoven, porous geotextile (DOT Class 1) in accordance with manufacture's written recommendations and DOT Specifications, over the entire field sub-grade. Collector drain trenches shall be lined with non-porous geotextile.

Additionally, overlap joints a minimum of 8". All laps shall be overlapped in the direction the stone aggregate is to be spread. Place a suitable amount of ballast on the fabric to prevent movement by the wind. Ballast shall be in a form which will not damage fabrics. Direct loading on fabric by traffic will not be permitted. Fabric must completely cover perimeter trenches.

2. FIELD COMPOSITE DRAINS

Install perforated under drain conduits at 16 feet on-center as a 45-degree angle on top of the geotextile, securing to fabric every 10-15 linear feet with duct tape, or other suitable material. These conduits shall be a composite drainage system as J-Drain 12 as manufactured by JDR Enterprises, Inc., (800) 843-7569, or acceptable equivalent. Connect ends of these composite drains into the perimeter collector drain pipe, or otherwise direct downward into 50% of the trench depth.

3. COLLECTOR DRAINS

Place perforated under drain pipes in the collector trenches, size per plan. Centerline of the pipe shall coincide with centerline of trench. The pipes shall be capable of withstanding the anticipated loading without deformation. Pipe meeting ASTM standard F-405 (stiffness at 5 percent deflection if 40 psi (2.8 kg/cm^2) minimum and the stretch resistance is 10 percent maximum) are suitable for use as under drain. Collector drains must be connected as shown on plans.

(a) A minimum of 2" of clean, drainable crushed stone aggregate (AASHTO #57) shall be placed in the bottom of the collector trenches, on top of moisture barrier. Compact to 95 percent.

(b) Place a minimum of 6" of the clean, crushed aggregate on the sides of the under-drain pipes and headers, and 6" minimum of the aggregate on top of the pipe network. Compact suitably.

(c) Prior to placement of the aggregate layer, verify the planarity of the subgrade to tolerance specified, and remove all "lipping" at both sides of all collector drain trenches, to ensure no impediment of surface flow of water into the trenches.

C. AGGREGATE LAYER

1. A uniformly mixed aggregate shall be placed over the entire sub-base which has been covered with the geotextile filter fabric. The aggregate shall comprise a minimum of 6" of compacted, stable, permeable crushed limestone aggregate. Care shall be taken to maintain the grade designed for the sub-base. The capability of the aggregate drainage layer to meet the stability and permeability requirement must be determined by a certified laboratory or Contractor prior to construction of the course. It is recommended that the aggregate layer be consolidated to a density of 90 percent. A nuclear density gauge should be used during aggregate placement and rolling to ensure adequate compaction.

2. Submit procedure how contractor proposes to for place, level and consolidate the stone aggregate drainage layer, for Owner and Architect approval.

3. Material shall be a minimum of 75 percent fractured with at least one fractured face by mechanical means on each individual particle larger than 1/4". Material shall be clean of mineral fines.

4. Typical aggregate or aggregate blends found acceptable as an aggregate drainage course conform to the following gradation: (DelDOT NO. 57 Coarse Aggregate may meet the above requirements)

Sieve	Sieve -Metric (mm)	Percent Passing by Weight
1-1/2"	38.1	100
1"	25.4	95 - 100
3/4"	19.0	80 - 100
1/2"	12.7	60 - 80
3/8"	9.52	30 - 50
No. 4	4.75	20 - 40
No. 8	2.38	10 - 30
No. 40	0.42	5 - 17
No. 200	75 mm	1 – 4

D. PLACEMENT OF PERMEABLE AGGREGATE BASE

1. Install permeable aggregate base to the lines and grades indicated.

2. The Contractor shall shape the complete surface of the aggregate base to receive the overlying elastomeric layer pad base and continue until the deviation from the required elevation does not exceed a compensating maximum deviation from grade of 1/8" in 10'.

3. The surface of the aggregate base course shall be well drained at all times. The permeability of the aggregate shall be checked by using 10" diameter cylinder and five (5) gallons of water to drain in less than one (1) minute. Test samples shall be taken (at a minimum of) one sample per every 5,000 square feet or as otherwise directed.

4. All test results will be logged and documented by the Contractor or Site Engineer. If, at any time, the aggregate base does not meet specifications, it shall be the Contractor's responsibility to restore, at his expense, the aggregate base to the required grade, cross section, density and permeability.

5. Moisture Content:

Aggregate must contain 3.5 percent to 4.0 percent moisture content to ensure that fines do not migrate and to facilitate proper compaction. This is critical. Contractor shall ensure that aggregate leaving the source plant meets this requirement and is required to apply water to aggregate on site to attain and maintain this minimum moisture content.

6. Placement:

(a) Prior to aggregate placement, remove any excess or contaminated backfill from the drainage trenches.

(b) The sub-grade surface must be free of standing water prior to aggregate placement.

(c) Ruts in the subgrade created by offloading and placement of the aggregate material shall be thoroughly repaired, by filling with competent material and compacting and rolling, in accordance with procedures specified herein.

(d) The aggregate should be placed in one lift.

(e) The aggregate layer must be spread uniformly with equipment that will not cause perceptible separation in gradation (segregation of the aggregates), preferably a self-propelled paving machine.

(f) Should this occur, during any stage of the spreading or stockpiling (a separation of the materials or particles), the contractor must

immediately remove and dispose of segregated material and correct or change handling procedures to prevent any further separation.

(g) The Contractor shall utilize dual-plane laser-guided slope and grade equipment control systems for the grading of the permeable aggregate to ensure accuracy in the grade tolerances.

7. Compaction and Planarity:

(a) The aggregate layer shall be compacted (consolidated) to a minimum density of 90 percent of maximum dry density, utilizing a static, tandem drum-type roller, and as determined by ASTM 0698 and measured using a nuclear method, and to where it is stable.

(b) Proof roll wherever possible and mark "soft spots" for additional compaction. Use static tandem drum-type roller of not less than five (5) tons weight (non-vibratory roller), to consolidate. Excess rolling will produce segregation of fines and shall be avoided.

(c) The finished surface shall not deviate (tolerance-to-grade) from designated compacted grade. This means that the surface shall not deviate more than 1/8" in 10' (any direction) when placed under a 10' long straight edge. This tolerance is required over the entire field.

(d) Provide survey elevation of finish graded aggregate base layer specified for verification of field slope and planarity, as specified in Section 02535, 3.2 (A).

Areas that deviate should be marked with spray paint and corrected with material and rolled tight. Such remedial actions should be done by hand.

8. Contractor shall provide written certification that the sub-grade and aggregate base has been properly constructed, tested for drainage, slope and planarity, and meet the requirements of the specifications.

END OF SECTION

SECTION 32 1824
SYNTHETIC RUNNING TRACK SURFACING

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. General Conditions, Special Conditions and section "Scope of Work" are a part of and govern work under this section.

B. Paving
   a. Section 32 1216 – Asphalt Paving
   b. Section 31 1313 – Concrete Paving

C. Track perimeter drain
   a. Section 32 1814 – Subgrade and Stone Aggregate Drainage Layer

1.2 SCOPE

A. Accept finished bituminous pavement as suitable for these operations. Provide new finished running surface over entire track and field event areas complete with all markings, certifications, testing and warranty. Repair any damage on existing areas or facilities caused by these operations to original or better condition.

B. Color of synthetic surface shall be red. Overall surface thickness shall not be less than 13 mm.

1.3 STANDARDS

A. Contractor experience: Contractor shall demonstrate experience in the installation of at least five full sized synthetic polyurethane tracks within the last two years, utilizing the selected surfacing system. Polyresin or water-bound latex systems will not be acceptable. Any contractor wishing to offer an “or equal” must provide a sample, references, installation list and test results from an independent testing lab stating that the proposed product has been tested and

meets the requirements of IAAF performance specifications for synthetic track surfaces.

B. Manufacturer experience: Documented experience producing polyurethane athletic sports surface, as specified herein.

C. Quality control: Provide ISO 9001 certification for product design, manufacture and distribution for surfacing product / system utilized.

D. The primary surfacing materials utilized in the construction shall have proven compatibility and shall be obtained from a single manufacturer

E. Coordinate installation of synthetic surface with related work in all sections, including placement and acceptance of bituminous pavement.

F. Quantities of materials: The Contractor will be held accountable for all quantities of material utilized as measured on site, and in accordance with manufacturers printed specifications. Containers shall be labeled, and proof shall be furnished of quantities delivered, stockpiled and utilized.

G. Utilize only the highest quality materials and precision machinery. Installation and construction shall be first class, utilizing experienced, skilled workmen, installers and supervisors.

H. Warranty: A written manufacturer's/installer's warranty shall be furnished for all surfacing material for a period of five years from final acceptance for the track and field event surfaces. Warranty shall be against defects in material, workmanship, installation (including adherence to the asphalt), merchandising and fitness. Any defects occurring within the warranty period shall be promptly repaired upon written notification, at no cost to the Owner. Track striping and markings shall be warranted for a period of 2 years.

I. Certification: All markings shall be certified in writing by qualified personnel that the track has been marked and measured to be in accordance with NFHS requirements. Track and field event surface shall be monitored for performance requirements; established to measure imperfections, surface flatness, surface thickness, force reductions, vertical deformation, friction, tensile properties, color, and drainage characteristics. A letter of certification shall be provided to the Architect that the finished surfaces are furnished and installed in accordance with the manufacturer's printed specification.

J. Maintenance: The installer shall supply the Owner with written instructions for care of this surface.

PART 2 – PRODUCTS

2.1 SUBMITTALS

A. Product Data: Submit manufacturer's technical data and installation instructions for track surface material.

B. Submit (3) samples of track surfacing material. Minimum size 3"x 4".

2.2 TRACK AND FIELD EVENT SURFACE

A. Synthetic Surface: Provide a black, paved, polyurethane-bound base mat system utilizing SBR rubber with multiple applications of a pigmented (red) structural spray, utilizing EPDM rubber, as Spurtan "BS", in accordance with the manufacturer's latest revised specification, as furnished by Advanced Polymer Technology, Harmony, Pa, (856) 767-3088, or approved equal.

2.2 MATERIALS

A. Primers: Polyurethane based primers specifically formulated to be compatible with the base and track surfacing material.

B. Black SBR Granules: The rubber granules for the base mat shall be recycled SBR (styrene Butadiene Rubber) rubber, processed and chopped to 1-3 mm size containing less than 4% dust.

C. EPDM Granules: The rubber granules for the structural spray wearing coats shall be EPDM peroxide cured, man-made rubber containing a minimum of 20% EPDM and having a specific gravity of 1.5 +/-0.1. The EPDM rubber will be 0.5mm to 1.5mm EPDM granules. EPDM granules shall be the color of the track surface.

D. Polyurethane Binder: Binder for the black rubber mat shall be an MDI-based mono-component, polyurethane binding agent. The binding agent shall not have a free TDI monomer level above 0.2%, must be clear in color, not milky, and must be solvent free. The binding agent must be specially formulated for compatibility with SBR stranded or rubber crumb.

E. Structural Spray Coating: The spray coating shall be the MDI-based mono-component, moisture cured, pigmented polyurethane, specifically formulated for compatibility with EPDM granules. The coating shall be red.

F. Line Marking Paint: The line marking paint shall be polyurethane-based paint specifically manufactured to be compatible with polyurethane synthetic track surfaces.

PART 3 - EXECUTION

3.1 BITUMINOUS SURFACE

A. Curing: Bituminous paving shall be allowed to cure a minimum of fourteen days prior to track surfacing application. It shall be the responsibility of the surfacing contractor to determine if the paving has cured sufficiently to allow application of the track surfacing.

B. Bituminous paving shall be verified for pitch and planarity and in accordance with Section _____; and flooded with water to check for depressions or low spots, prior to installation of final running surface.

3.2 PREPARATION

A. The entire area of the new bituminous paving to receive synthetic surface shall be thoroughly cleaned with mechanical air blowers, removing all loose and foreign material. All areas having dirt in the bituminous pores shall be cleaned by means of a high-pressure washer, flushing the surface with clean water. The area shall then be inspected for pitch and planarity in accordance with the requirements of this and the paving section. Areas not found to be in conformance shall be repaired.

3.3 INSTALLATION OF SURFACE

A. Apply primer and selected surfacing system in strict accordance with manufacturer's printed specification. An additional third spray coat shall be applied to all areas of the field events, as well as the inside two lanes of the track, the start areas for the 200m and 300m intermediate hurdles, and the entire sprint straight (home side). The third spray coat shall be applied at a rate of 1.0 pounds per square yard, in addition to the two coats applied at the standard manufacture's rate of 1.80 pounds per square yard per coat.

B. Priming: The primer shall be spray-applied in accordance with the manufacturer's specifications. Only those areas which can be installed the same day should be primed.

C. Mixture Composition: Job mix formulas shall be as follows:

1. Black Mat
   SBR Rubber 1-3mm
   Binding Agent 20% of total rubber weight
   Application Temperature Min. 45 Degrees F.

2. Structural Spray Top Coats 2 or 3 as indicated
   Structural Spray 60% by weight
   EPDM Rubber 0.5 – 1.5mm 40% by weight
   Application Temperature Min. 45 Degrees F.

D. Black Mat: The black rubber granules and polyurethane binding agent are blended together in a suitable mixer for a period of 2 to 3 minutes. The blended materials are then spread onto the asphalt/concrete base by means of a mechanical tandem leveler at a rate of 16 to 16.5 lbs. per square yard. The tandem leveler shall have a heated oscillating screed bar to obtain both smoothness and compaction. The heated screed bar normally works at a temperature of 158 to 176 degrees F.

The layering procedure shall be bay-to-bay and limiting the length of the passes so as not to have any cold (cured) joints between the bays. At the beginning of each day's work, the traverse joint from the previous day shall be tack coated to ensure a good bond. Small irregularities still in the surface after the tandem leveler has passed may be removed using a light polyethylene or teflon roller.

The surface hardens through the reaction of the binding agent with humidity. The speed of the reaction depends on temperature and relative humidity. Usually the surface may be walked upon the next day.

E. Structural Spray Wearing Coats: After the black mat has properly cured, apply a thixotropic mixture, using red Spurtan polyurethane binder and red EPDM granules, mixed in a metal container using a drill and mixing paddle and spray applied with approved air spray equipment designed for this use.

F. Physical Properties (ASTM)

Thickness:	½" (12-13mm) or as specified
Shore A Hardness (ASTM D-2240):	55 +/- 5
Elongation at break (ASTM D-412):	Approx. 90%
Tensile Strength (ASTM D-412):	0.75 N/mm^2 @ 70F
Compression Set Recovery (ASTM D-412):	90% to 95% @ 70F over a 24-hour period
Abrasion Resistance (ASTM D-501):	0.25 grams loss after 1000 cycles
Chalking (ASTM D-822):	No change after 1000 hours in weather meter.
Coefficient of Friction (ASTM D-1984):	Dry: 0.70 to 0.75 Wet: 0.60 to 0.65
Resilience (ASTM D-2632):	37% to 39%
Tear Resistance (ASTM D-624):	50-65 psi

3.4 OFFICIAL TRACK MARKINGS

A. Contractor shall provide the Owner with a color-coded working drawing showing all necessary track and field event markings. Submit for review and comment prior to any layout or line striping. The track markings shall include all necessary lane lines, start and finish line, relay exchange zones, hurdle markings, lane numbers and all other necessary markings in accordance with NFHS requirements. The paint for all markings shall be an approved polyurethane-based product specifically manufactured to be compatible with the running surface, installed by experienced personnel.

3.5 CERTIFICATIONS

A. Contractor shall provide the Owner with a document identifying and certifying that all calculations and markings are accurate in accordance with Paragraph 1.3.I. This document shall be field-verified and certified by a registered surveyor or professional engineer experienced in this work.

- - E N D - -

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences and gates.
2. Swing Gates
3. Ball Safety Netting System.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for cast-in-place concrete for equipment bases/pads for gate operators and controls and post footings.
2. Division 26 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches, and safety features and for system disconnect switches.

1.3 PERFORMANCE REQUIREMENTS

a. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gates and hardware.

4. Ball Safe Netting System

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

1.5 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site.
1. Review required testing, inspecting, and certifying procedures.
2. Coordination of new fencing installation and removal of existing fencing.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer/Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:

1. Fabric Height: As indicated on Drawings.
2. Steel Wire Fabric: Wire with a diameter of 0.192 inch (6 gauge).

a. Mesh Size: 2 inches.
b. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied after weaving.

c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

3. Selvage: Twisted top and knuckled bottom.

2.2 FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1. Fence Height: As indicated on Drawings.

2. Heavy Industrial Strength: Material Group IA, round steel pipe, Schedule 40.

   a. Line Post: 4.0 inches.
   b. End, Corner and Pull Post: 4.0 inches.

3. Horizontal Framework Members: Top and bottom rails complying with ASTM F 1043, 1 5/8 inch diameter.

4. Brace Rails: Comply with ASTM F 1043, 1 5/8 inch diameter.
5. Metallic Coating for Steel Framing:

   a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M.

2.3 SWING GATES

A. General: Comply with ASTM F 900 for gate posts and single swing gate types.

1. Gate Leaf Width: As indicated.
2. Gate Fabric Height: As indicated.

B. Pipe and Tubing:

1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framing.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hinges: 180-degree inward swing.
2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

3. Padlock and Chain: Owner will provide locks.
4. Lock: Closer: Manufacturer's standard.

2.4 FITTINGS

A. General: Comply with ASTM F 626.

B. Rail and Brace Ends: For each gate, corner, pull, and end post.

C. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting bottom rails in the fence line-to-line posts.

D. Tension and Brace Bands: Pressed steel.

E. Tension Bars: Steel length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

F. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel: 0.106-inch; galvanized coating thickness matching coating thickness of chain-link fence fabric.

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

2.5 GROUT AND ANCHORING CEMENT

A. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide

formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

2.6 BALL SAFETY NETTING SYSTEM

A. Ball safety netting system shall as sown on the project plans and as manufactured by Sportsfield Specialties or approved equal meeting the plan requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect/Engineer/Construction Manager.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

D. Line Posts: Space line posts uniformly at 10 feet o.c.

E. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

F. Bottom Rails: Install and secure to posts with fittings.

G. Chain-Link Fabric: Prior to placing fabric, excavate trench for placement of fence anchoring concrete. Apply fabric to outside of enclosing framework. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released. Pour anchoring concrete as shown on the plans embedding 3-inches of the fabric in the concrete.

H. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

J. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 FIELD QUALITY CONTROL

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware, gate operator, and other moving parts.

3.8 Ball Safety Netting Installation

A. The ball safety netting system shall be installed per manufacturer's recommendations.

END OF SECTION 32 3113

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SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Drains.
6. Encasement for piping.
7. Manholes.
8. Channel drainage systems.
9. Catch basins.
10. Stormwater inlets.
11. Stormwater detention structures.
12. Pipe outlets.
13. Stormwater disposal systems.
14. Stormwater Management Facilities
15. Sectional Track Perimeter Drain
16. Infield Edge Drains
17. Turf Field Underdrains

B. Delaware Department of Transportation (DelDOT) Standard Specifications.

C. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Erosion Control Handbook.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins: Include plans, elevations, sections, details, frames, covers, and grates.
3. Piping: Include manufacturer's certification for each pipe type.
4. Stormwater Management Facility Outlet Structures.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins according to manufacturer's written rigging instructions.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect/Engineer, Construction Manager and Owner no fewer than two days in advance of proposed interruption of service.

PART 2 - PRODUCTS

2.1 PIPING

A. All storm drainage piping shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

2.2 MANHOLES

A. All storm water manholes shall be as shown on the plans and in accordance with the DelDOT Standard Specifications.

2.3 CATCH BASINS

A. All catch basins shall be as shown on the plans and in accordance with the DelDOT Standard specifications.

2.4 STORMWATER MANAGEMENT STRUCTURES

A. All structures shall be as shown on the plans and in accordance with either the DelDOT Standard Specifications or the DNREC Erosion and Sediment Control Handbook.

2.5 SECTIONAL TRACK PERIMETER DRAIN

A. Utilize ACO Sport System #4020 at track perimeter and Sport System #2000 at 'D' Areas, as manufactured by Sports Field Specialties, Delhi, N.Y. 13753, (607) 746-8911; Pro Channel Drain #SE426 at track perimeter and 'XT' slot drain at 'D' Areas as manufactured by Sports Edge, ABT, Inc., Troutman, N.C. (800) 334-6057; or approved equivalent. Drain shall be furnished with eight (8) catch basins with removable trash buckets.

B. Drain shall be connected at the 8 catch basin locations to the field's collector drainage system, as shown on plans and detailed.

C. Provide manufacturer's descriptive information for these products for approval as well installation instructions and procedures.

2.6 "HYDROBLOX" INFIELD EDGE DRAINS

A. Hydroblox is a prefabricated thermoplastic non-clogging drainage plank approximately 2"x 9"x 40" long, installed in a single line a 4-5" wide trench that is cut with hand trenching equipment.

B. Provide the hydroblox where shown and detailed at the circular edge of skinned infields starting at the center of the skinned area, and sloping at no less than 0.50% toward either side of the infield to discharge points a shown on plans. The initial high point of the trench should be cut to a level that the top of the hydroblox plank is positioned at or slightly below the level of the subgrade at the circular edge of the infield.

C. Upon completion of trenching and installation of the Hydroblox, backfill and clean excess soil from trenches, ready for seeding.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure drainage piping according to DelDOT Standard Specifications.

3.4 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated in accordance with the DelDOT Standard Specifications.

3.5 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated in accordance with the DelDOT Standard Specifications.

3.6 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.7 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

3.8 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 33 41 00