Delaware Technical Community College

21179 COLLEGE DR.
GEORGETOWN, DE 19947

Owens Campus
Stephen J. Betze Learning Commons Renovation

BSA+A PROJECT #25.006

PROJECT MANUAL

100% CONSTRUCTION DOCUMENTS

MAY 1, 2026

BSA + A

PROJECT MANUAL

DELAWARE TECHNICAL COMMUNITY COLLEGE

Owens Campus
Stephen J. Betze Learning Commons Renovation

ARCHITECT
Buck Simpers Architect + Associates, Inc.
965 Justison St.
Wilmington, DE 19801
302.658.9300
fax 302.658.1125

STRUCTURAL ENGINEER
Pilottown Engineering, Inc
17587 Nassau Commons BLVD, Unit 3
Lewes , DE 19958
302.703.1770

CIVIL ENGINEER
McKim & Creed, Inc.
200 Continental Dr. Ste 400
Newark, DE 19713
302.323.9377
fax 302.323.9461

MEP ENGINEER
Gipe Associates, Inc.
8719 Brooks Dr.
Easton, MD 21601
410.822.8688

ACOUSTICS ENGINEER
Metropolitan Acoustics LLC.
1628 JFK BLVD, 8 Penn Center STE 1902
Philadelphia , PA 19103
215-248-4352

100% CONSTRUCTION DOCUMENTS **May 1, 2026**

Title Page/Consultants Directory

By

Project Contacts

Owner's Representative
Delaware Technical Community College
100 Campus Drive
Dover, Delaware 19904

Architects
BSA+A
954 Justison Street
Wilmington, Delaware 19801
302-658-9300

Construction Manager
Richard Y. Johnson & Son
18404 Johnson Road
PO Box 105
Lincoln, Delaware 19960
302-422-3732/302-422-4696 fax

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Public notice is hereby given that sealed bids for Project No. 23.003, DTCC C9004020002 will be received by the State of Delaware, Delaware Technical Community College at **DTCC Owens Campus located at 21179 College Drive Georgetown, DE 19947 in the Theatre, in the Arts and Sciences Building until 2:00PM local time on July 28, 2026**, at which time they will be publicly opened and read aloud. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

Project involves the interior renovations located at the DTCC Owens Campus with associated site improvements. This is a construction management project. Bids are to be for the following contracts:

A-1	Demolition		
A-2:	Site Work	A-10:	Drywall/Metal Stud
A-3:	Concrete Work	A-11:	Acoustical Work
A-4:	Masonry Work	A-12:	Floor Covering Work
A-5:	Steel Work	A-13:	Caulking/Painting
A-6:	Carpentry & General Work	A-14:	Casework
A-7:	Roofing Work	A-15:	Mechanical
A-8:	Furnish Hollow Metal/Doors/Hardware	A-16:	Sprinkler System
A-9:	Aluminum Storefront/Windows/ Glass & Glazing	A-17:	Electrical

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

A **MANDATORY** Pre-Bid Meeting will be held on June 30, 2026, at 10:00am at **DTCC Owens Campus located at 21179 College Drive Georgetown DE 19947 in the Theatre, in the Arts and Sciences Building** for the purpose of establishing the listing of subcontractors and to answer questions. Following the meeting, the Betze Library will be available for contractors to view the building jobsite. All representatives must be employed by the company you are representing. Representatives of each party to any Joint Venture must attend this meeting. **ATTENDANCE OF THIS MEETING IS A PREREQUISITE FOR BIDDING ON THIS CONTRACT.**

Sealed bids shall be addressed to DTCC Owens Campus, Attn: Mark Devore P.E. – Collegewide Director of Facilities The outer envelope should clearly indicate: **BETZE LEARNING COMMONS Project No. 23.003, DTCC C9004020002, Company Name, Contract you are bidding, SEALED BID - DO NOT OPEN."**

Construction documents will be available for review at the following locations: Richard Y Johnson & Son Inc., and Delaware Contractors Association. Contract documents may be purchased at DiCarlo Printers, located at 2006 Northwood Drive, Salisbury MD, 21801 or RCI Printing and Graphics located at 298 Churchmans Road, New Castle DE, 19720. Electronic documents will be available on Richard Y. Johnson & Son, Inc's website www.ryjson.com under plan room. It is the responsibility of each bidder to review and coordinate all project documents. This includes plans, specifications and addendums. Electronic documents will be available at no cost on the day of the pre-bid via www.ryjson.com on planroom.

Questions should be directed to the Construction Manager, Richard Y. Johnson & Son, Inc. in writing only. The fax number is (302) 422-4696. Email questions too Attn: Jesse Dixon (jdixon@ryjson.com).

A bid security in the amount of 10% of the bid must accompany each bid. Bid Security shall specify the Owner as the obligee. Owner: DTCC Owens Campus 21179 College Drive Delaware 19947.

Minority Business Enterprises (MBE), Disadvantaged Business Enterprises (DBE) and Women-Owned Business Enterprises (WBE) will be afforded full opportunity to submit bids on this contract and will not be subject to discrimination on the basis of race, color, national origin or sex in consideration of this award. Each bid must be accompanied by a bid security equivalent to ten percent of the bid amount and all additive alternates. The successful bidder must post a performance bond and payment bond in a sum equal to 100 percent of the contract price upon execution of the contract. The Owner reserves the right to reject any or all

bids and to waive any informalities therein. The Owner may extend the time and place for the opening of the bids from that described in the advertisement, with not less than two calendar days notice by certified delivery, facsimile machine or other electronic means to those bidders receiving plans.

INSTRUCTIONS TO BIDDERS

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8. FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

ARTICLE 1: GENERAL

1.1 DEFINITIONS

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

1.2 STATE: The State of Delaware.

1.3 AGENCY: Delaware Technical and Community College ("Delaware Technical Community College" or "DTCC")

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, as modified by the State of Delaware's Supplement to Agreement Between Owner and Contractor A132-2019, and the Agency's Amendment to Contract for Construction Between Delaware Technical Community College and Contractor. In the case of conflict between the instructions contained in the AIA Document A132 Contract form and the General Requirements herein, these General Requirements shall prevail.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 2: BIDDER'S REPRESENTATIONS

2.1 PRE-BID MEETING

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

2.2 By submitting a Bid, the Bidder represents that:

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

2.2.2 The Bidder has visited the site, become familiar with existing conditions under which the Work is to be performed, and has correlated the Bidder's his personal observations with the requirements of the proposed Contract Documents.

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

2.3 JOINT VENTURE REQUIREMENTS

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

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

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

2.3.4 All required insurance certificates shall name both Joint Venturers.

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

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

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

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

2.4 ASSIGNMENT OF ANTITRUST CLAIMS

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

ARTICLE 3: BIDDING DOCUMENTS

3.1 COPIES OF BID DOCUMENTS

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

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

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

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

3.2 INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS

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

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

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

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

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

3.3 SUBSTITUTIONS

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

3.3.2 Requests for substitutions shall be made in writing to the Architect at least ten days prior to the date of the Bid Opening. Such requests shall include a complete description of the

proposed substitution, drawings, performance and test data, explanation of required installation modifications due the substitution, and any other information necessary for an evaluation. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval shall be final. The Architect is to notify Owner prior to any approvals.

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

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

3.4 ADDENDA

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

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

3.4.3 No Addenda will be issued later than 4 days prior to the date for receipt of Bids except an Addendum withdrawing the request for Bids or one which extends the time or changes the location for the opening of bids.

3.4.4 Each bidder shall ascertain prior to submitting his Bid that they have received all Addenda issued, and shall acknowledge their receipt in their Bid in the appropriate space. Not acknowledging an issued Addenda could be grounds for determining a bid to be non-responsive.

ARTICLE 4: BIDDING PROCEDURES

4.1 PREPARATION OF BIDS

4.1.1 Submit the bids on the Bid Forms included with the Bidding Documents.

4.1.2 Submit the original Bid Form for each bid. Bid Forms may be removed from the project manual for this purpose.

4.1.3 Execute all blanks on the Bid Form in a non-erasable medium (typewriter or manually in ink).

4.1.4 Where so indicated by the makeup on the Bid Form, express sums in both words and figures, in case of discrepancy between the two, the written amount shall govern.

4.1.5 Interlineations, alterations or erasures must be initialed by the signer of the Bid.

4.1.6 BID ALL REQUESTED ALTERNATES AND UNIT PRICES, IF ANY. If there is no change in the Base Bid for an Alternate, enter "No Change". The Contractor is responsible for verifying that they have received all addenda issued during the bidding period. Work required by Addenda shall automatically become part of the Contract.

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

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

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

4.1.10 In the construction of all Public Works projects for the State of Delaware or any agency thereof, preference in employment of laborers, workers or mechanics shall be given to bona fide legal citizens of the State who have established citizenship by residence of at least 90 days in the State.

4.1.11 Each bidder shall include in their bid a copy of a valid Delaware Business License.

4.1.12 Each bidder shall include signed Affidavit(s) for the bidder and each listed Subcontractor certifying compliance with OMB Regulation 4104 “Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on “ Large Public Works Projects” “large Public Works” is based upon the current threshold required for bidding Public Works as set by the Purchasing and Contracting Advisory Council.

4.2 BID SECURITY

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

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

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

4.3 SUBCONTRACTOR LIST

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

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

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

4.4 EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS

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

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

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

4.5 PREVAILING WAGE REQUIREMENT

4.5.1 Wage Provisions: In accordance with Delaware Code, Title 29, Section 6960, renovation projects whose total cost shall exceed $45,000, and $500,000 for new construction, the minimum wage rates for various classes of laborers and mechanics shall be as determined by the Department of Labor, Division of Industrial Affairs of the State of Delaware.

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

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

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

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

4.6 SUBMISSION OF BIDS

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

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

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

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

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

4.7 MODIFICATION OR WITHDRAW OF BIDS

4.7.1 Prior to the closing date for receipt of Bids, a Bidder may withdraw a Bid by personal request and by showing proper identification to the Architect. A request for withdraw by letter or fax, if the Architect is notified in writing prior to receipt of fax, is acceptable. A fax directing a modification in the bid price will render the Bid informal, causing it to be ineligible for consideration of award. Telephone directives for modification of the bid price shall not be permitted and will have no bearing on the submitted proposal in any manner.

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

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

ARTICLE 5: CONSIDERATION OF BIDS

5.1 OPENING/REJECTION OF BIDS

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

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

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

5.2 COMPARISON OF BIDS

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

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

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

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

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

5.3 DISQUALIFICATION OF BIDDERS

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

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

B. The Bidder's record of performance on past public or private construction projects, including, but not limited to, defaults and/or final adjudication or admission of violations of the Prevailing Wage Laws in Delaware or any other state;

C. The Bidder's written safety plan;

D. Whether the Bidder is qualified legally to contract with the State;

E. Whether the Bidder supplied all necessary information concerning its responsibility; and,

F. Any other specific criteria for a particular procurement, which an agency may establish; provided however, that, the criteria be set forth in the Invitation to Bid and is otherwise in conformity with State and/or Federal law.

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

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

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

5.3.3.2 Evidence of collusion among Bidders.

5.3.3.3 Unsatisfactory performance record as evidenced by past experience.

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

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

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

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

5.4 ACCEPTANCE OF BID AND AWARD OF CONTRACT

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

5.4.2 Per Section 6962(d)(13) a., Title 29, Delaware Code, “The contracting agency shall award any public works contract within thirty (30) days of the bid opening to the lowest responsive and responsible Bidder, unless the Agency elects to award on the basis of best value, in which case the election to award on the basis of best value shall be stated in the Invitation To Bid.”

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

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

5.4.5 The successful Bidder shall execute a formal contract, submit the required Insurance Certificate, and furnish good and sufficient bonds, unless specifically waived in the General Requirements, in accordance with the General Requirement, within twenty (20) days of official notice of contract award. Bonds shall be for the benefit of the Agency with surety in the amount of 100% of the total contract award. Said Bonds shall be conditioned upon the faithful performance of the contract. Bonds shall remain in affect for period of one year after the date of substantial completion.

5.4.6 If the successful Bidder fails to execute the required Contract and Bond, as aforesaid, within twenty (20) calendar days after the date of official Notice of the Award of the Contract, their Bid guaranty shall immediately be taken and become the property of the State for the benefit

of the Agency as liquidated damages, and not as a forfeiture or as a penalty. Award will then be made to the next lowest qualified Bidder of the Work or readvertised, as the Agency may decide.

5.4.7 Each bidder shall supply with its bid its taxpayer identification number (i.e., federal employer identification number or social security number) and a copy of its Delaware business license, 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 award of a Contract is under consideration shall, if requested by the Agency, submit a properly executed AIA Document A305, Contractor's Qualification Statement, unless such a statement has been previously required and submitted.

6.2 BUSINESS DESIGNATION FORM

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

ARTICLE 7: PERFORMANCE BOND AND PAYMENT BOND

7.1 BOND REQUIREMENTS

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

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

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

7.2 TIME OF DELIVERY AND FORM OF BONDS

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

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

ARTICLE 8: FORM OF AGREEMENT BETWEEN AGENCY AND CONTRACTOR

8.1 Unless otherwise required in the Bidding Documents, the Agreement for the Work will be written on AIA Document A101, Standard Form of Agreement Between Owner and Contractor Where the Basis of Payment is a Stipulated Sum, as modified by the State of Delaware's Supplement to Agreement Between Owner and Contractor A132-2019, and the Agency's Amendment to Contract for Construction Between Delaware Technical Community College and Contractor.

END OF INSTRUCTIONS TO BIDDER

Betze Learning Commons
Delaware Technical and Community College
DTCC No. C9004020002
21179 College Drive Georgetown Delaware 19947
Project No. 25.006

BID FORM

For Bids Due: July 28, 2026 **To:** Delaware Technical Community College
Attn: Mark Devore P.E.
Collegewide Director of Facilities

Contracts

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

For Bid Package A:

___ **Contract #1** **Demolition**
___ **Contract #2** **Site Work**
___ **Contract #3** **Concrete Work**
___ **Contract #4** **Masonry Work**
___ **Contract #5** **Steel Work**
___ **Contract #6** **Carpentry & General Work**
___ **Contract #7** **Roofing Work**
___ **Contract #8** **Furnish Hollow Metal/Doors/Hardware**
___ **Contract #9** **Aluminum Storefront/Windows/Glass & Glazing**
___ **Contract #10** **Drywall/Metal Studs**
___ **Contract #11** **Acoustical Work**
___ **Contract #12** **Floor Covering Work**
___ **Contract #13** **Caulking/Painting**
___ **Contract #14** **Casework**
___ **Contract #15** **Mechanical**
___ **Contract #16** **Sprinkler System**
___ **Contract #17** **Electrical**

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:

$_____
($)

Betze Learning Commons
Delaware Technical and Community College
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21179 College Drive Georgetown Delaware 19947
Project No. 25.006

BID FORM

ALTERNATES

Alternate prices conform to applicable project specification section. Refer to specifications for a complete description of the following Alternates. An "ADD" or "DEDUCT" amount is indicated by the crossed out part that does not apply. Contract numbers are a recommendation; it is the contractor's responsibility to determine if an alternate cost affects their pricing

Alternate No. One – Outdoor Gathering Space (Patio) (Contracts A-2, A-3, A-4 & A-5)

1. Base Bid: Sod turf replacement at disturbed area with 1'-0" mow strip at building edge.
2. Alternate: New Specialty stamped concrete with brick knee wall & mounted ornamental site fencing. New sidewalk connector to existing sidewalk.

Add/Delete: _____
($)

Alternate No. Two – Interior Library/Learning Commons, Lounge and Circulation Corridor Floor Finishes – 50% Carpet / 50% Terrazzo at first floor & Second Floor. (Contract A-12)

1. Base Bid: As noted on floor plans (Terrazo)
2. Alternate: As noted on floor plans. (LVT)

Add/Delete: _____
($)

Alternate No. Three – Terrazzo Flooring in Main Connector Corridor. (Contract A-12)

1. Base Bid: As noted on plans – Provide Terrazzo in C100 where noted on plans.
2. Alternate: Provide LVT in C100 where noted on plans.

Add/Delete: _____
($)

Alternate No. Four – ATC System by Siemens. (Contract A-15)

1. Base Bid: Provide ATC Controls by any listed ATC vendor.
2. Alternate: Provide additional costs, if any, for ATC system by Siemens as specified in specification section 230900 "Instrumentation and Controls of HVAC and Plumbing Systems." If Siemens is the low cost ATC subcontractor, then the alternate value on the big form shall be listed as $0.

Add/Delete: _____
($)

Alternate No. Five – Glass Backed Markerboards (Contract A-6)

1. Base Bid: No markerboards to be provided.
2. Alternate: Provide Glass Backed Markerboards (4'-0" W x 2'-0") at locations noted on floor plans

Add/Delete: _____
($)

BID FORM

ALTERNATES (CON'T)

Alternate No. Six – Hybrid Thermoplastic Membrane Roofing (Contract A-7)

1. Base Bid: Provide EPDM membrane roofing as noted on plans.
2. Alternate: Provide Hybrid Thermoplastic membrane Roofing per 075200, in lieu of EPDM membrane roofing.

Add/Delete: _____

($)

ALLOWANCES

Contract No. 1 Demolition
1 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 2 Sitework
2 - Include the lump sum of the following amount **$10,000** in the contract for exterior temporary fence. See Section 012100 Allowances.

Contract No. 5 Steel Work
3 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 6 Carpentry & General Works
4 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 6 Carpentry & General Works
5 - Include the lump sum of the following amount **$20,000** in the contract for temporary closures during construction for the exterior wall construction. See Section 012100 Allowances.

Contract No. 7 Roofing Work
6 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 9 Aluminum Storefront/Windows/Glass & Glazing
7 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 10 Drywall/Metal Studs
8 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 12 Floor Covering Work
9 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 15 Mechanical
10 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

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BID FORM

Contract No. 15 Mechanical
11 – Include the lump sum of the following amount **$50,000** in the contract for the temp heat fuel cost. Cost of work to be determined by fuel company receipts with the amount of fuel and cost per gallon. All equipment and labor for temp heat is part of the contract. This allowance is for fuel cost only. See Section 012100 Allowances.

Contract No. 16 Sprinkler System
12 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 17 Electrical
13 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 17 Electrical
14 – Include the lump sum of the following amount **$25,000** in the contract for short circuit analysis gear revisions. See Section 012100 Allowances.

Contract No. 17 Electrical
15 – Include the lump sum of the following amount **$25,000** in the contract for selective demolition of the existing building See Section 012100 Allowances.

UNIT PRICES

NOT USED

Betze Learning Commons
Delaware Technical and Community College
DTCC No. C9004020002
21179 College Drive Georgetown Delaware 19947
Project No. 25.006

BID FORM

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

This bid shall remain valid and cannot be withdrawn for thirty (30) days from the date of opening of bids (60 days for School Districts and Department of Education), 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.			
A.			
B.			
C.			
2.			
A.			
B.			
C.			

BID FORM

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

Betze Learning Commons
Delaware Technical and Community College
DTCC No. C9004020002
21179 College Drive Georgetown Delaware 19947
Project No. 25.006

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 Delaware Technical and Community College.

All the terms and conditions of Project No. 19.021, Contract #: DTCC22C900406SSC-A 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.

Betze Learning Commons
Delaware Technical and Community College
DTCC No. C9004020002
21179 College Drive Georgetown Delaware 19947
Project No. 25.006

BID FORM

AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM

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

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

Betze Learning Commons
Delaware Technical and Community College
DTCC No. C9004020002
21179 College Drive Georgetown Delaware 19947
Project No. 25.006

BID FORM

AFFIDAVIT
OF
CONTRACTOR QUALIFICATIONS

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

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

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.

Betze Learning Commons
Delaware Technical and Community College
DTCC No. C9004020002
21179 College Drive Georgetown Delaware 19947
Project No. 25.006

AFFIDAVIT OF
CRAFT TRAINING COMPLIANCE

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

In accordance with Title 29, Chapter 69, Section 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.

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

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

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 TO BE CONSIDERED.

BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That: _____ _____ of _____ in the County of _____ _____ and State of _____ as **Principal**, and _____ _____ of _____ in the County of _____ and State of _____ as **Surety**, legally authorized to do business in the State of Delaware ("**State**"), are held and firmly unto the **State** in the sum of _____ _____ Dollars ($_____), or _____ percent not to exceed _____ _____ Dollars ($_____) of amount of bid on Contract No. _____, to be paid to the **State** for the use and benefit of _____ (***insert State agency name***) for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole firmly by these presents.

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

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

SEALED, AND DELIVERED IN THE
Presence of

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of Surety

Witness:_____ By: _____

_____

AIA® Document A132™ – 2019

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

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

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

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

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

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

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

The Owner and Contractor agree as follows.

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

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

This document is intended to be used in conjunction with AIA Documents A232™–2019, General Conditions of the Contract for Construction, Construction Manager as Adviser Edition; B132™–2019, Standard Form of Agreement Between Owner and Architect, Construction Manager as Adviser Edition; and C132™–2019, Standard Form of Agreement Between Owner and Construction Manager as Adviser. AIA Document A232™–2019 is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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ARTICLE 1 THE CONTRACT DOCUMENTS

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

ARTICLE 2 THE WORK OF THIS CONTRACT

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

ARTICLE 3 DATE OF COMMENCEMENT AND DATES OF SUBSTANTIAL COMPLETION

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

[ ] The date of this Agreement.

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

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

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

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

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§ 3.3 Substantial Completion of the Project or Portions Thereof

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

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

Portion of Work	Substantial Completion Date

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

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

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

[ ] By the following date:

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

Portion of Work	Date to be substantially complete

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

ARTICLE 4 CONTRACT SUM

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

[ ] Stipulated Sum, in accordance with Section 4.2 below

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

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

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

§ 4.2 Stipulated Sum

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

§ 4.2.2 Alternates

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

Item	Price

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

Item	Price	Conditions for Acceptance

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

Item	Price

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

Item	Units and Limitations	Price per Unit ($0.00)

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

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

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

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

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

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

Item	Units and Limitations	Price per Unit ($0.00)

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

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

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

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

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

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

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

Item	Units and Limitations	Price per Unit ($0.00)

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

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

Item	Price

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

Item	Price	Conditions for Acceptance

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

Item	Price

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

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

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

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

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

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

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

.5 Retainage withheld pursuant to Section 5.1.7.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

.6 Retainage withheld pursuant to Section 5.1.7.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

.6 Retainage withheld pursuant to Section 5.1.7.

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

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

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

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

§ 5.1.7 Retainage

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

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

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

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

§ 5.2 Final Payment

§ 5.2.1 Final Payment Where the Contract Sum is Based on a Stipulated Sum

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

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A232–2019, and to satisfy other requirements, if any, which extend beyond final payment; and

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

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

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

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

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A232–2019, and to satisfy other requirements, if any, which extend beyond final payment;

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

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

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

§ 5.3 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

%

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

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

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§ 6.2 Binding Dispute Resolution

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

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

[ ] Litigation in a court of competent jurisdiction.

[ ] Other: *(Specify)*

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

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 Where the Contract Sum is a Stipulated Sum

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

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

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

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

§ 7.2.1 Termination

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

§ 7.2.1.2 Termination by the Owner for Cause

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

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

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

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

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

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

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

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

§ 7.2.1.3 Termination by the Owner for Convenience

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

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

§ 7.3 Suspension

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

ARTICLE 8 MISCELLANEOUS PROVISIONS

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

§ 8.2 The Owner's representative:

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

§ 8.3 The Contractor's representative:

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

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

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§ 8.5 Insurance and Bonds

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

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

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A232–2019, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:
(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

§ 8.7 Relationship of the Parties

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

§ 8.8 Other provisions:

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

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

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

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

.4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

.5 Drawings

Number	Title	Date

.6 Specifications

Section	Title	Date	Pages

.7 Addenda, if any:

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Number	Date	Pages

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

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

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

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

[ ] The Sustainability Plan:

Title	Date	Pages

[ ] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

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

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

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

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Additions and Deletions Report for

AIA® Document A132™ – 2019

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Certification of Document's Authenticity

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

_____

(Signed)

_____

(Title)

_____

(Dated)

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Amendment to Contract for Construction
Between
Delaware Technical and Community College
And

_____

The parties hereby agree and reaffirm that the AIA Document A132 – 2019 "Standard Form of Agreement between Owner and Contractor" between Delaware Technical and Community College ("Owner") and_____, a _____ corporation ("Contractor"), dated _____ ___, 202_, shall govern this transaction as supplemented by A232-2019 General Conditions of the Contract for Construction, Supplementary General Conditions, and as amended herein ("Contract Documents"). At times Owner and Contractor shall be collectively referred to the "Parties".

The parties expressly agree to enter into this amendment ("Amendment") which shall govern in the event of a conflict between the terms of the Contract Documents or any document referenced or incorporated therein, and that any contrary provision of any such document shall be superseded hereby. The parties agree to this Amendment as follows:

1. Contractor represents and warrants that it has not employed or retained any company or person, other than a bona fide employee working primarily for the firm offering professional services, to solicit or secure this agreement, and that he has not been paid or agreed to pay any person, company, corporation, individual, or firm, other than a bona fide employee working primarily for the firm offering professional services, any fee, commission, percentage, gift, or any other consideration, contingent upon or resulting from the award or making of this agreement;

2. All provisions of the Bid Package and Project manual are incorporated herein by reference as though fully set forth. In the event of a conflict between any provision of the Bid Package or Project Manual and the bid or proposal submitted by Contractor, the Bid Package and Project Manual shall control.

3. §3.3 is amended to require substantial completion of all construction not later than _____ days from the commencement of construction. Time is of the essence. If the Contractor fails to complete the work within the time specified, the Contractor shall pay liquidated damages to the Owner in the amount of $ _____ for each calendar day of delay until the work is completed or accepted. If the Owner terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to all sums and remedies available to Owner upon termination for cause.

4. In the event the attached contract or aggregate of contracts is in excess of $500,000 for new construction (including painting and decorating) or $45,000 for alteration, repair,

renovation, rehabilitation, demolition or reconstruction (including painting and decorating of buildings or works) and requires or involves the employment of mechanics and/or laborers, then the minimum wages to be paid to the various classes of laborers and mechanics shall be based upon greater of the Davis-Bacon Wage Rates (if the project is federally funded) or the wages that will be determined by the Delaware Department of Labor, Division of Industrial Affairs, to be prevailing in the county in which the work is to be performed.

5. Contractor shall pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than the prevailing wages, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics, and shall provide sworn payroll information, as required by the Department of Labor, on a weekly basis.

6. All changes to the scope of construction shall be authorized in writing by Owner in advance. Owner shall not be liable for payment of any change order that has not received prior written authorization. The cost of any change order shall be set forth therein. If no such provision is set forth in the change order, then the cost to the Owner shall be the Contractor's costs for wages, labor costs other than wages, wage taxes, materiel, equipment rentals, insurance and subcontracts attributable to the additional activity plus a reasonable sum for overhead and profit not to exceed 5%;

7. 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. Contractor shall pay a penalty to the Secretary of Finance equal to the amount of compensation paid to any person in violation of this section;

8. Contractor 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 Owner. Contractor shall pay a penalty equal to 150% of the amount of the proposal or subcontract submitted by the subcontractor identified in the accompanying statement for violating this paragraph.

9. Payments are due 30 days after receipt of a valid Application for Payment. Payments due and unpaid after 30 days shall bear simple interest at the rate of 1 percent per month not greater than 12% annual percentage rate;

10. Final payment shall not be due until all non-conforming work has been corrected and all other provisions of the agreement have been met, including, but not limited to, all reporting requirements. Furthermore, a written release of mechanics' liens signed by all persons who would otherwise be entitled to avail themselves of the provisions of Chapter 27 of Tile 25 of the Delaware Code, containing a notarized, verified certification signed by the Contractor that all of the persons signing the release constitute all of the persons who have furnished materials and performed labor in and for the construction, erection,

building, improvement, alteration and repair to the date of the release and who would be entitled otherwise to file mechanics' liens claims shall be provided simultaneously with the receipt of final payment;

11. Owner may terminate this agreement or suspend work hereunder for any reason authorized by applicable Delaware law;

12. §6.2 is hereby deleted. The parties reserve all remedies available at law or equity for any dispute not resolved in accordance with §6.1;

13. §7.1.1 is hereby deleted and there shall be no Termination Fee or paid to Contractor. Any reference to a Termination Fee in §14.4.3 of the A232-2019 is also deleted.

14. Article 10 Insurance and Bonds is hereby deleted. Simultaneous with the execution of the this contract, Contractor shall also execute a good and sufficient bond for the benefit of Owner, with corporate surety authorized to do business in this State, in a sum equal to 100% of the contract price and the bond form used shall be the standard form issued 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 and plans and specifications thereof, at the time and in the manner prescribed by the contract and the plans and specifications, including the payment in full, to every firm furnishing materiel or performing labor in the performance of the contract, of all sums of money due it for such labor or materiel. The bond shall also contain the Contractor's guarantee to indemnify and save harmless the Owner from all costs, damages and expenses growing out of or by reason of Contractor's failure to comply and perform the work and complete the contract in accordance with its terms. No firm or surety, in any action brought under 29 Del C §6962, or any successor law, or on the bond required by such statute, shall assert as a defense to such action the claim that the bond given contained a limitation or restriction not provided for by Chapter 69, Title 29 of the Delaware Code, the provisions of which are incorporated herein by reference as though fully set forth. Contractor shall obtain all insurance required by Owner and provide proof thereof prior to execution.;

15. Owner shall have the right to terminate the contract upon receipt of notice from Contractor's surety that bond claims have been made or are anticipated to be made against Contractor on this or any other project of Contractor. If Owner elects to terminate the contract pursuant to this paragraph, it shall be deemed a termination for cause.

16. Owner may, when it considers that its interests so require, cause judgment to be confessed upon the bond. All sums received through confession of judgment shall be paid for the credit of the Owner to the Secretary of Finance;

17. Owner or any of its duly authorized representatives shall have access to any documents, books, papers, and records of Contractor (which are directly pertinent to a specific grant program) for the purpose of making an audit, examination, excerpts, and transcriptions.

Contractor shall maintain all required records for at least three years after Owner makes final payment and all pending matters are closed;

18. Contractor shall submit a report to Owner not less frequently than monthly covering the general progress of the job and describing any problems or factors contributing to delay;

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

The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, sexual orientation, gender identity, pregnancy, or national origin. The Contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex, sexual orientation, gender identity, pregnancy, 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.

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

All Owner facilities and campus locations, both indoor and outdoor, are tobacco free. Contractor agrees that it will not permit smoking nor the use of any tobacco product by Contractor, its employees, agents, and/or guests or invitees on any Owner facility or campus location utilized in connection with this contract.

20. The parties agree that this agreement shall be governed by and construed pursuant to the laws of The State of Delaware, and that the Delaware courts shall have sole and exclusive jurisdiction of any dispute arising under this agreement.

[Signatures Begin on Following Page]

IN WITNESS WHEREOF, the parties, through their acknowledged and duly authorized agents set forth below, have set their hand and seal on this indenture on this _____ day of _____, 202__.

Delaware Technical and Community College

_____(Seal)
Mark T. Brainard, President

(Contractor)

_____(Seal)
By:

PERFORMANCE BOND

Bond Number: _____

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

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

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

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

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

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

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

PAYMENT BOND

Bond Number: _____

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

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

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

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

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

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

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

PRINCIPAL

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

SURETY

Name: _____

Witness or Attest: Address: _____

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

(Corporate Seal)

AIA® Document G732™ – 2019

Application and Certificate for Payment, Construction Manager as Adviser Edition

TO OWNER:

PROJECT: DT & CC

APPLICATION NO: 001

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

PERIOD TO:
CONTRACT DATE:
PROJECT NOS: / /

FROM CONTRACTOR:

VIA CONSTRUCTION MANAGER:

CONTRACT FOR: General Construction

VIA ARCHITECT:

CONTRACTOR'S APPLICATION FOR PAYMENT

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

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

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

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

CONTRACTOR:

By: _____ Date: _____

State of:
County of:
Subscribed and sworn to before me this day of
Notary Public:
My Commission expires:

CERTIFICATE FOR PAYMENT

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

AMOUNT CERTIFIED $0.00

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

CONSTRUCTION MANAGER:

By: _____ Date: _____

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

By: _____ Date: _____

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

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AIA® Document G703®CW – 2021

Continuation Sheet for Cost of the Work Projects

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

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

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

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SECTION 006300 - CLARIFICATION AND MODIFICATION FORMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Standard Forms.

1.2 RELATED SECTIONS

A. General and Supplementary Conditions.

1.3 STANDARD FORMS

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

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

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

D. FORMS

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

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 006300

AIA® Document A232™ – 2019

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

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

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

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

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

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

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

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

TABLE OF ARTICLES

1 GENERAL PROVISIONS

2 OWNER

3 CONTRACTOR

4 ARCHITECT AND CONSTRUCTION MANAGER

5 SUBCONTRACTORS

6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

7 CHANGES IN THE WORK

8 TIME

9 PAYMENTS AND COMPLETION

10 PROTECTION OF PERSONS AND PROPERTY

11 INSURANCE AND BONDS

12 UNCOVERING AND CORRECTION OF WORK

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13 MISCELLANEOUS PROVISIONS

14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

Init.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

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

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

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

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

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

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

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

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

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

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

Init.
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§ 1.2 Correlation and Intent of the Contract Documents

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

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

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

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

§ 1.3 Capitalization

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

§ 1.4 Interpretation

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

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

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

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

§ 1.6 Notice

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

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

§ 1.7 Digital Data Use and Transmission

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

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

§ 1.8 Building Information Models Use and Reliance

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

ARTICLE 2 OWNER

§ 2.1 General

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

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

§ 2.2 Evidence of the Owner's Financial Arrangements

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

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

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

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

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§ 2.3 Information and Services Required of the Owner

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

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

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

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

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

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

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

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

§ 2.4 Owner's Right to Stop the Work

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

§ 2.5 Owner's Right to Carry Out the Work

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

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ARTICLE 3 CONTRACTOR

§ 3.1 General

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

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

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

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

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

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

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

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

§ 3.3 Supervision and Construction Procedures

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

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

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

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

§ 3.4 Labor and Materials

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

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

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

§ 3.5 Warranty

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

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

§ 3.6 Taxes

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

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

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

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

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

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

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

§ 3.8 Allowances

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

§ 3.8.2 Unless otherwise provided in the Contract Documents:

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

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

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

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

§ 3.9 Superintendent

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

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

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

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

§ 3.10 Contractor's Construction and Submittal Schedules

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

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

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

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

§ 3.11 Documents and Samples at the Site

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

§ 3.12 Shop Drawings, Product Data, and Samples

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 3.13 Use of Site

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

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

§ 3.14 Cutting and Patching

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

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

§ 3.15 Cleaning Up

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

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

§ 3.16 Access to Work

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

§ 3.17 Royalties, Patents and Copyrights

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

§ 3.18 Indemnification

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

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

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

ARTICLE 4 ARCHITECT AND CONSTRUCTION MANAGER

§ 4.1 General

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

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

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

§ 4.2 Administration of the Contract

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

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

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

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

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

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

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

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

§ 5.3 Subcontractual Relations

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

§ 5.4 Contingent Assignment of Subcontracts

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

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

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

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

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

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

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

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

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

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

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

§ 6.2 Mutual Responsibility

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

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

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

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

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

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§ 6.3 Owner's Right to Clean Up

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

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

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

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

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

§ 7.2 Change Orders

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

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

§ 7.3 Construction Change Directives

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

§ 7.4 Minor Changes in the Work

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

ARTICLE 8 TIME

§ 8.1 Definitions

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

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

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

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

§ 8.2 Progress and Completion

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

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

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

§ 8.3 Delays and Extensions of Time

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

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

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

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

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

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

§ 9.2 Schedule of Values

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

§ 9.3 Applications for Payment

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

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

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

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

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

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

§ 9.4 Certificates for Payment

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

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

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

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

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

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

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

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

§ 9.5 Decisions to Withhold Certification

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

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

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

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

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

§ 9.6 Progress Payments

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

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

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

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

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

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

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

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

§ 9.7 Failure of Payment

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

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

§ 9.8 Substantial Completion

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

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

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

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

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

§ 9.9 Partial Occupancy or Use

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

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

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

§ 9.10 Final Completion and Final Payment

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

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

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

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

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

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

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ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

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

§ 10.2 Safety of Persons and Property

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

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

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

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

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

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

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

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

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

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

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

§ 10.2.8 Injury or Damage to Person or Property

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

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§ 10.3 Hazardous Materials

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

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

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

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

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

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

§ 10.4 Emergencies

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

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

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

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

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

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

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

§ 11.2 Owner's Insurance

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

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

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

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§ 11.3 Waivers of Subrogation

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

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

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

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

§ 11.5 Adjustment and Settlement of Insured Loss

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

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

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

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

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

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

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

§ 12.2.2 After Substantial Completion

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

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

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

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

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

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

§ 12.3 Acceptance of Nonconforming Work

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

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ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

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

§ 13.2 Successors and Assigns

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

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

§ 13.3 Rights and Remedies

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

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

§ 13.4 Tests and Inspections

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

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

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

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

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

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

§ 13.5 Interest

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

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

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

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

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

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

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

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

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

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

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

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

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

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

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

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

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

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

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

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

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

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

§ 14.3 Suspension by the Owner for Convenience

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

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

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

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

§ 14.4 Termination by the Owner for Convenience

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

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

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

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

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

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

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

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

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§ 15.1.2 Time Limits on Claims

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

§ 15.1.3 Notice of Claims

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

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

§ 15.1.4 Continuing Contract Performance

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

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

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

§ 15.1.6 Claims for Additional Time

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

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

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

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

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

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

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§ 15.2 Initial Decision

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

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

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

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

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

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

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

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

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

§ 15.3 Mediation

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

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

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

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

§ 15.4 Arbitration

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

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

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

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

§ 15.4.4 Consolidation or Joinder

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

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

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

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(Signed)

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(Title)

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(Dated)

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SECTION 007313 - SUPPLEMENTARY GENERAL CONDITIONS A232-2009

The following supplements modify the "General Conditions of the Contract for Construction," AIA Document A232-2009. Where a portion of the General Conditions is modified or deleted by the Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect.

TABLE OF ARTICLES

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

ARTICLE 1: GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.1 THE CONTRACT DOCUMENTS

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

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

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following Paragraphs:

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

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

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

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

Add the following paragraphs:

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

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

ARTICLE 2: OWNER

2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

To Subparagraph 2.2.3 – Add the following sentence:

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

Delete Subparagraph 2.2.5 in its entirety and substitute the following:

2.2.5 The Contractor shall be furnished free of charge up to one (1) set of the Drawings and Project Manuals. Additional sets will be furnished at the cost of reproduction, postage and handling.

ARTICLE 3: CONTRACTOR

3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

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

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

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Paragraphs:

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

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

3.3.5 When any room is used as a shop, storeroom, office, etc., by the Contractor or Subcontractor(s) during the construction of the Work, the Contractor making

use of these areas will be held responsible for any repairs, patching or cleaning arising from such use.

3.4 LABOR AND MATERIALS

Add the Following Paragraphs:

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

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

3.5 WARRANTY

Add the following Paragraphs:

3.5.1 The Contractor will guarantee all materials and workmanship against original defects, except injury from proper and usual wear when used for the purpose intended, for two (2) years after Acceptance by the Owner, and will maintain all items in perfect condition during the period of guarantee.

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

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

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

3.11 DOCUMENTS AND SAMPLES AT THE SITE

Add the following Paragraphs:

3.11.1 During the course of the Work, the Contractor shall maintain a record set of drawings on which the Contractor shall mark the actual physical location of all piping, valves, equipment, conduit, outlets, access panels, controls, actuators,

including all appurtenances that will be concealed once construction is complete, etc., including all invert elevations.

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

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

ARTICLE 4: ADMINISTRATION OF THE CONTRACT

4.2

Add the following Paragraph:

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

ARTICLE 5: SUBCONTRACTORS

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

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

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

ARTICLE 7: CHANGES IN THE WORK

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

ARTICLE 8: TIME

8.2 PROGRESS AND COMPLETION

Add the following Paragraphs:

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

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

8.3 DELAYS AND EXTENSION OF TIME

Add the following Paragraph:

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

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

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

Add the following Paragraph:

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

ARTICLE 9: PAYMENTS AND COMPLETION

9.2 SCHEDULE OF VALUES

Add the following Paragraphs:

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

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

9.3 APPLICATIONS FOR PAYMENT

Add the following Paragraph:

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

Add the following Paragraphs:

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

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

9.5 DECISIONS TO WITHHOLD CERTIFICATION

Add the following to 9.5.1:

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

9.6 PROGRESS PAYMENTS

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

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

ARTICLE 10: PROTECTION OF PERSONS AND PROPERTY

10.1 SAFETY PRECAUTIONS AND PROGRAMS

Add the following Paragraphs:

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

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

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following Paragraph:

10.2.4.1 As required in the Hazardous Chemical Act of June 1984, all vendors supplying any material that may be defined as hazardous, must provide Material Safety Data Sheets for those products. Any chemical product should be considered hazardous if it has a caution warning on the label relating to a potential physical or health hazard, if it is known to be present in the work place, and if employees

may be exposed under normal conditions or in foreseeable emergency situations. Material Safety Data Sheets shall be provided directly to the Owner, along with the shipping slips that include those products.

ARTICLE 11: INSURANCE AND BONDS

11.1 CONTRACTOR'S LIABILITY INSURANCE

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

11.2 OWNER'S LIABILITY INSURANCE

Delete Paragraph 11.2 in its entirety.

11.3 PROPERTY INSURANCE

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

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

11.4 PERFORMANCE BOND AND PAYMENT BOND

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

ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

12.2.2 AFTER SUBSTANTIAL COMPLETION

Add the following Paragraph:

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

12.2.2.1 Strike "one" and insert "two".

12.2.2.2 Strike "one" and insert "two".

12.2.2.3 Strike "one" and insert "two".

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

ARTICLE 13: MISCELLANEOUS PROVISIONS

Add the following Paragraph:

13.1 GOVERNING LAW

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

13.6 INTEREST

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

13.8 CONFLICTS WITH FEDERAL STATUTES OR REGULATIONS

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

ARTICLE 14: TERMINATION OR SUSPENSION OF THE CONTRACT

14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

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

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

END OF SUPPLEMENTARY GENERAL CONDITIONS

SECTION 007313 - ATTACHMENT A - CONSTRUCTION MANAGER GENERAL CONDITIONS

COORDINATION OF THE CONTRACT

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

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

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

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

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

5. The Construction Manager will:

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

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

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

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

6. Construction Manager's Daily Inspection Review:

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

7. Construction Manager's Review of Safety Program:

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

8. Construction Manager – Submittals Expediting Schedule:

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

9. Construction Manager – Contractor's Progress Payments:

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

10. Construction Manager – Change Orders:

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

11. Construction Manager – Expansion of the Construction Schedule:

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

12. Construction Manager – Master Schedule Bar Chart:

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

RECORD DRAWINGS

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

COOPERATION OF PRIME CONTRACTORS

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

JOB MEETINGS

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

CONTRACTOR'S PLANT AND PERSONNEL

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

(a) Job Site Office with telephone.

(b) Personnel/Tool Locker.

(c) Equipment and Material Storage Facilities.

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

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

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

(g) Extension cords and light bulbs.

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

(i) Pay for all power consumed.

SAFETY

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

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

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

SCHEDULE

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

CONSTRUCTION MANAGER'S AUTHORITY REGARDING CLEANUP

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

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

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

END CM GENERAL CONDITIONS

SECTION 007316 – INSURANCE REQUIREMENTS

ACORD. CERTIFICATE OF LIABILITY INSURANCE DATE (MM/DD/YYYY)

PRODUCER

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

INSURED

INSURERS AFFORDING COVERAGE | NAIC #

INSURER A:
INSURER B:
INSURER C:
INSURER D:
INSURER E:

COVERAGES

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

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

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

SAMPLE

CERTIFICATE HOLDER

CANCELLATION

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

AUTHORIZED REPRESENTATIVE

ACORD 25 (2001/08)

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END OF SECTION

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

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

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

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

PREVAILING WAGES FOR BUILDING CONSTRUCTION EFFECTIVE MARCH 13, 2026

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
ASBESTOS WORKERS	30.70	37.78	55.01
BOILERMAKERS	91.87	46.61	68.52
BRICKLAYERS	68.29	68.29	68.29
CARPENTERS	64.06	64.06	52.30
CEMENT FINISHERS	96.91	68.92	53.44
ELECTRICAL LINE WORKERS	61.02	52.34	39.90
ELECTRICIANS	86.87	86.87	86.87
ELEVATOR CONSTRUCTORS	121.73	86.57	109.37
GLAZIERS	88.42	88.42	76.04
INSULATORS	71.54	71.54	71.54
IRON WORKERS	79.33	79.33	79.33
LABORERS	59.65	59.65	59.65
MILLWRIGHTS	91.00	91.00	73.10
PAINTERS	61.53	61.53	61.53
PILEDRIVERS	93.37	52.83	42.72
PLASTERERS	40.06	40.06	29.69
PLUMBERS/PIPEFITTERS/STEAMFITTERS	82.05	85.29	78.26
POWER EQUIPMENT OPERATORS	85.29	85.29	85.29
ROOFERS-COMPOSITION	36.41	31.28	33.64
ROOFERS-SHINGLE/SLATE/TILE	24.68	29.36	23.08
SHEET METAL WORKERS	87.84	87.84	87.84
SOFT FLOOR LAYERS	63.69	63.69	50.43
SPRINKLER FITTERS	77.63	77.63	77.63
TERRAZZO/MARBLE/TILE FNRS	73.75	73.75	84.10
TERRAZZO/MARBLE/TILE STRS	81.93	81.93	93.27
TRUCK DRIVERS	58.41	36.83	28.66

CERTIFIED: 5-4-2026 BY: Salina Crossland /fc
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: DTCC25C9004020002 DTCC Betze Learning Commons, Sussex County

END OF SECTION

SECTION 00 81 13

GENERAL REQUIREMENTS

TABLE OF ARTICLES

1. GENERAL PROVISIONS
2. OWNER
3. CONTRACTOR
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5. SUBCONTRACTORS
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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

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 require, cause judgement to be confessed upon the bond.

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

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

4.2 FAILURE TO COMPLY WITH CONTRACT

4.2.1 If any firm entering into a contract with the State, or Agency that neglects or refuses to perform or fails to comply with the terms thereof, the Agency which signed the Contract may terminate the Contract and proceed to award a new contract in accordance with this Chapter 69, Title 29 of the Delaware Code or may require the Surety on the Performance Bond to complete the Contract in accordance with the terms of the Performance Bond. Nothing herein shall preclude the Agency from 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, shall not be provided by the Contractor under this contract. The Owner shall insure the existing building and all of its contents and all this new alteration work under this contract during entire construction period for the full insurable value of the entire work at the site. Note, however, that the Contractor and their Subcontractors shall be responsible for insuring building materials (installed and stored) and their tools and equipment whenever in use on the project, against fire damage, theft, vandalism, etc.

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

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

11.7.1 Contractor's Contractual Liability Insurance

Minimum coverage to be:

Bodily Injury	$500,000	for each person
	$1,000,000	for each occurrence
	$3,000,000	aggregate
Property Damage	$500,000	for each occurrence
	$3,000,000	aggregate

11.7.2 Contractor's Protective Liability Insurance

Minimum coverage to be:

Bodily Injury	$500,000	for each person
	$1,000,000	for each occurrence
	$3,000,000	aggregate
Property Damage	$500,000	for each occurrence
	$300,000	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 OF CONTRACT

14.1 If the Contractor defaults or persistently fails or neglects to carry out the Work in accordance with the Contract Documents or fails to perform a provision of the Contract, the Owner, after seven days written notice to the Contractor, may make good such deficiencies and may deduct the cost thereof from the payment then or thereafter due the Contractor. Alternatively, at the Owner's option, and the Owner may terminate the Contract and take possession of the

site and of all materials, equipment, tools, and machinery thereon owned by the Contractor and may finish the Work by whatever method the Owner may deem expedient. If the costs of finishing the Work exceed any unpaid compensation due the Contractor, the Contractor shall pay the difference to the Owner.

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

END OF SECTION 00 81 13

EMPLOYEE DRUG TESTING REPORT FORM

Period Ending:_____

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

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____
_____
_____

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

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

Number of Negative Results _____ Number of Positive Results _____

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

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

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date: _____

EMPLOYEE DRUG TESTING
REPORT OF POSITIVE RESULTS

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

Project Number: _____

Project Name: _____

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____
_____
_____

Name of employee with positive test result: _____

Last 4 digits of employee SSN: _____

Date test results received: _____

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

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

Authorized Representative of Contractor/Subcontractor: _____
(signature)

Date: _____

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

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

SECTION 009300 – RECORD CLARIFICATIONS AND PROPOSALS

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

1. SURVEY:

2. CADD FILES

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

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

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

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

3. WAGE DETERMINATION

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

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

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

4. ASBESTOS REPORT: Asbestos Survey performed by Batta Environmental; report dated May 1, 2026. (This is to be done under owners contract; FOR REFERENCE ONLY)

END OF SECTION

Mr. Mark DeVore
Mr. Scott Iseman
DTCC – Owens Campus
21179 College Dr.
Georgetown, DE 19947

May 1, 2026

RE: Full NESHAP Asbestos Survey and Bulk Sampling – Betze Library – Owen's Campus BEA #1094323

Address: 21179 College Ave., DTCC Owens Campus			
City: Georgetown	County: Sussex	State: DE	Zip: 19947
Site Contact Name: Scott Iseman			Contact Phone: (302) 259-6230

Mr. DeVore & Mr. Iseman:
In response to your request BATTA ENVIRONMENTAL ASSOCIATES, INC. is pleased to provide this report summarizing the findings of the requested Full NESHAP Asbestos Survey, Sampling and Analytical Services required for the planned renovation project in the Betze Library located on the DTCC Owens Campus in Georgetown, Delaware. This survey of the areas impacted by the renovation work is to document the asbestos content of the impacted materials within the scope of work prior to performing the planned renovations at the above address.

Over several days between April 17th and 24th, 2026, an asbestos survey and sampling was performed by Jeffrey Hogate, a certified Asbestos Building Inspector with Batta Environmental, in response to your request for an inspection of the renovation areas within the Library. This inspection provided the data contained in this report and is the basis for the summary of findings included here.

ASBESTOS

The asbestos survey performed was intrusive / destructive in nature since the renovation areas of interest are scheduled for renovation, but not all hidden areas of the structure that are not a part of the renovation were investigated (they are considered homogeneous with the sampled area). A visual inspection combined with representative bulk sampling was performed for the asbestos investigations of the impacted materials within the areas.

The following materials were suspected, sampled and found to contain asbestos (all non-friable):

- **Cement Asbestos panel walls** — **1st Floor Mechanical areas & 2nd Floor HVAC Rooms** — **3,288 SF** — **15-25% Chrysotile**
- **Duct Mastic (black only)** — **Hallways & 1st Floor Library** — **+/-100 SF** — **5% Chrysotile**
- **Floor Tile Mastic** — **Staff Work Area &Stair Towers** — **1,790 SF** — **5% Chrysotile**
- **Sink Undercoating** — **Staff Work Area** — **2 SF** — **4% Chrysotile**

The following materials were suspected, but NOT sampled due to current use of items would be impaired by sampling at this time. These are presumed to be asbestos containing (PACM) until sampled and analyzed.

- **Fire Doors** — **Museum, Mechanical Rooms, & 2nd floor area** — **9 EA** — **PACM**
- **Mirror Mastics** — **Bathrooms** — **+/- 20 SF** — **PACM**

RE: Full NESHAP Asbestos Survey and Bulk Sampling – Betze Library – Owen's Campus **BEA #1094323**

Address: 21179 College Ave., DTCC Owens Campus			
City: Georgetown	County: Sussex	State: DE	Zip: 19947
Site Contact Name: Scott Iseman			Contact Phone: (302) 259-6230

Suspect materials that were observed, sampled, and had no asbestos detected include:

Roof Flashing Adhesive (upper roof)
IsoFoam Mastic @ deck (upper roof)
Skylight Caulks (upper roof)
Skylight Mastic (upper roof)
Clerestory Window Caulk (upper roof)
TPO Seam Adhesive (upper & lower roofs)
Roof Flashing (upper & lower roofs)
Roof Coating (cool seal) (lower roof)
Flashing Caulk @ metal roof (lower roof)
Exterior Door Caulks
Exterior Window Caulks
Exterior Building Expansion Caulk
SOME Duct Mastics (white)
Ceiling Tiles
Drywall
Joint Compound
Wall Plasters
Wall Board Adhesive
Wall Panel Adhesive
Cloth Wall Covering Adhesive
Ceramic Wall Tile Grout
Ceramic Wall Tile Adhesive
Interior Window Caulk
Cove Base
Cove Base Mastic
Carpet Mastic
Sheet Flooring
Sheet Floor Mastic
Floor Coating
12" x 12" Floor Tile (Mastic is ACM)
Stair Treads
Stair Tread Mastic

(Additional hidden materials may also exist inside concealed locations).

Asbestos Bulk samples were analyzed using Polarized Light Microscopy (PLM), following standard protocol which stops analysis on subsequent samples (B,C, etc.) for a specific homogeneous material once a positive result is obtained for a previous sample (ie. A). These numerous samples (A,B,C,D,.) of homogeneous materials are necessary in order to definitively identify a material as non-asbestos containing with statistically significant confidence.

No lead-based paint, coatings or other lead-based survey or sampling was included in this investigation. Also, no investigation of other hazardous materials was performed as part of this investigation.

Asbestos containing materials (ACM) **were** identified by these investigations. Prior to demolition or any work impacting directly or indirectly on known ACM or suspect materials not tested, and therefore presumed to be asbestos containing, the known or presumed asbestos containing materials potentially impacted must be either tested and proven to be non-asbestos or removed as asbestos according to the regulations of the EPA and Delaware Department of Natural Resources and Environmental Control (DNREC). Work on Asbestos materials requires specially trained and licensed workers, supervisors, and companies. (In addition to the specialized removal requirements, there may also be a 10-day notification requirement to DNREC prior to demolition of some materials in some situations.) Batta Environmental Associates, Inc. is able to provide you with recommendations for qualified contractors if needed. Following removal, a visual inspection and air clearance testing by a certified professional services third party such as Batta is required to verify that all of the identified asbestos containing materials have been removed as needed, no debris remains, and the air in the area is acceptable for re-occupancy.

RE: Full NESHAP Asbestos Survey and Bulk Sampling – Betze Library – Owen's Campus **BEA #1094323**

Address: 21179 College Ave., DTCC Owens Campus			
City: Georgetown	County: Sussex	State: DE	Zip: 19947
Site Contact Name: Scott Iseman			Contact Phone: (302) 259-6230

I hope that this report conveys to you in brief format the findings of this investigation. Detailed documentation for the survey is contained following this letter. If you should have any questions, comments, or need additional services in the future, please call me at 302 737-3376 ext 106.

Sincerely,

Todd K. Zeisloft
Senior Project Manager and EHS Training Manager / Instructor
(O) 302.737.3376 x115 | (C) 302.893.3006 | Zeisloft@battaenv.com

Enclosure: Laboratory Certificates
Field Pack

BATTA Environmental

BULK SAMPLING RECORD / CHAIN OF CUSTODY

Project Name: DTCC - Owens Campus, Georgetown Library BEA#: 1094323

Site Inspected: 21179 College Dr, Georgetown, DE

Building Inspector: Hospito BI#: _____ Date: 4 / 17-23 26

Building Inspector: _____ BI#: _____ MO TU WE TH FR SA SU (circle one)

Project Manager: T. Zeuskoft

FIELD DATA:

Included	Not Applicable		
X	☐	1. Job safety Analysis	111 Total # of Samples Submitted
X	☐	2. Bulk Sample Data Sheet / Log	
X	☐	3. Materials Inventory Work Sheet	
X	☐	4. Survey Data Sheet	
X	☐	5. Floor Plan Sketch with Location Diagram	
X	☐	6. Events Log	Site Arrival Time: — hrs
X	☐	7. Asbestos Survey Data Checklist	Site Departure Time: — hrs

POST ANALYSIS DATA REVIEW / QAQC:

Project Manager: T.K. Zeuskoft Date Reviewed: 5/1/26

Ph: 302.737.3376
Fx: 302.737.5754

BATTA Environmental Associates, Inc
6 Garfield Way
Newark, DE. 19713

info@battaenv.com
Battaenv.com

JOB SAFETY ANALYSIS

Project Name: DTCC-Owens campus Batze Library **BEA#:** 1094323

Site Inspected: 21179 College Dr. Georgetown, DE. **DATE:** 4/17-23/26

Prepared by: J Hogate

Task Description: ☐ **Air Monitoring** ☐ **Bulk Sampling** ☐ **XRF/Pb Survey** ☐ **Mold Sampling**
☐ **Other:** _____

Instructions: Identify the steps that you will have to perform to complete the assigned task. Review the following safety subjects and place a checkmark next to the ones that apply to this task. Also, place a checkmark next to any sub-item that is a concern.

☒ **Tools & Equipment** – 1. ✓ Do you have the proper tools & equipment to safely perform the task? 2. ✓ Are your tools in safe condition? 3. ✓ Are you trained to safely use the required tools & equipment?

☐ **Hazardous Energy Control** – 1. __ Will you be exposed to hazards from equipment movement or excessive heat/cutting/etc.? 2. __ Have all hazardous energy sources been identified? 3. __ Do you need a hazardous energy source(s) locked out / tagged out? 4. __ Have you verified with the owner or owners representative that all hazardous energy sources are controlled?

☐ **Fall Protection** – 1. __ Will the task require you to be at heights more than six feet? 2. __ Will you have to lean out over platform guard rails to perform the task? 3. __ Will you be using a manlift, aerial lift, or scaffolding? 4. __ If using a manlift, aerial lift, or scaffolding have they been inspected and approved for use? 5. __ Will a qualified ground person be present when using a lift? 6. __ Are there any roof or floor openings where you will be working? 7. __ Will you be working next to an unguarded roof edge? 8. __ Is your ladder proper for the task and in safe condition?

☐ **Confined Space** – 1. __ Will you be working in a permit required confined space? 2. __ Have you inspected the confined space to identify any potential safety hazards? 3. __ Are you knowledgeable of all the confined space entry procedures? 4. __ Will you continuously monitor the air when in a confined space?

☐ **Hazardous Materials** – 1. __ Are you familiar with all the hazards of any chemicals you will be using? 2. __ Are you knowledgeable about any potential chemical exposure that might be created by the task? 3. __ Will you need to wear a respirator?

☐ **Cutting & Welding** – 1. __ Is a Hot Work Permit required before starting the task? 2. __ Do you have a fire watch person on each floor level that is exposed to weld sparks? 3. __ Will the fire watch remain at the scene for one-half hour after completion of the task? 4. __ Is there proper ventilation for the task being performed?

☐ **Mobile Equipment Operation** – 1. __ Have you been trained and issued a permit (must be displayed) to operate this type of Mobile equipment? 2. __ Do you perform a Safety Inspection of the mobile equipment before operation?

☒ **Personal Protective Equipment** – 1. ✓ Will performing this task require the use of Personal Protective Equipment?

Eye ✓	Face ✓	Head
Clothing ✓	Hand	Other
Foot ✓	Respiratory	Other

☒ **Safety Training** – 1. ✓ Have you been trained in the safety procedures required to perform the task? Ex: Lockout, confined space, fall protection, respirator usage, etc.

☒ **Other Safety Hazards** – 1. ✓ Are there any other potential safety hazards that you feel are present in performing this task? (Hidden electrical / piping / materials behind walls or equipment skins, etc.) Explain:
Ladder Safety

☒ **I/We have reviewed this task for the above safety subjects and made a plan for all the areas that have been checked.**

Signed: J Hogate **Date:** 4/17/26

Signed: _____ **Date:** _____

Ph: 302.737.3376
Fx: 302.737.5754

BATTA Environmental Associates, Inc
6 Garfield Way
Newark, DE. 19713

info@battaenv.com
Battaenv.com

L341723

EPA 600 CVAE

BULK SAMPLE DATA SHEET

BATTA Environmental

PLM: EPA POINT COUNT NOB TEM: YES/NO NOB EPA NOTE TO ANALYST – POSITIVE STOP UNLESS OTHERWISE NOTED

Project Name: OTCC - owens campus Bettye Lebrary BEA# 1094323 Results Required: 5 / 1 / 26 1500 HRS

Site Inspected / Address: 21179 College Dr Georgetown, DE Cert of Analysis Req: 5 / 6 / 26 1500 HRS

Inspector(s): Hogate Results to: Inspector Hogate

B.I. #: Date Inspected 4 / 17-23 / 26 Manager: T. Zeiroloff

Page 1 of 4 Client: :

SAMPLE NUMBER FIELD	SAMPLE NUMBER LAB	MATERIAL SAMPLED Note 2	AHERA CLASS	CONDITION G/D	CONDITION /S .D	ALL LOCATIONS, Name & Circle Sample Locations (E.1, E.2 ,0.1, 1.1, 1.3, 2.2, ...)	MATERIAL QUANTITY	SAMPLE COMPOSITION Note 3	SAMPLE COLOR	RESULTS %	RESULTS TYPE
4/23-	848/849	Dry wall	M	D	F	1.01, 1.02, 1.03, 1.04, 1.05, 1.06, 1.07, 1.08		H	gray	NAD	N/A
002	850/851	Joint Compound		D	F				wht		
003	852/853	2x2 Ceiling Tile		G	F	1.01			wht gray		
004	854/855	cove Base 4"		G	F	1.01			Blue		
005	856/857	Cove Base Mastic		G	F	1.01			Tan		
006	858/859	Carpet Mastic		G	F	1.01, 1.02, 1.09, 1.10, 1.11			Tan		
007	—	fire Door			NF	Not Sampled - PACM					
008	860/861	cove Base 4"		G	F	1.01, 1.02,			gray		
009	862/863	cove Base Mastic		G	F	.			wht		
010	864/865	2x2 Ceiling Tile		G	F	1.02, 2.02,			wht gray		
011	866/867	wall Plaster undercoat		D	F	1.02			gray		
012	868/869	wall Plaster finish		D	F	1.02			wht		
013	870/871	Duct Mastic		G	F	Through out			Blk	5%	Chrys.
014	872/873	Wall Board adhesive	↓	D	F	1.02		↓	Tan	NAD	N/A
015	874/875	Carpet Mastic	M	G	F	1.02		H	grn	NAD	N/A

Notes: 1 AHERA Classification T=Thermal Insulation, S=Surfacing, M=Miscellaneous 2 Material Sampled: Pipe Covering, Boiler Breeching Ceiling Tile Floor Tiles Sheet Flooring, etc 3 Sample Composition. Homogeneous Mixed, Layered

Relinquished By: J Hogate Date: 4/24/26 Time: Received By: ACM Date: 4/26/26 Time: 1115

Delivered By: Date: / / Time: Received By: Date: / / Time:

Delivered By Date: / / Time: Received By: Date: / / Time

BATTA Environmental

BULK SAMPLE DATA SHEET L341723 EPA 600 CVAE

PLM: | EPA | POINT COUNT | NOB TEM: | YES/NO | NOB | EPA NOTE TO ANALYST – POSITIVE STOP UNLESS OTHERWISE NOTED

Project Name: DTCC - owens Campus Betye Library BEA# 1094323

Site Inspected / Address: 21179 College Dr. Georgetown, DE

Inspector(s): Hopate

I. #:

Results Required: 5 / 1 / 26 1500 HRS

Cert of Analysis Req: 5 / 6 / 26 1500 HRS

Results to: Inspector Hopate

Manager: T. Zeisloft

Client:

Date Inspected 4/17-23/26

SAMPLE NUMBER FIELD	SAMPLE NUMBER LAB	MATERIAL SAMPLED Note 2	AHERA CLASS	Note1 CONDITION G/D	CONDITION /S .D	ALL LOCATIONS, Name & Circle Sample Locations (E.1, E.2 ,0.1, 1.1, 1.3, 2.2, ...)	MATERIAL QUANTITY	Note 3 SAMPLE COMPOSITION	SAMPLE COLOR	RESULTS %	RESULTS TYPE
4/23	876/877	ceramic wall tile adhesive	M	G	F	1.03, 1.06		H	Tan	NAD	N/A
C 017	878/879	ceramic wall tile grout		G	F	1.03, 1.06			wht		
C 018	880/881	cove Base 4"		G	F	1.03, 1.06			gray		
C 019	882/883	cove Base Mastic		G	F	1.03, 1.06			Tan		
C 020	884/885	floor sheeting		G	F	1.03, 1.06			Blue		
C 021	886/887	floor sheeting mastic		G	F	1.03, 1.06			gray		
C 022	888/889	cement Board (Tackstrip)		D	F	1.05, 1.08, 2.03			gray	15%	Chrys.
C 023	890/891	floor coating		D	F	1.05			grey	NAD	N/A
C 024	892/893	cloth wall cover adhesive		D	F	1.02, 1.10, 2.01			Tan		
C 025	894/895	cove Base 4"		G	F	1.07, 1.09, 2.01, 2.02, 2.04			Brn		
C 026	896/897	cove Base Mastic		G	F	1.07, 1.10, 2.01, 2.02, 2.04			Brn		
C 027	898/899	2x2 ceiling Tile (pinhole)		G	F	2.05 1.09, 1.10, 1.11, 2.01, 2.03, 2.04			gray wht		
C 028	900/901	12x12 floor tile		G	F	1.09			Tan		
C 029	902/903	Tile Mastic assoc w/028	↓	G	F	1.09		↓	Blk	5%	Chrys
B, C 030	904	sink undercoat	M	G	F	1.09		H	wht.	4%	Chrys.

Notes 1 AHERA Classification: T=Thermal Insulation S=Surfacing M=Miscellaneous 2 Material Sampled: Pipe Covering, Boiler Breeching, Ceiling Tile, Floor Tiles, Sheet Flooring, etc 3 Sample Composition: Homogeneous, Mixed, Layered

Relinquished By: J Hopate	Date: 4/24/26	Time:	Received By: Aom	Date 4/26/26	Time 1115
Relinquished By:	Date: / /	Time:	Received By:	Date	Time
Relinquished By:	Date: / /	Time:	Received By	Date	Time

BATTA Environmental

BULK SAMPLE DATA SHEET LBH1723 EPA 600 CVAE

PLM: EPA | POINT COUNT | NOB TEM: YES/NO | NOB | EPA NOTE TO ANALYST – POSITIVE STOP UNLESS OTHERWISE NOTED

roject Name: DTCC-owens campus, Bettye Library BEA# 1094323 Results Required: 5 / 1 / 26 1500 HRS

ite Inspected / Address: 21179 college Dr. Georgetown, DE. Cert of Analysis Req: 5 / 6 / 26 1500 HRS

ıspector(s): Hogate Results to: ☒Inspector Hogate

.I. #: Date Inspected 4 /17-23/ 26 ☒Manager: J. Zeeslogt

Page 3 of 4 Client:

SAMPLE NUMBER FIELD	LAB	MATERIAL SAMPLED Note 2	AHERA CLASS	Note1 CONDITION G/D /S .D		ALL LOCATIONS, Name & Circle Sample Locations (E.1, E.2 ,0.1, 1.1, 1.3, 2.2, ...)	MATERIAL QUANTITY	Note 3 SAMPLE COMPOSITION	COLOR	RESULTS %	TYPE
4/23 – 3/100, C	905/906	Drywall (columns)	M	D	F	1.10, 2.01,		H	grey	NAD	N/A
100, C 032	907/908	Joint Compound (columns)		D	F	1.10, 2.01,			wht		
100, C 033	909/910	Wall Panel adhesive		D	F	1.10, 2.01			Tan		
100, C 034	911/912	interior window Caulk		G	F	1.10, 1.11, 2.01, 2.04			wht		
100, C 035	913/914	Duct Mastic		G	F	1.11			wht		
100, C 036	915/916	cove Base 4"		G	F	1.11			Tan Blue		
100, C 037	917/918	cove Base Mastic		G	F	1.11			Tan		
100, C 038	919/920	Drywall		D	F	2.05			grey		
100, C 039	921/922	Joint Compound		D	F	2.05			wht		
100, C 040	923/924	Drywall		D	F	2.03			wht		
100, C 041	925/926	Joint Compound		D	F	2.03			wht		
100, C 042	927/928	Stair Tread	↓	G	F	2.04		↓	Brn		
100, C 043	929/930	stair Tread Mastic	M	G	F	2.04		H	Blk		
A, B, C 044	—	Mirror Mastic			N F	Not sampled - PACM					
100, C 045	931/932	exterior Door Caulk	M	G	F	exterior		H	Brn		

Notes 1 AHERA Classification T=Thermal Insulation S=Surfacing M=Miscellaneous 2 Material Sampled Pipe Covering Boiler Breeching Ceiling Tile Floor Tiles Sheet Flooring etc 3 Sample Composition Homogeneous, Mixed, Layered

Relinquished By: J Hogate Date: 4 / 24 / 26 Time: Received By: ACM Date: 4/26/26 Time: 1115

Delivered By: Date: / / Time: Received By: Date: / / Time:

Delivered By: Date: / / Time: Received By: Date: / / Time:

BATTA Environmental

BULK SAMPLE DATA SHEET L341723 EPA 600 EVAL

PLM: | EPA | POINT COUNT NOB TEM: | YES/NO | NOB | EPA NOTE TO ANALYST – POSITIVE STOP UNLESS OTHERWISE NOTED

Project Name: DTC-Owens Campus, Pietzy Library BEA# 1094323 Results Required: 5 / 1 / 26 1500 HRS

Site Inspected / Address: 21179 College Dr. Georgetown, DE. Cert of Analysis Req: 5 / 6 / 26 1500 HRS

Inspector(s): Hogate Results to: Inspector Hogate

B.I. #: Date Inspected 4 / 17-23 / 26 Manager: T. Zeisloft

Page 4 of 4 Client: :

SAMPLE NUMBER FIELD	SAMPLE NUMBER LAB	MATERIAL SAMPLED Note 2	AHERA CLASS	CONDITION G/D	CONDITION S/D	ALL LOCATIONS, Name & Circle Sample Locations (E.1, E.2, 0.1, 1.1, 1.3, 2.2, ...)	MATERIAL QUANTITY	SAMPLE COMPOSITION Note 3	SAMPLE COLOR	RESULTS %	RESULTS TYPE
4/23	933/934	exterior Door caulk	M	G	F	exterior		H	gray	NAD	N/A
047	935/936	exterior window caulk		G	F				gray		
048	937/938	Bldg expansion caulk		G	F				gray		
049	939/940	Roof coating (Cool Seal)		D	F	Lower Roof			wht		
050	941/942	TPO seam adhesive		—	F	Lower + upper Roof			—		
051	943/944	Roof flashing		G	F				Blk		
052	945/946	flashing caulk @ metal Roof		D	F	Lower Roof			wht		
053	947/948	Isofoam mastic @ Deck		G	F	upper Roof			Blk		
054	949/950	Roof flashing adhesive		G	F				Tan		
055	951/952	Skylite caulk		D	F				wht		
056	953/954	Skylite caulk		D	F				Blk		
057	955/956	Skylite mastic		D	F				wht		
058	957/958	Clere Story Window Caulk	M	D	F	upper Roof		H	wht		
A, B, C					N F						
A, B, C					N F						

Notes 1 AHERA Classification T=Thermal Insulation, S=Surfacing, M=Miscellaneous 2 Material Sampled Pipe Covering, Boiler Breeching, Ceiling Tile, Floor Tiles, Sheet Flooring, etc 3 Sample Composition Homogeneous, Mixed, Layered

Relinquished By: J Hogate Date: 4/24/26 Time: Received By: ACM Date: 4/24/26 Time: 1115

Delivered By: Date: / / Time: Received By: Date: / / Time:

Delivered By: Date: / / Time Received By Date: / / Time:

MATERIALS INVENTORY SHEET

Project Name: DTCC - owens campus Betty e Library
Site Inspected / Address: 21179 College Dr. Georgetown, DE
Inspector(s): Hogate

BEA# 1094323
Date Inspected: 4/17 - 4/23/26

HA#	Material Description		Sample A Location	Sample B Location	Sample C Location	Sample D Location	Sample E Location	Sample F Location	Sample G Location	Sample H Location	Sample I Location
045	exterior Door Caulk	BRN	EXT	EXT							
046	exterior door caulk	gray									
047	exterior window caulk	gray									
048	Building expansion caulk	gray	EXT	EXT							
049	Roof coating Cool seal		LOWER	Roof							
050	TPO seam adhesive			upper							
051	Roof flashing	BLK		upper							
052	flashing caulk @ metal Roof	wht		Lower							
053	ISO foam mastic @ Deck	BLK	upper	same							
054	Roof flashing adhesive	Tan									
055	skylite caulk	white									
056	skylite caulk	BLK									
057	skylite mastic	WHT									
058	clere story window caulk	wht									

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BATTA Environmental

MATERIALS INVENTORY SHEET

Project Name: DTCC-Owens Campus - Betze Library

Site Inspected / Address: 21179 College Dr. Georgetown, DE.

Inspector(s): Hogate

BEA# 1074323

Date Inspected 4/17-23/26

HA#	Material Description	Sample A Location	Sample B Location	Sample C Location	Sample D Location	Sample E Location	Sample F Location	Sample G Location	Sample H Location	Sample I Location
001	Drywall gray	1.01	1.02							
002	Joint Compound	1.01	1.02							
003	2x2 Ceiling Tile area	1.01	1.01							
004	Cove Base & Blue	1.01	1.01							
005	cove Base mastic, Tan	1.01	1.01							
006	Carpet Mastic under Dg Tan	1.01	1.09							
007	fire Door	P	A	C	M					
008	cove Base 4" gray	1.02	1.09							
009	cove Base mastic wht	1.02	1.09							
010	2x2 Ceiling Tile Decorative		2.02							
011	wall Plaster undercoat gray	1.02	1.02							
012	wall Plaster finish wht	1.0	1.02							
013	Duct mastic BLK	1.02	1.10							
014	wall Board adhesive	1.02	1.10							
015	Carpet mastic gray	1.02	1.10							
016	ceramic wall adhesive	1.03	1.06							
017	ceramic wall Tile grey	1.03	1.06							
018	cove Base 4 grn	1.03	1.06							
019	cove Base mastic Tan	1.03	1.06							
2	fleur sheeting Blue	1 3	1.06							
01	fleur sheeting mastic gray	1.03	1.06							
	cement Board (Transite) walls	1 05	1.08							

MATERIALS INVENTORY SHEET

Project Name: DTCC - Owens Campus, Betze Library
Site Inspected Address: 21179 College Dr Georgetown, DE.
Inspector(s): Hogate

BEA# 1094323
Date Inspected 4/17-23 26

HA#	Material Description	Sample A Location	Sample B Location	Sample C Location	Sample D Location	Sample E Location	Sample F Location	Sample G Location	Sample H Location	Sample I Location
023	Floor coating grey	1.05	1.05							
024	Cloth wall cove adhesive	1.02	1.10							
025	cove Base 4" Brn	1.07	1.10							
026	cove Base mastic Brn	1.07	1.10							
027	2x2 Ceiling Tile pinhole	1.09	2.01							
028	12x12 floor tile Tan	1.09	2.04							
029	Tile mastic over w/28 BLK	1.09	2.04							
030	sink undercoat wht	1.09								
031	Drywall @ columns	1.10	2.01							
032	Joint Compound	1.10	2.01							
033	wall fiber adhesive	1.10	1.10							
034	interior windows Caulk wht	1.10	1.11							
035	Duct mastic wht	1.11	1.11							
036	cove Base 4" Blue/grn	1.11	1.11							
037	cove Base mastic Tan	1.11	1.11							
038	Drywall grey	2.01	2.01							
039	Joint Compound wht	2.01	2.01							
040	Drywall wht	2.03	2.03							
041	Joint Compound	2.03	2.03							
042	Stair Tread Brn	2.04	2.04							
043	Stair Tread Mastic BLK	2.04	2.04							
044	Mirror Mastic	P	A	C	M					

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DTCC - owens campus
Belye Library
Georgetown, DE.

SURVEY DATA COLLECTION

WT #:

Date:

Project File: 1094323 Date: 4/17-23/26 Area: Subarea: Detail: Representative: Hogate

Grid ID# 1.01 MUSEUM

HA #	CODE	QTY	UNITS
001	DW		SF
002	JC		SF
003	CTZ		SF
004	CB		LF
005	CBM		LF
006	CM		SF
007	FD	2	EA.
008	CB		LF
009	CBM		LF
10x22			

21x89 Areas Not Assessed/Notes
18x20, Metal Deck, No Duct
Work, Cond/Pipe, Pipe, Conc
Deterioration Conc Cracks.

Grid ID# 1.02 Hall

HA #	CODE	QTY	UNITS
001	DW		SF
002	TC		SF
006	CM		SF
008	CB		LF
009	CBM		LF
010	CTZ		SF
011	WPW		SF
012	WPF		SF
013	DM		LF
014	MUR		SF

8x10 Areas Not Assessed/Notes
DM Spirocastic - Both Conn in
Hall, Spray-Iron under Black, Spray
under Spray

Grid ID# 1.02 Conf.

HA #	CODE	QTY	UNITS
015	CM		SF
024	MUR	54x8	SF

20x20 Areas Not Assessed/Notes

Grid ID# 1.03 404 Womens Rm

HA #	CODE	QTY	UNITS
001	DW		SF
002	TC		SF
016	CWT A		SF
017	CWT B		SF
018	CB		LF
019	CBM		LF
020	ES		SF
021	ESM		SF
044	MM	9x6M	SF

9x8 Areas Not Assessed/Notes
ES over Concrete

Grid ID# 1.04 Facilities 403

HA #	CODE	QTY	UNITS
001	DW		SF
002	TC		SF
007	FD	1	EA

6x6 Areas Not Assessed/Notes
Ceramic Floor

Grid ID# 1.05 Exploratory 402

HA #	CODE	QTY	UNITS
022	TM	600	SF
023	FC	150	SF
007	FD	1	EA

10x15x12 Areas Not Assessed/Notes

OTCC - owens campus
Betze Library
Georgetown, DE.

SURVEY DATA COLLECTION

WO #

Date

Project File 1044323 Date 4/17-23/26 Area Subarea Detail Representative Hogate

Grid ID#	106 Mens Bath 400		
HA #	CODE	QTY	UNITS
001	DW		SF
002	TC		SF
016	CWT A		SF
017	CWT B		SF
018	CB		LF
019	CBM		LF
020	ES		SF
021	FSM		SF
044	MM	DRM	SF

9x18 Areas Not Assessed/Notes

Grid ID#	107 Corridor 400		
HA #	CODE	QTY	UNITS
007	ED	1	EA
025	CB		LF
026	CBM		LF

9x18 Areas Not Assessed/Notes
wood wall Base, concrete floor

Grid ID#	108 Boiler Room 400		
HA #	CODE	QTY	UNITS
007	ED	1	EA
022	TM	1008	SF

21x21x8 Areas Not Assessed/Notes
concrete floor MEP Boilers
FG pipe/2 section

Grid ID#	109 Staff Workroom		
HA #	CODE	QTY	UNITS
001	DW		SF
002	TC		SF
006	CM	40	SF
025	CB		LF
026	CBM		LF
027	CT22		SF
028	FT12		SF
029	FT12M	1,500	SF

68x22 Areas Not Assessed/Notes
Ceiling removed & floor No Damage

Grid ID#	110 Library 1st floor		
HA #	CODE	QTY	UNITS
001	DW		SF
002	TC		SF
006	CM		SF
013	DM		LF
024	misc		SF
025	CB		LF
026	CBM		LF
027	CT22		SF
031	DW		SF
032	TC		SF

155x69 Areas Not Assessed/Notes
117x22

Grid ID#	110 Corridor		
HA #	CODE	QTY	UNITS
033	MASK		SF
034	CLK		LF

Areas Not Assessed/Notes

DTCC-
Belge Library
Georgetown, DE

SURVEY DATA COLLECTION

WO #

Date

Project File 2094323 Date 4/17-23/26 Area Subarea Detail Representative Hagerty

Grid ID#	1.11 Tutor area		
HA #	CODE	QTY	UNITS
001	DW		SF
002	JC		SF
006	CM		SF
027	CT24		SF
034	CLK		LF
035	DM		SF
036	CB		LF
037	CBM		LF

42x46 Areas Not Assessed/Notes
035 - sporadic

Grid ID#	2.01 2ND floor		
HA #	CODE	QTY	UNITS
006	CM		SF
007	FD	3	EA
024	misc		SF
025	CB		LF
026	CBM		LF
027	CT22		SF
031	DW		SF
032	JC		SF
038	DW		SF
039	JC		SF

144x90 Areas Not Assessed/Notes

Grid ID#	2.02 offices + IT Room		
HA #	CODE	QTY	UNITS
010	CT22		SF
025	CB		LF
026	CBM		LF
027	CT22		SF
038	DW		SF
039	JC		SF

5x11x5 Areas Not Assessed/Notes

Grid ID#	2.03 HVAC Rms 2 ea		
HA #	CODE	QTY	UNITS
022	TM	1680	SF
040	DW	525	SF
041	JC	525	SF

144x8 Areas Not Assessed/Notes
66x8

Grid ID#	2.04 Stair Towers (2)		
HA #	CODE	QTY	UNITS
001	DW		SF
002	JC		SF
025	CB		LF
026	CBM		LF
028	FTR		SF
029	FTRM	290	SF
042	misc		SF
043	MAST		SF

12x12x2 Areas Not Assessed/Notes

Grid ID#	2.05 Gym mech Room		
HA #	CODE	QTY	UNITS
026	CB		LF
027	CBM		LF
028	DLW		SF
039	JC		SF

8x9 Areas Not Assessed/Notes

DTCC - Owens campus
Beiye Library
Georgetown, DE.

SURVEY DATA COLLECTION

WO #

Date

Project File 1084323 Date 4/12-23/26 Area: Subarea: Detail: Representative: Kayla D

Grid ID#	Exterior		
HA #	CODE	QTY	UNITS
045	CLK		LF
046	CLK		LF
047	CLK		LF
048	CLK		LF
049	BC		SF
050	BM		SF
051	BF		SF
052	CLK		LF
053	BM		SF
054	BF		SF

Areas Not Assessed/Notes

Grid ID#	EXTERIOR CONT		
HA #	CODE	QTY	UNITS
055	CLK		LF
056	CLK		LF
057	MWST		SF
058	CLK		LF

Areas Not Assessed/Notes

Grid ID#			
HA #	CODE	QTY	UNITS

Areas Not Assessed/Notes

Grid ID#			
HA #	CODE	QTY	UNITS

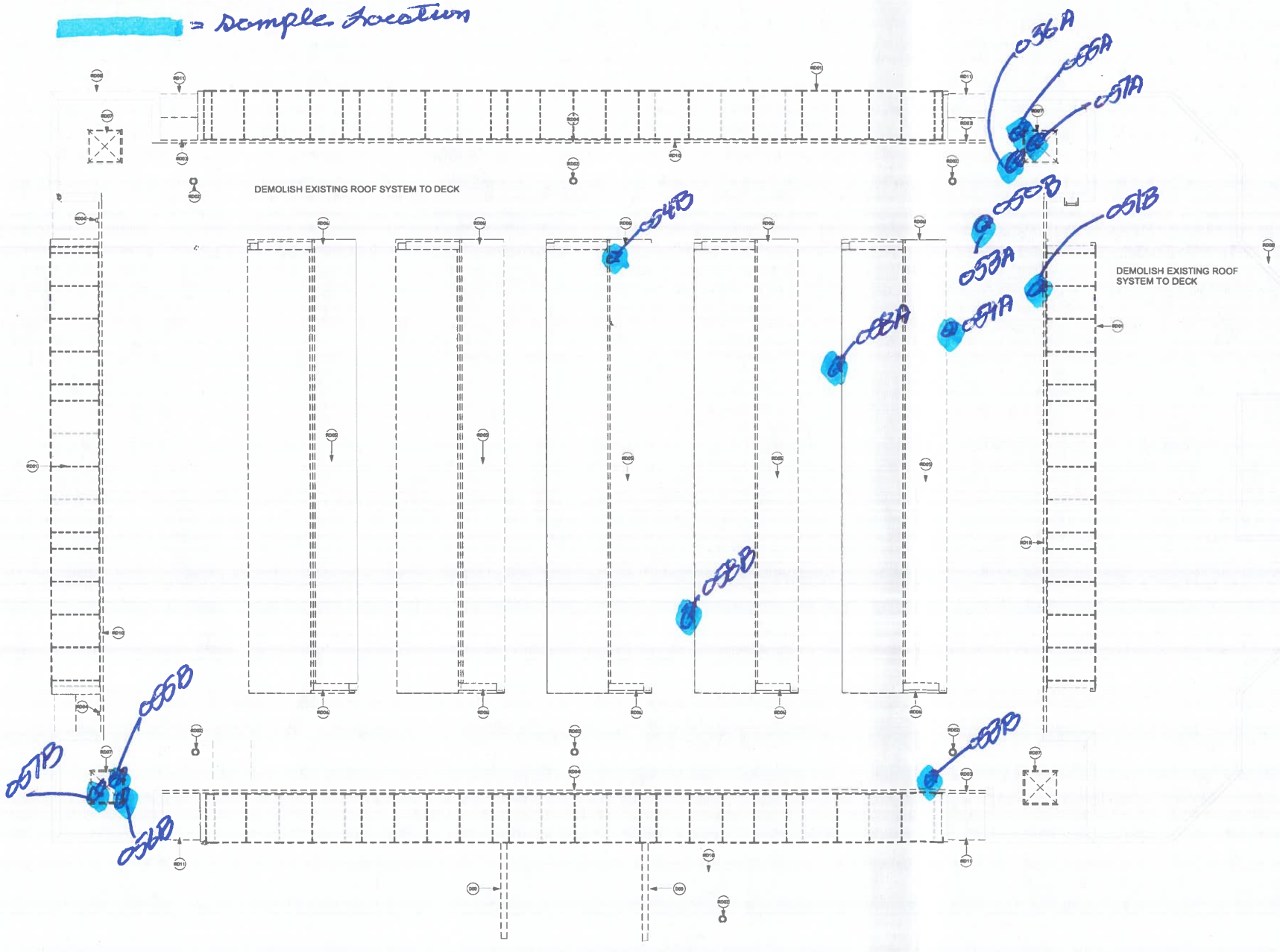
Areas Not Assessed/Notes

Grid ID#			
HA #	CODE	QTY	UNITS

Areas Not Assessed/Notes

3/27/2026 9:56:19 AM

#1094323
4/17-23/26
upper Rib
[redacted] = Sample Location



1 ROOF DECK (DEMOLITION)
1/8" = 1'-0"

ROOF LEGEND:

- CRICKET - SLOPE TO DRAIN (TYPICAL) 1/2"/FT. MIN. (TYPICAL)
- TAPERED RIGID INSULATION SLOPE TO DRAIN (TYPICAL) 1/4"/FT. MIN. (TYPICAL)
- METAL ROOF PANEL
- 36" PROTECTIVE WALKWAY PADS
- ROOF TRANSITION or ROOF STEP
- INDICATES DIRECTION OF SLOPE TO DRAIN 1/4" PER FOOT MIN. (U.O.N.)
- R## ROOF ASSEMBLY TAG (SEE ROOF ASSEMBLIES SCHEDULE ON A-004)
- DS DOWN SPOUT
- SS THRU-WALL SCUPPER - BOTTOM ELEV. MAX 4" ABOVE ROOF SURFACE
- RV ROOF VENT
- HP HIGH POINT
- LP LOW POINT
- EF EXHAUST FAN
- PV PLUMBING VENT
- RD ROOF DRAIN
- DO ROOF DRAIN W/ OVERFLOW OUTLET
- ROOF TOP UNIT
- PP PITCH POCKET
- DBT DUCT SUPPORT

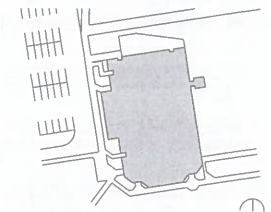
GENERAL ROOF PLAN NOTES

A. PROVIDE SINGLE PLY EPDM (WHITE) ROOFING SYSTEM (UON)
B. REFER TO STRUCTURAL DRAWINGS FOR STRUCTURAL INFORMATION
C. REFER TO MEP DRAWINGS FOR MECHANICAL, ELECTRICAL, & PLUMBING INFORMATION.
D. COORDINATE ALL ROOF PENETRATIONS W/ MEP & STRUCTURAL DWGS.
E. PROVIDE 5-1/2" MINIMUM ROOF INSULATION AT CONDITIONED SPACES
F. PROVIDE EAVE PROTECTION MEMBRANE AT ALL EAVE, RAKE, AND RISING WALL CONDITIONS.
G. LIGHTNING PROTECTION: COORDINATE WITH LIGHTNING PROTECTION SYSTEM INSTALLER FOR AIR TERMINAL LOCATIONS. INCLUDE ALLOWANCE FOR FORTY (40) PENETRATIONS

ROOF DEMOLITION NOTES

Key Value	Keynote Text
D00	Demolition Plan Notes
RD01	DEMOLISH EXISTING SLOPED GLAZING SYSTEM, PREPARE FOR NEW WALL & ROOF ASSEMBLIES.
RD02	DEMOLISH EXISTING ROOF DRAIN COLLECTOR SYSTEM, PREPARE FOR NEW ROOF DRAIN COLLECTOR SYSTEM
RD03	DEMOLISH EXISTING SCUPPER SYSTEM, PREPARE FOR NEW SCUPPER SYSTEM
RD04	DEMOLISH EXISTING SCUPPER SYSTEM
RD05	DEMOLISH EXISTING ROOFING MEMBRANE TO SUBSTRATE, PREPARE FOR NEW ROOF INSULATION AND MEMBRANE
RD06	DEMOLISH EXISTING METAL WALL PANEL AND INSULATION SYSTEM TO SHEATHING, PREPARE FOR NEW INSULATION & RAINSCREEN SYSTEM
RD07	DEMOLISH EXISTING DOMED SKYLIGHT SYSTEM, PREPARE OPENING FOR NEW SKYLIGHT SYSTEM
RD08	DEMOLISH EXISTING MANUFACTURED COPING, TYP - PREPARE FOR NEW COPING SYSTEM
RD10	DEMOLISH EXISTING METAL WALL PANEL ASSEMBLY TO SUBSTRATE, PREPARE FOR NEW INTERIOR FINISH
RD11	DEMOLISH EXISTING ROOFING SYSTEM TO DECK, DEMOLISH EXISTING FASCIA & CEILING - PREPARE FOR NEW ROOFING SYSTEM, FASCIA, AND CEILING - PROTECT IN PLACE EXISTING METAL THROUGH WALL FLASHING

No.	Description	Date



KEYPLAN

DELAWARE TECHNICAL COMMUNITY COLLEGE

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21179 COLLEGE DR.
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3/27/2026

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GEORGETOWN, DE 19947

DEMOLITION ROOF PLAN

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A103

Roof 20
Drawings

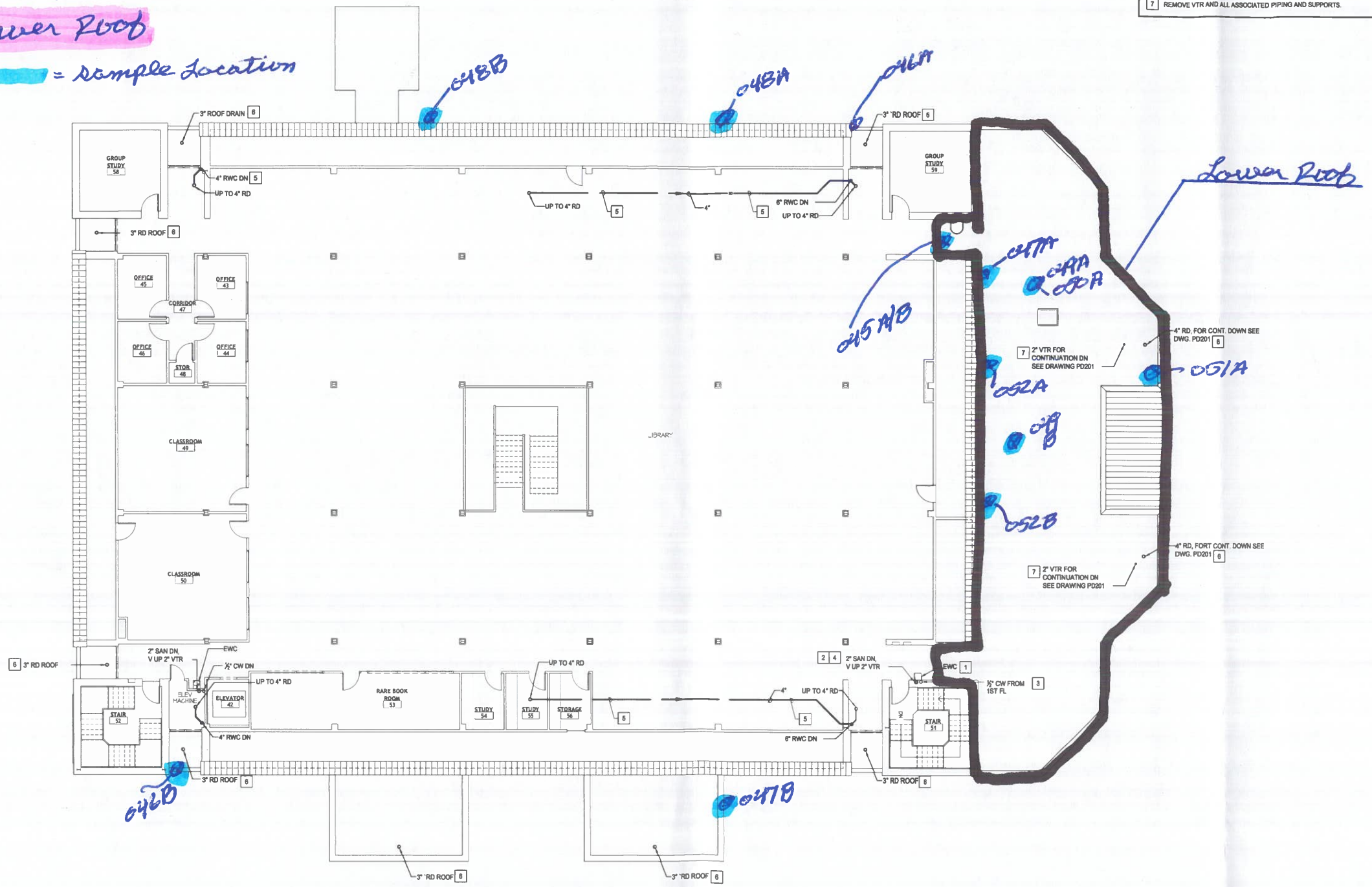
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#1094323
4/17-23/26
Lower Roof
= Sample Location

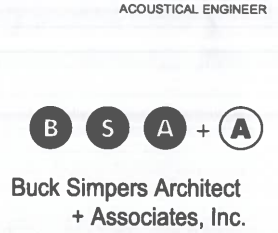
DRAWING NOTES:
(APPLY TO THIS DRAWING ONLY)

1. REMOVE WATER COOLER AND ALL ASSOCIATED SAN., CW AND VENT PIPING INCLUDING VALVES.
2. REMOVE ALL SANITARY PIPING AND ALL ASSOCIATED SUPPORTS.
3. REMOVE CW PIPING AND ALL ASSOCIATED SUPPORTS, INSULATION, AND VALVES.
4. REMOVE VENT PIPE AND ALL ASSOCIATED PIPING AND SUPPORTS.
5. REMOVE STORMWATER PIPING AND ALL ASSOCIATED SUPPORTS, INSULATION, AND VALVES.
6. REMOVE ROOF DRAINS AND ALL ASSOCIATED SUPPORTS, INSULATION, PIPING AND VALVES.
7. REMOVE VTR AND ALL ASSOCIATED PIPING AND SUPPORTS.

No.	Description	Date



1 SECOND FLOOR PLAN - PLUMBING - DEMOLITION
1/8" = 1'-0"



KEYPLAN

DELAWARE TECHNICAL COMMUNITY COLLEGE

OWNER:
DTCC
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WO# 25053

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Fax 658-1125

SAVE FOR ARCHITECTURAL SEAL

JOB NO. 25053

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GEORGETOWN, DE 19947

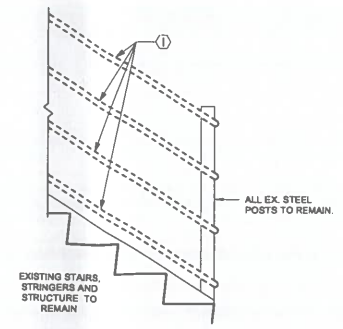
SECOND FLOOR PLAN
PLUMBING - DEMOLITION

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PD101

6
PI/SEALANT

#1094323
4/17-23/26
= sample location



2 B-WING STAIRWELL GUARD DEMOLITION DETAIL
3/4" = 1'-0"

DEMOLITION PATTERN LEGEND

- REMOVE EXISTING **FLOORING, BASE, BABEBOARDS, WALL PARTITIONS (AS NOTED), CEILINGS, LIGHTING AND MEP (AS NOTED)**. EXISTING EXTERIOR WALLS, STRUCTURE AND SLAB TO REMAIN UNLESS NOTED OTHERWISE (SEE KEYNOTES). PATCH AND REPAIR IN PREPARATION FOR NEW CONSTRUCTION
- REMOVE EXISTING **FLOORING, BASE, AND CEILINGS**. PATCH AND REPAIR AS REQUIRED TO RECEIVE NEW FINISHES.
- REMOVE EXISTING **FLOORING AND BASE**. PATCH AND REPAIR CEILINGS AS REQUIRED TO RECEIVE NEW FINISHES.
- REMOVE EXISTING **CEILING AND LIGHTING FIXTURES**. PATCH AND REPAIR AS REQUIRED TO PREPARE FOR NEW CONSTRUCTION
- REMOVE EXISTING FLOOR SLAB & DECK, REF STRUCTURAL

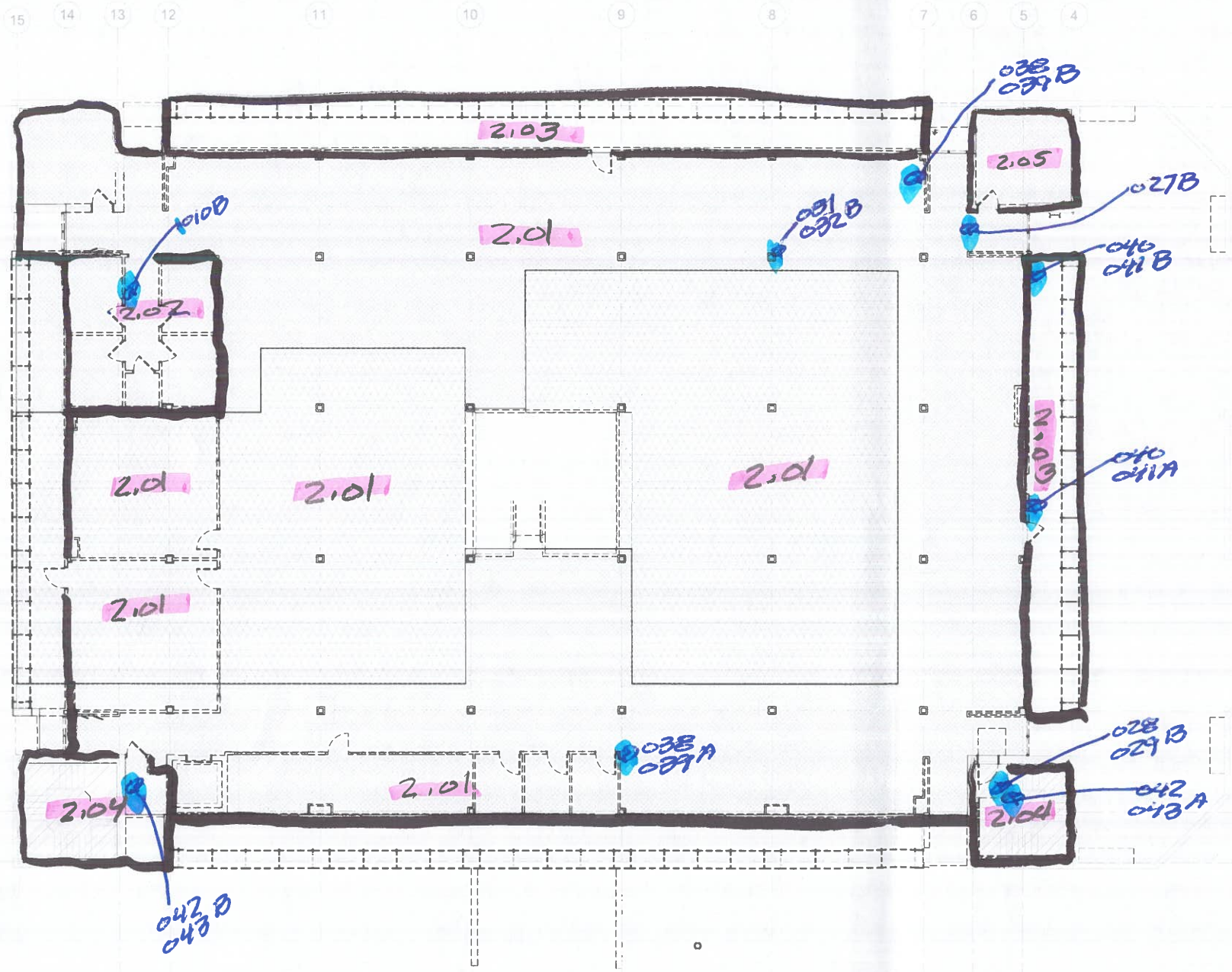
GENERAL DEMOLITION NOTES

1. DEMOLITION WORK INCLUDES, BUT IS NOT LIMITED TO THE WORK INDICATED HEREWITH, AS COORDINATED WITH WORK OF ALL OTHER TRADES AND AS REQUIRED TO ACCOMMODATE CONSTRUCTION. ALL DEMOLITION REQUIRED SHALL BE INCLUDED IN EACH CONTRACTOR'S BASE BID TO PERFORM AND COMPLETE CONSTRUCTION UNLESS OTHERWISE INDICATED. REFER TO ASBESTOS ABATEMENT REPORT AND MECHANICAL, ELECTRICAL, AND PLUMBING DRAWINGS FOR ADDITIONAL INFORMATION.
2. ITEMS TO BE SALVAGED, RELOCATED, OR REINSTALLED SHALL BE AS INDICATED. ALL ITEMS DESIGNATED AS 'SALVAGED' SHALL BE TURNED OVER TO OWNER. SPECIAL CARE IS TO BE TAKEN SO AS NOT TO DAMAGE THESE ITEMS. THE G.C. SHALL COORDINATE THE STORAGE OF ALL SALVAGED ITEMS TO BE EITHER RELOCATED OR REINSTALLED WITH THE OWNER.
3.
4. ALL EXISTING DISPLAYS, TELEVISIONS, AND WALL MOUNTED ELECTRICAL DEVICES DISPLAY DEVICES SHALL BE SALVAGED AND RETURNED TO OWNER PRIOR TO DEMOLITION IN ACCORDANCE WITH NOTE 2.
5. LOCATIONS AND/OR ELEVATIONS OF EXISTING ITEMS, AS SHOWN ON THE DRAWINGS, ARE APPROXIMATE. RESPECTIVE TRADES SHALL FIELD VERIFY ALL LOCATIONS
6. WHEN A NEW WALL, CEILING, ROOF, OR FLOOR ASSEMBLY IS INDICATED WHERE AN EXISTING WALL, CEILING, ROOF, OR FLOOR ASSEMBLY EXISTS, THE EXISTING SHALL BE COMPLETELY REMOVED, WITH ASSOCIATED UTILITIES REMOVED AND CAPPED BEHIND THE SURFACE OF THE REMAINING SUBSTRATE, UNLESS NOTED OTHERWISE. ALL DEPRESSIONS, INDENTS, OR PROTRUSIONS ETC. LEFT AFTER THE REMOVAL OF ITEMS WHICH WILL INTERFERE WITH THE CONSTRUCTION SHALL BE REPAIRED, REPLACED OR REMOVED TO PROVIDE A SMOOTH TRANSITION BETWEEN NEW AND OLD SURFACES.
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9. CONTRACTORS ARE RESPONSIBLE FOR SHORING, BRACING, AND UNDERPINNING RELATED TO THE DEMOLITION, REMOVAL, OR CUTTING OF ANY WALL, PARTITION, OR ANY OTHER STRUCTURAL ELEMENT.

DEMOLITION DRAWING LEGEND

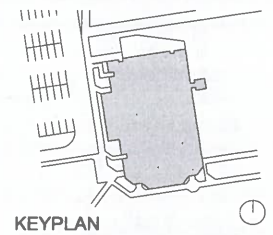
- EXISTING WALLS (TO REMAIN)
- EXISTING WALLS (TO BE DEMOLISHED)
- EXISTING DOOR (TO REMAIN)
- EXISTING DOOR (TO BE DEMOLISHED)

Keynote Legend	
Key Value	Keynote Text



1 SECOND FLOOR (DEMOLITION)
1/8" = 1'-0"

No.	Description	Date



KEYPLAN

DELAWARE TECHNICAL COMMUNITY COLLEGE

OWNER:
DTCC
21179 COLLEGE DR.
GEORGETOWN, DE 19947

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954 JUSTISON ST.
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302 658-9300
Fax 658-1125

3/27/2026

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GEORGETOWN, DE 19947

DEMOLITION PLAN - LEVEL TWO

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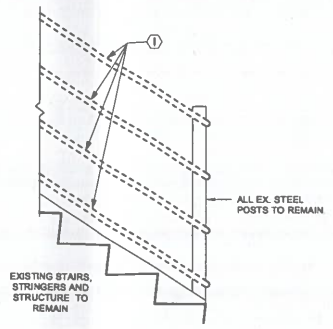
A102

Duke 4
CT 2
Floors B
CB 4

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3/27/2026 8:56:04 AM

#1094323
4/17-23/26
[redacted] = sample location



17 EGRESS STAIRWELL GUARD DEMOLITION DETAIL
3/4" = 1'-0"

DEMOLITION PATTERN LEGEND

- REMOVE EXISTING FLOORING, BASE, BASEBOARDS, WALL PARTITIONS (AS NOTED), CEILINGS, LIGHTING AND MEP (AS NOTED). EXISTING EXTERIOR WALLS, STRUCTURE AND SLAB TO REMAIN UNLESS NOTED OTHERWISE (SEE KEYNOTES). PATCH AND REPAIR IN PREPARATION FOR NEW CONSTRUCTION.
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- REMOVE EXISTING FLOORING AND BASE. PATCH AND REPAIR CEILINGS AS REQUIRED TO RECEIVE NEW FINISHES.
- REMOVE EXISTING CEILING AND LIGHTING FIXTURES. PATCH AND REPAIR AS REQUIRED TO PREPARE FOR NEW CONSTRUCTION.
- REMOVE EXISTING FLOOR SLAB & DECK, REF STRUCTURAL

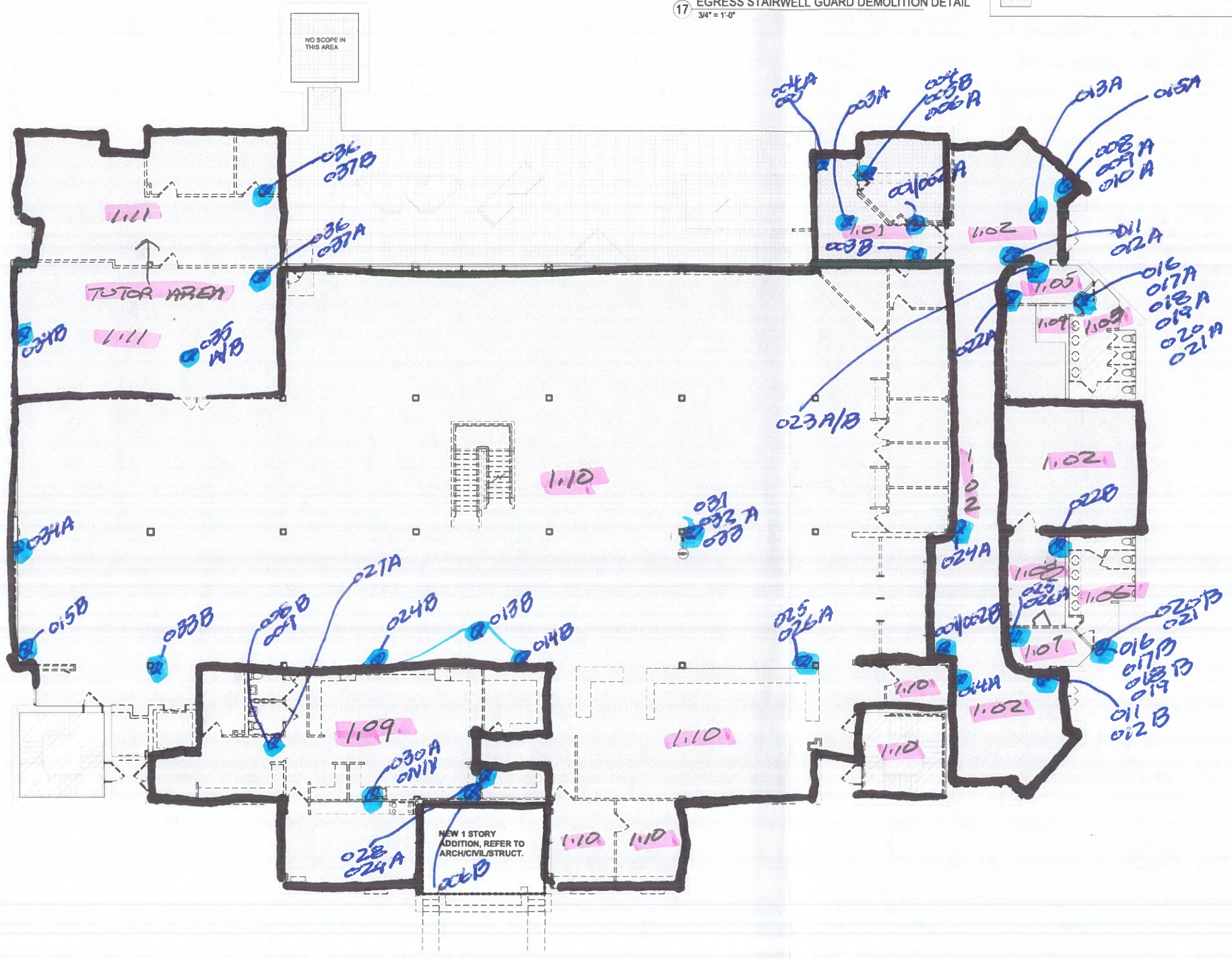
GENERAL DEMOLITION NOTES

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DEMOLITION DRAWING LEGEND

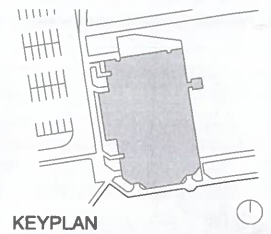
- EXISTING WALLS (TO REMAIN)
- EXISTING WALLS (TO BE DEMOLISHED)
- EXISTING DOOR (TO REMAIN)
- EXISTING DOOR (TO BE DEMOLISHED)

Keynote Legend	
Key Value	Keynote Text
D001	DEMOLISH EXISTING COLUMN WRAP AND PREP FOR NEW WRAP SYSTEM, TYP.



1 FIRST FLOOR (DEMOLITION)
1/8" = 1'-0"

No.	Description	Date



KEYPLAN

DELAWARE TECHNICAL COMMUNITY COLLEGE

OWNER:
DTCC
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3/27/2026

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Renovation

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GEORGETOWN, DE 19947

DEMOLITION PLAN - LEVEL ONE

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A101

Dw/sc 6
CT 3
Floors 10
CB 6
25

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BATTA Environmental

EVENTS LOG

Project Name: DTCC-owens campus, Betye Library
Site Inspected: 21179 College Dr Georgetown, DE.
Building Inspector (s): Hogate

BEA#: 1094323
Date: 4 /17-23 / 26
Events Log Sheet 1 of 1

Time(24hr)	Event
1020	enroute to site.
1203	arrived on site, Met w/ facilities (Chevey) who escorted Batta to library and conducted a Thorough walk through of all areas
1326	Batta began grid of work areas
1500	advised facilities of Departure
4/21/26	0645, enroute to site. arriving @ 0823 hrs, obtained Keys from facilities and continued inspection + sampling
1503	Returned Keys to facilities + Departed site
4/22/26	0650 hrs, enroute to site, arriving @ 0830 hrs. obtained Keys from facilities, Proceeded to library continued inspection
Note	began exterior + roof sampling prior to expected weather this PM.
Note	all core sampling Patched. Roof + exterior complete
1144	continued interior inspection
1609	Returned Key to facilities, Briefed facilities (Chevey) of findings, Roof Patched, Water closed + secure. all facilities Room secure. 111 PLM samples collected Photo's Taken
1517	Departed site
4/23/26	1700-2200 hrs, completed all paperwork
4/25/26	Paperwork + samples submitted.

Ph: 302.737.3376
Fx: 302.737.5754

BATTA Environmental Associates, Inc
6 Garfield Way
Newark, DE. 19713

info@battaenv.com
Battaenv.com

BATTA Environmental

ASBESTOS SURVEY DATA CHECKLIST

Project Name: DTCC-Carvers Campus, Betye Library
BEA#: 1094323
Site Inspected: 21179 College Dr. Georgetown, DE
Date: 4 /17-23 / 26
Building Inspector(s): Bogata
Checklist Sheet 1 of 1

Instructions: *'~~Strikethrough~~' if not observed, not present or not included, 'X' box if present and inspected*

Scope of Work: [X] Renovation [ ] Demolition
[ ] Limited Renovation (list areas)_____
[ ] Roof Included [ ] Exterior Included

Number of structures included in survey: 1

Structure # 1 Type or Usage of structure: Library

Structure Description: [ ] one story [X] two story [ ] three story [ ] split level [ ] _____

Elements of the structure

[X] Roof	[ ] Shingles	[ ] Rolled	[ ] Built-up(flat)	[X] Membrane	[ ] Multiple layers
	[ ] Transite	[ ] Metal	[ ] Tar Paper	[ ] _____	
[X] Flashing	[ ] Chimney	[X] Edge	[X] Wall	[ ] Parapet/Cap	[ ] Patch
	[ ] Vent	[ ] Mechanical	[ ] Drain	[ ] Pitch Pocket	[ ] _____
[X] Exterior	[ ] Wood	[ ] Vinyl	[ ] Alum./Steel	[ ] _____	[ ] _____
	[X] Brick	[ ] Block	[ ] Stone	[ ] Stucco	[ ] Transite
	[ ] Peaks	[ ] Dormers	[ ] Multiple layers		
[X] Structure	[ ] Wood Frame	[X] Steel Frame	[X] Full Masonry	[ ] _____	
[X] Foundation	[X] Slab	[ ] Crawlspace	[ ] Basement	[ ] Dirt Floor	[ ] Concrete Floor
	[ ] Debris	[ ] Bearing Plates	[ ] _____		
[ ] Attic					
[ ] Fireproofing	[ ] Beams	[ ] Decking	[ ] Columns	[ ] _____	
[X] Insulation	[ ] Attic/Roof	[ ] Ceilings	[ ] Walls	[ ] Floors	
	[ ] Pipe	[X] Duct	[ ] Duct Board	[ ] Wiring	
	[ ] Boiler	[ ] Heater	[ ] Gaskets	[ ] Water Heater	
	[ ] Heat Shield	[ ] Wood Stove	[ ] Fireplace	[ ] Flue Packing	[ ] Flue Pipe
[X] Vibration Damper Cloth on Ducts					
[X] Fire Doors	[ ] Insulated	[X] unknown - PACM			
[X] Caulk	[X] Building	[X] Window	[X] Door	[ ] Tel/Elec Entry	[ ] _____
[ ] Glazing Bed	[ ] Putty	[ ] Rubber/Vinyl	[ ] None	[ ] _____	
[ ] HVAC units	[X] Duct Insul.	[ ] Pipe Insul.			
[ ] Cooling Tower	[ ] Exterior	[ ] In-Fill	[ ] Pipe Insul.	[ ] _____	
[X] Ceiling	[ ] Plaster	[X] Drywall/JC	[ ] Textured	[ ] Open	[ ] _____
	[ ] Glued Tiles	[ ] Stapled Tiles	[ ] Splined Tiles	[X] Drop in tiles	[ ] _____
[X] Walls	[X] Drywall/ JC	[X] Plaster	[ ] Textured	[ ] Ceramic, metal or plastic tile mastic	
	[ ] Paneling/nails	[ ] Paneling/mastic	[ ] Baseboard mastic	[X] Transite + wood	
[X] Floors	[X] Concrete	[ ] Stone/Slate	[X] Ceramic	[ ] Terrazzo	[ ] _____
	[ ] Wood	[X] Carpet	[X] Sheet Floor	[X] Floor Tile	[ ] _____
	[X] Sheet mastic	[X] Tile mastic	[X] Ceramic mastic	[ ] Stone/Slate mastic	[ ] _____
[X] Sinks	[X] Sound deadener spray-on		[ ] Stone-like Utility/ Laundry		
[ ] Electrical Panel Backer Board				[ ] other_____	
[ ] Containers of Asbestos containing mastics, glues, roofing coatings				[ ] other_____	
[ ] other_____			[ ] other_____		

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U.S. Department of Labor
Employment Standards Administration
Wage and Hour Division

PAYROLL

(For Contractor's Optional Use; See Instructions, Form WH-347 Inst.)

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

Rev. April 2006

NAME OF CONTRACTOR ☐ OR SUBCONTRACTOR ☐ | ADDRESS | OMB No.: 1215-0149 Expires: 04/30/2009

PAYROLL NO. | FOR WEEK ENDING | PROJECT AND LOCATION | PROJECT OR CONTRACT NO.

(1) NAME, ADDRESS, AND SOCIAL SECURITY NUMBER OF EMPLOYEE	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	OT. OR ST.	(4) DAY AND DATE HOURS WORKED EACH DAY	(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS FICA	WITH-HOLDING TAX			OTHER	TOTAL DEDUCTIONS	(9) NET WAGES PAID FOR WEEK
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The Copeland Act (40 U.S.C. 3145) requires contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) Regulations 29 CFR Part 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. Compliance with these requirements is mandatory. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

We estimate that it will take an average of 56 minutes to complete this collection of information, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection of information, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, ESA, U. S. Department of Labor, Room S3502, 200 Constitution Avenue, N. W., Washington, D. C. 20210.

Date _____

I, _____ _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by

_____ on the
(Contractor or Subcontractor)

_____; that during the payroll period commencing on the
(Building or Work)

_____ day of _____, _____, and ending the _____ day of _____, _____,

all persons employed on said project have been paid the full weekly wages earned, that no rebates have been or will be made either directly or indirectly to or on behalf of said

_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part 3 (29 CFR Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948, 63 Start. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. 276c), and described below:

_____

_____

_____

_____

(2) That any payrolls otherwise under this contract required to be submitted for the above period are correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the applicable wage rates contained in any wage determination Incorporated into the contract; that the classifications set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and Training, United States Department of Labor, of if no such recognized agency exists in a State, are registered with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:

(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

☐ – in addition to the basic hourly wage rates paid to each laborer or mechanic listed in the above referenced payroll, payments of fringe benefits as listed in the contract have been or will be made to appropriate programs for the benefit of such employees, except as noted in Section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

☐ – Each laborer or mechanic listed in the above referenced payroll has been paid, as indicated on the payroll, an amount not less than the sum of the applicable basic hourly wage rate plus the amount of the required fringe benefits as listed in the contract, except as noted in Section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE 31 OF THE UNITED STATES CODE.

* U.S. G.P.O.:1997 519.861

SECTION 011100 – SUMMARY OF WORK

PART 1 – GENERAL

1.1 Drawings and general provisions of contract, including General and Supplementary Conditions and other Division – 1 Specifications Sections, apply to this Section.

1.2 PROJECT DESCRIPTION

A. This part of the project consists of the Bid Pac A Contracts, No. 1 through No. 17. The description of the contracts are as follows:

Bid Pac A

Contract 1	Demolition
Contract 2	Site Work
Contract 3	Concrete Work
Contract 4	Masonry Work
Contract 5	Steel Work
Contract 6	Carpentry & General Work
Contract 7	Roofing Work
Contract 8	Furnish Hollow Metal/Doors/Hardware
Contract 9	Aluminum Storefront/Windows/Glass and Glazing
Contract 10	Drywall/Metal Stud
Contract 11	Acoustical Work
Contract 12	Floor Covering Work
Contract 13	Caulking/Painting
Contract 14	Casework
Contract 15	Mechanical
Contract 16	Sprinkler System
Contract 17	Electrical

1.3 CONTRACTOR USE OF PREMISES

A. General: During the construction period the contractor will be allowed reasonable use of the premises. However, the contractors use of the premises will not limit the Owners use of premises.

1.4 The Construction Managers scope of work is part of this section and denotes the work to be performed.

1.5 MISCELLANEOUS PROVISIONS

A. Miscellaneous Provision

1. The construction will start on August 15 2026 Note that weekend and evening work may be required to meet the schedule. All materials may be procured early so that they are readily available. The Owner will pay ninety-five percent (95%) of stored materials providing they are properly insured, stored and can be verified.

B. Project Meetings

1. Pre-Construction Conference: Attendance by Owner, Architect, Engineers, Construction Manager, Contractor, major Subcontractors, and Suppliers.

2. Progress Meetings: Bi-weekly; attendance by Owner, Architect, Engineers, Construction Manager, Contractor, applicable Subcontractors, and Suppliers.

NOTE: Meetings may be held more frequently as required. Must attend these meetings and missing meetings will not be tolerated from Primary Contractors. Missing meetings will result in a penalty of $200.00 dollars per meeting if your firm was requested to attend at the previous progress meeting.

C. Record Drawings

1. The contractors of the respective Contracts 1 thru Contract 15 shall be responsible for maintaining record "as builts" throughout construction as indicated in Section 017000.

D. Schedule

Construction starts August 15, 2026. Project is to be finished by January 15, 2028. Please provide sufficient manpower in your cost to meet the completion date of January 15, 2028.

Bid Pac A

Contract 1	Demolition
Contract 2	Site Work
Contract 3	Concrete Work
Contract 4	Masonry Work
Contract 5	Steel Work
Contract 6	Carpentry & General Work
Contract 7	Roofing Work
Contract 8	Furnish Hollow Metal/Doors/Hardware
Contract 9	Aluminum Storefront/Windows/Glass and Glazing
Contract 10	Drywall/Metal Stud
Contract 11	Acoustical Work
Contract 12	Floor Covering Work
Contract 13	Caulking/Painting
Contract 14	Casework
Contract 15	Mechanical
Contract 16	Sprinkler System
Contract 17	Electrical

Bid Pac A

The following parts of the specifications are to be considered part of each and every one of the contracts of Bid Pac A, Contracts No. 1 through 17. However, they shall not be listed with the Scope of Work for each of the Scopes of Work for the contracts. They will be referred to as the Administrative Sections with each of the Scope of Work for the contracts.

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

000101	PROJECT CONTACTS
000111	TABLE OF CONTENTS
000115	LIST OF DRAWINGS
000113	ADVERTISEMNET FOR BIDS
002113	INSTRUCTIONS TO BIDDERS
004126	BID FORMS INCLUDING:
	BID FORM
	SUB LISTING
	NON-COLLUSION STATEMENT
	AFFIDAVIT OF EMPLOYEE DRUG TESTING PROGRAM
	AFFIDAVIT OF CONTRACTOR QUALIFICATIONS
004313	STATE OF DELAWARE BID BOND

CONTRACTING INFORMATION

005226	AGREEMENT INCLUDING STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR (AIA A132 – 2019)
005313	AMENDMENT TO CONTRACT FOR CONSTRUCTION BETWEEN DELAWARE TECHNICAL AND COMMUNITY COLLEGE AND CONTRACTOR
006113.13	STATE OF DELAWARE PERFORMANCE BOND FORM
006113.16	STATE OF DELAWARE PAYMENT BOND FORM

006276 MONTHLY REQUISTION & CONTINUATION SHEET (AIA G732-2019 & G703-2021)
006300 STANDARD FORMS CERTIFICATES AND MODIFICATION FORMS
007226 GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION (AIA A232-2019)
007300 SUPPLEMENTARY GENERAL CONDITIONS A232-2019 INCLUDING ATTACHMENT "A" CONSTRUCTION MANAGER GENERAL CONDITIONS
007316 INSURANCE INCLUDING SAMPLE CERTIFICATE OF INSURANCE
007346 DELAWARE PREVAILING WAGE RATES
008013 GENERAL REQUIREMENTS
008114 DRUG TESTING FORMS
009300 RECORD CLARIFICATION AND PROPOSALS
PAYROLL REPORT FORM

DIVISION 01 – GENERAL REQUIREMENTS

011100 SUMMARY OF WORK
011200 MULTIPLE CONTRACT SUMMARY
011216 WORK SEQUENCE
011400 WORK RESTRICTIONS
012000 PRICE AND PAYMENT PROCEDURES
012100 ALLOWANCES
012116 CONTINGENCY ALLOWANCES
012200 UNIT PRICES
012300 ALTERNATES
012500 SUBSTITUTION PROCEDURES
012500A SUBSTITUTION REQUEST FORM
012600 CONTRACT MODIFICATION PROCEDURES
012900 PAYMENT PROCEDURES
012973 SCHEDULE OF VALUES
013100 PROJECT MANAGEMENT AND COORDINATION
013113 PROJECT COORDINATION
013216 CONSTRUCTION SCHEDULE
013233 CONSTRUCTION PROGRESS DOCUMENTATION
013300 SUBMITTAL PROCEDURES
013319 FIELD ENGINEERING
013500 SAFETY PROGRAM
014000 QUALITY REQUIREMENTS
014200 REFERENCES
015000 TEMPORARY CONSTRUCTION UTILITIES, FACILITIES & CONTROLS
016000 MATERIALS AND EQUIPMENT PRODUCT REQUIREMENTS
017000 CONTRACT CLOSEOUT
017329 CUTTING AND PATCHING
017419 CONSTRUCTION WASTE MANAGEMENT
017700 CLOSEOUT PROCEDURES
017836 WARRANTIES
019113 GENERAL COMMISSIONING REQUIREMENTS
019114 PLUMBING COMMISSSIONING REQUIREMENTS
019115 HVAC COMMISSIONING REQUIRMENTS
019116 ELECTRICAL SYSTEMS COMMISSIOING REQUIRMENTS

SCOPE OF WORK - Bid Pac A
CONTRACT NO. 1 DEMOLITION

A. The administrative sections, prints, addendums, and technical specification 024119.

B. Provide removal and disposal of PCB ballasts per local and federal codes and guild lines. Cost will be determined by unit price and amount of ballast that are encountered during the demolition phase.

C. Provide removal off site of all debris in a required manner meeting all local, state and federal laws.

D. Provide documentation the proper removal and disposal of universal waste such as mercury thermostats, mercury containing fluorescent light bulbs, and lead acid batteries from emergency lighting.

E. Provide temporary closures to the existing library of any areas that are open to exterior from the result of demolition of portions of the building.

F. Provide coordinatin of disconnecting and safing of existing building electrical system before building demolition starts; disconnect and remove service not limited to meter aerial and underground service complete to source point if required. Contract 17 Electrical will provide disconnecting and safing off of electrical system.

G. Each prospective bidder must visit the site to familiarize themselves with the current existing conditions.

H. Construction Manager will provide all temporary fencing. This contract is responsible for the moving and closing up the fencing on a daily basis to ensure the site is secure.

I. Provide removal of doors, frames and hardware as noted.

J. Provide removal of all furniture, trash, supplies, etc..; that is in the building at time of the pre-bid meeting complete.

K. Provide the demolition permit and all soil testing and license to perform the demolition scope of work.

L. Provide the draining and proper removal of all HVAC fluids, Freon and gas before the starting of demolition.

M. Provide gas line removal complete.

N. Provide all concrete demolition on interior of building. Contract No. 1 Sitework to provide exterior demolition including exterior concrete steps, rail pads and ramps as required.

O. Provide all temporary shoring and underpinning as needed where walls, roof, floors and foundations are removed or existing structure bears on a demolished structure.

P. If any areas that are to remain are damaged by this Contract's demolition, the areas are to be patched and repaired to a satisfactory condition acceptable to the Architect and Construction Manager.

Q. Provide all demolition required to install new product including the demolition of all built ins, display cases, casework, doors, hollow metal windows, frames, shelving, lockers, book lift, fire extinguishers, corner edge protection, book shelves, T.V. brackets, casework and window treatments as shown. Modification and demolition of chalk and tack boards, toilet partitions, toilet accessories, flooring, display cases, all wood framed walls with attachments, railings, projection screens, operable walls, and column covers. Provide demolition to all wood stud walls and metal stud walls that are covered with any material. Drywall and plaster covered walls are demolished also by this contract.

R. This contract is to provide demolition of existing windows, storefront, curtain walls and doors complete. Temporary protection and waterproof existing openings until new unit is installed.

S. Provide the demolition of any drywall, metal or wood stud framing that have plaster or drywall installed on them. Plaster or drywall ceilings and soffits or attachment to these walls or soffits.

T. Provide removal of all existing acoustical ceilings, grids, supports and insulation and all other layers of ceiling assemblies. This includes plaster ceilings and wood lath.

U. Provide demolition of all casework and millwork as needed to install new finishes.

V. Provide demolition of the existing elevator and all associated equipment.

W. Provide removal off site of all demolition debris in a required manner meeting all local, state and federal laws.

Y. Provide the demolition required to install new carpet, floor tile, ceramic tile, resinous flooring and base. Others will remove floor tile that has environmental issues but this Contract must remove all other flooring that does not contain asbestos and other floor coverings. Also provide removal of all glues, adhesives, grout, etc.. and coordinate with the flooring contract on method of removal to so it will not jeopardize new flooring installation and requirements.

Z. Provide removal of wall tile and mastic as noted in project documents.

AA. Provide demolition of existing roof drains as noted. Coordinate with roofing contract.

BB. Provide the selective demolition of all existing mechanical items and plumbing items. This will require the capping of the utilities associated with the casework. Provide removal of louvers, water coolers, boilers, air handlers fans, window A/C units, ductwork, chiller, all piping, valves, unit ventilators, hot water converters, fined tube radiators, roof top units, ATC panels , fan coil units, electric cabinet heaters, fans, RTU, ventilators, PRV, boilers and freezers, plumbing fixtures, panels, sump pumps, water heaters, etc..

CC. Provide demolition of existing sprinkler system as shown or noted in specifications.

DD. Provide demolition of existing fire alarm, security system, intercom system, speaker system, electrical system and clock system.

EE. Provide demolition of all existing electrical items including wiring, lighting, boxes conduit as noted in documents.

FF. Provide removal and disposal of PCB ballasts per local and federal codes and guild lines. Cost will be determined by unit price and amount of ballast that are encountered during the demolition phase.

GG. Provide demolition of all electrical items including lights, wiring, panels, speakers, water coolers, fire alarms, power poles, ect..

HH. Areas where selective demolition is being done, provide temporary weather protection to interior space where windows and doors and drains are being removed. Coordinate removal of roof drains at the time of roof removal with Contract 7 Roofing. Note that wood flooring in gym and auditorium and other areas is not being removed.

II. Provide demolition of column wraps complete.

JJ, Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

KK. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

LL. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

MM. See section 012300 Alternates and bid form for your responsibility for the alternates.

NN. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

OO. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK - Bid Pac A
CONTRACT NO.2 SITE WORK

A. The administrative sections, prints, addendums, and technical specifications 024119, 033000, 079200 & 323119.

B. Provide all layout work required to accomplish this Contract work. A Licensed surveyor must perform the layout work.

C. Provide topsoil stripping as required. Retain and stockpile all topsoil or soil needed to re-grade the site. Any soils not needed will be disposed of offsite by this contract in a proper manner. This is inclusive of all new and renovated building area footprints.

D. Provide all grading and fine grading of sub-grades for swales, berms, walks, pavement and playground fields.

E. Provide all site select fill for the building and site concrete.

F. Provide all storm drainage and storm water control including compost filter logs.

G. Provide all crusher run for site concrete.

H. Provide all lawns, grasses, hydro seeding, sodding, turf relocation and erosion control materials complete.

I. Provide all sediment and erosion control, including the installation, maintenance, and removal after construction of the silt fence and construction entrance. Restore areas where sediment and erosion control has been removed after construction. Also, provide all bio-retention areas, detention basins complete. Maintain the construction entrance and a clean roadway and street.

J. Provide any temporary seeding required for erosion control.

K. Coordinate all construction work with other utilities and notify Miss Utility prior to the start of work to locate existing underground utilities. All other existing utilities on site to be located under this contract, including data communication lines if any. Any damage to the existing utilities will be repaired under this contract at no additional cost to the owner.

L. Provide all excavation and backfill required to accomplish the work of this Contract, including the proper compaction of all backfill materials. Provide the removal off site of any and all excess fill. Provide compaction testing. Provide all final grading of site.

M. Each prospective bidder must visit the site to familiarize themselves with the current existing conditions.

N. Install all bollards furnished by Contract No.5 Steel Work. Include concrete in fill as required.

O. Provide all site concrete work as shown. Run all concrete work to the face of the buildings to meet interior concrete work performed by Contract No. 4 Concrete Work. Provide all stone bases and preparation work to install the site concrete. Provide all slab work and frost walls at exterior,

as well as any necessary demolition to install pads and frost walls if under a canopy roof. Provide colored, stamped and patterned concrete and exposed aggregate concrete if noted in contract documents.

P. This contract is to provide the building, step and ramp fill to an elevation of plus or minus one (1") inch.

Q. Construction Manager will provide all temporary fencing.

R. Provide exterior caulking of expansion joints at all concrete locations including sidewalks and curbs.

S. Electrical service to your construction trailer to be provided by this contract.

T. Provide all underground roof and gutter drain lines, and roof drain curb outlets complete, including connections to downspouts and splash blocks. Provide the rainwater conductor and the cast iron rainwater boots. Also provide removal of drain lines where portion of the building is being demolished and relocate where needed.

U. Provide the demolition of all trees, shrubs and existing stumps as required. Provide offsite deposit of all demolition material.

V. Provide CCR Reports, soil testing and all license and permits to perform the Site Work scope of work. Owner will obtain the building permit.

W. Provide site furnishings including bike racks, gates, trash receptors, benches and all associated foundations for a complete installation.

X. All electric lines, data lines, phone lines, etc.. are to be provided by Contract No. 17 Electrical.

Y. This contract is responsible for all demolition that pertains to your scope of work.

Z. Provide all demolition required to install new work and shown on drawings including curbs sidewalks, tree and shrub removal, etc. Provide the demolition of anything that gets removed outside of the footprint of the main existing building to build the new building including canopies, walkway covers, concrete work, foundation, ramps, loading docks and miscellaneous steel. We suggest that the site work bidders visit the job site and note the extent of the demolition required to erect the new addition, and new site work. Also protect existing trees. Contract 2 Site Work is to remove all outdoor concrete and sidewalks as noted.

AA. Provide the relocation or adjustment of existing utility lines as necessary to install new lines.

BB. Provide all testing and inspections for your work.

CC. Provide testing of trenches that are opened and backfilled pertaining to your scope of work.

DD. Provide dewatering if needed for your scope of work.

EE. Provide all fine grading of landscape beds.

FF. Provide all soil amendments and fertilizers and the blending of these items into the top soil.

GG. Provide weed-control barriers and mulches complete.

HH. Provide all landscaping, trees and shrubs and the planting and pruning of these items complete. Provide protection of existing landscaping that is not to be removed. Provide relocation of existing landscaping as noted.

II. Provide plant maintenance and watering of landscaping for a period noted in the project documents.

JJ. Provide concrete wash out station for your concrete work and spill control station, including removal once complete.

KK. Provide bike racks and all associated concrete pads and footers.

LL. Provide demolition of patio area for new addition.

MM. Provide an allowance of $10,000 in your base bid for exterior temporary fence.

NN. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

OO. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

PP. See section 012300 Alternates and bid form for your responsibility for the alternates.

QQ. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

RR. It is the contracts responsibility to review all other contract scopes of work

SCOPE OF WORK - Bid Pac A
CONTRACT NO. 3 CONCRETE WORK

A. The administrative sections, prints, addendums, and technical specifications 030516, 033000, 071326, 072200 & 079200.

B. Provide all layout for the building foundations, locations and elevations by a registered surveyor complete. **NOTE:** The site work layout will be provided by the site work contractor (coordinate with Bid Pac A Contract No. 2 Site Work).

C. Install all anchor bolts and the leveling, grouting and setting of the bearing plates for the structural steel material furnished by Contract No. 5 Steel Work and Contract No. 10 Drywall/Metal Stud materials. Steel and metal stud shop drawings to be used for layout of anchor bolts.

D. Provide all perimeter insulation under concrete slabs and foundation walls, also provide under slab vapor barrier complete..

E. Provide the concrete infill for metal stairs and platforms.

F. Provide sufficient layout work in regards to the foundation so that the masonry contract can provide wall foundations. Maintain batter boards and lines until masonry contractor starts work after the masonry contract accepts layout and starts work. It is the masonry Contractors responsibility to maintain work from that point forward.

G. Provide all grading and grading of sub-grades for footings, foundation, floors and cast in place walls.

H. Provide all excavation required for foundation work and the backfill required to do the poured in place concrete work.

I. Provide all concrete foundations and rebar complete including any foundations outside the building foot print including planters, canopies, retaining walls, truck dock, piers, signage, etc..

J. Compact and backfill all trenches, foundations and other concrete work associated with this work only. Provide removal off-site of all excess soils due to excavation of your work.

K. Provide all floor slabs complete including weather (hot and cold) protection, mesh, vapor barriers, sealers, water proof barriers, composite waterproof membrane, expansion and control joints, caulking and perimeter insulation under slab for a complete system. Refer to Division 9 Flooring Sections in reference to floor finish tolerances. Concrete sealers and curing Compounds must be compatible with flooring adhesives. Any irregularities in concrete surfaces at expansion joints to be ground flat to meet flooring contractor's specifications. Provide all concrete floor slab infill areas where demolished masonry wall is removed below finish floor. Refer to Division 9 Flooring Sections in reference to floor finish tolerances.

L. Provide all concrete slab work to the exterior face of the enclosed building area. The site contract will pick it up from that point except for exterior outdoor gathering area noted on bid documents.

M. Provide stone drainage fill under all concrete slabs within the building footprint or under exterior concrete provided by this contract.

N. **NOTE:** The item X in the site work contract scope of work. All fill in the building, step and ramps are to be plus or minus one (1") inch. This Contract is responsible to handle the preparation from that point to the completion of the concrete work.

O. Provide all depressed concrete for floor mats at entrance and all other items that need concrete depressions. Locations and sized to be coordinated with other contracts.

P. All cast in place concrete beams, lintels and walls to be included in this contract. Bond beams and CMU grouting is responsibility of Masonry Scope.

Q. It is the responsibility of this contract to coordinate with the Mechanical and Electrical Contractors, the elevation and locations of all imbedded items, at the time of pour including the proper sloping of floors to floor drains and troughs.

R. Concrete footings to be clean of all debris and dirt prior to sign off to Masonry Contractor.

S. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

T. Provide assistance of all testing and inspections for your work. Owner will provide an inspection agency to do the testing. If testing fails, contractor will pay for additional testing.

U. Notify mechanical and electrical contractors with a schedule of when the concrete is to be poured so these contractors can verify their equipment locations.

V. Provide colored concrete finish complete and pattern concrete as noted in finish schedule and specifications.

W. Existing building elevations to be confirmed under this contract.

X. Provide infill of concrete where demolition has been performed.

Y. All concrete debris to be disposed of off-site in a required manner meeting all local, state and federal laws.

Z. Provide installation of steel edging in concrete as noted. Contract No. 6 Steel Work will furnish.

AA. Provide repair of concrete floor cracks as noted in documents.

BB. Provide all caulking and sealants for concrete slabs provided by this contract.

CC. The concrete contractor is to coordinate with surveyor on the amount of locations and elevations the surveyor is to locate. Concrete contractor is responsible for accuracy of the layout.

DD. Provide testing of trenches that are opened and backfilled pertaining to your scope of work.

EE. Provide dewatering if needed for your scope of work.

FF. Provide reinforcement for all concrete provided by this contract.

GG. Provide self adhering sheet waterproofing and composite waterproofing complete.

HH. Provide all concrete work for the elevators and shafts complete.

II. Provide termite control system.

JJ. Provide concrete wash out station.

KK. Provide cast in place stairs and landing and check wall at all interior and exterior locations.

LL. Provide insulation that is under concrete pads.

MM. Provide concrete infill at existing walls and floors where demolition items have been removed.

NN. Provide interior and exterior ramps and pads noted on structural drawings complete.

OO. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

PP. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

QQ. See section 012300 Alternates and bid form for your responsibility for the alternates.

RR. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

SS. It is the contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK – Bid Pac A
CONTRACT NO. 4 – MASONRY WORK

A. The administrative sections, prints, addendums, and technical specification sections 024119, 033000, 042000, 047200, 071326, 072200, 076200 & 079200.

B. Provide all masonry work complete including cmu block, ground face CMU and brickwork, jack arches, quoin corners, screenwalls, etc. All hollow metal doors and frames are to be stored and set by Contract No.6 Carpentry and General Work.

C. Provide all concealed and thru wall flashings.

D. Provide cavity wall insulation and other insulation attached between masonry walls and masonry veneer. Perimeter foundation wall insulation to be provided by Contract No. 3 Concrete Work. Provide cavity drainage mat system. Provide all ridged insulation that is located between masonry and masonry veneer. Contract No. 10 Drywall/Metal Stud will provide ridged insulation where attached to metal stud framing or masonry wall and no masonry veneer is located. Contract 10 Drywall/Metal Stud will provide all spray applied membrane air barriers.Contract 4 Masonry provides transition membrane around window and doors, etc.. where there is masonry backup and veneer.

E. Provide the installation of all bearing plates and bolts associated with the masonry for the steelwork and cold formed metal framing. The plates and bolts will be furnished by Contract No. 5 Steel Work. Steel contractor and masonry contractor to coordinate locations and placement of items at the time of masonry construction.

F. Install all steel lintels attached or resting on masonry work finished by contract No. 5 Steel Work. Provide masonry pockets and grout filling of masonry cores where steel beams are attached or resting on masonry work. All structural steel beams provided and installed by Contract No. 5 Steel Work.

G. Provide all cast stone as shown including window sills, bands, copings, accents and modular units.

H. Provide the concrete and rebar for all the filling of block cores, bond beams and bearing points. Include all reinforcements, wall anchors and fasteners to attach to sub surface.

I. Install joist bearing plates furnished by Contract No. 5 Steel Work that rest on masonry. Coordinate with Contract No. 5 Steel Work.

J. See Item F Contract No. 3 Concrete Work for the layout and maintenance responsibility. This contract is responsible for layout of their portion of their work.

K. Provide all grouting of masonry walls required. Also provide grouting of new doors and frames in existing openings.

L. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

M. Provide fire stopping and protection for masonry walls including fire safing with mineral wool insulation. Provide wall markings for masonry fire and smoke partitions. Provide fire or acoustical sealant where wall intersects with floor or roof deck.

N. All masonry debris to be disposed of off-site in a required manner meeting all local, state and federal laws.

O. Provide masonry opening required for mechanical and electrical equipment. Location and sizes must be coordinated with each contractor. Also include masonry openings for other trades and access panels and doors as noted by these trades.

P. All wall penetrations to be patched prier to painting or cost of touch up painting to be deducted from contract.

Q. Provide bituminous damp proofing and all related accessories as noted on the project documents that is attached to masonry. Also provide waterproof membrane at locations noted in project documents.

R. Furnish all wall anchors that are welded to steel beams and coordinate with Contract No. 5 Steel Work for the welding of these anchors only. All other wall anchors are to be furnished by the mason.

S. Provide the repairs of masonry due to the removal of existing attachments to the existing building.

T. Masonry contractor to coordinate the cleaning of debris from the foundation with the concrete contractor in a timely manner. Concrete contractor to clean foundation one time.

U. Provide removal, point up, repair, restoration and cleaning of existing brick and cast stone as noted on the project documents including crack, and joint repairs, flashings, reinforcing treatment, etc..

V. Provide modifications and relocation for masonry openings for windows, doors and louvers. Include patching and infill of masonry where new and existing windows and doors are to be located.

W. Provide masonry infill as shown in details throughout the prints. **NOTE**: Read all prints carefully. Also provide all the flashing required as shown on the details to secure a waterproof building.

Y. Provide all concrete floor slab infill areas where demolished masonry wall is removed below finish floor. Refer to Division 9 Flooring Sections in reference to floor finish tolerances.

Z. Provide date stones and time capsule complete.

AA. All anchor bolts set in CMU is to be furnished by Contract 6 Steel Work and installed by Contract 4 Masonry. Any fasteners required other than anchor bolts provided by each contractor for their scope of work.

BB. Provide all masonry work for the elevator and shafts complete.

CC. Provide all testing and inspections for your work.

DD. Provide 100% cleaning of brick and stone masonry complete.

EE. Provide spray polyurethane foam between masonry wall and roof and floor connections.

FF. Provide removal off site of all demolition debris in a required manner meeting all local, state and federal laws.

GG. Provide all select demolition required of all interior and exterior masonry areas in the project. The debris must be disposed of off-site in a required manner meeting all local, state, and federal laws. Provide shoring, bracing or other support where required due to demolition.

HH. Provide caulking for control joints in masonry, expansion joints in masonry, cast stone joints and any place that are similar products with masonry. Any masonry to a dissimilar product is to be by other contract.

II. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

JJ. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

KK. See section 012300 Alternates and bid form for your responsibility for the alternates.

LL. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of for the project.

MM. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK – Bid Pac A
CONTRACT NO. 5 STEEL WORK

A. The administrative sections, prints, addendums, and technical specification sections 024119, 051200, 053100, 055000, 055213, 057313 & 142460.

B. Provide and install all structural steel, steel joist, bridging, decking, and other miscellaneous steel for a complete job. Touch up with metal primer all areas required caused by welding. Provide structural steel framing and supports for mechanical and electrical equipment.

C. Furnish all steel lintels, bearing plates or bolts shown to install in the masonry by Contract No. 4 Masonry. Steel contractor is responsible for verifying dimensions and elevations of these items prior to setting steel. Provide required steel coatings on lintels.

D. Furnish all anchor bolts for structural steel to be installed in concrete by Contract No. 3 Concrete Work. Steel contractor is responsible for verifying dimensions and elevations of these items prior to setting steel.

E. Provide all railings at ramps or steps complete. Rails are to be core bored into concrete pads or masonry. Provide aluminum or steel rails, posts and hardware as shown. Provide translucent resin panels and glass on guardrails.

F. Furnish all bollards required on the site to Contract No. 2 Site Work and Contract No. 3 Concrete Work for their installation.

G. Provide all miscellaneous steel items along with support system for each item including wall termination plates and angles where walls terminate next to steel decking. Provide miscellaneous steel framing for operable partitions and other suspension systems. Provide all gauge bent plate and continuous gauge plate. Provide elevator sump pit cover.

H. Provide glazed decorative metal railing complete.

I. Provide all railings complete including sleeves if required.

J. Provide all stairs, ladders, safety cages, rails, railings, guardrails, steel corner guards, steel stair nosing and any other aluminum or steel products shown. Provide steel gates.

K. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

L. Provide all steel products that are anchored in to the walls. Provide steel post supports in stud walls complete. Also provide top of wall steel angle bracing, grating, edge guards, and metal nosing. Provide metal fabrication complete. Provide bent plates and angles complete. Provide parapet steel plate and roof edge steel angles.

M. Provide all steel decking, including any decking that maybe fastened to cold form metal trusses and framing if shown. See specification for different types of decking. Include deck cell insulation on acoustical deck.

N. Provide welding of wall anchors furnished and located by Contract No. 4 Masonry Work that are attached to steel.

O. Provide new metal mesh and handrails on new and existing guardrails complete.

P. Provide miscellaneous steel for the elevator and shaft complete.

Q. Provide assistance of all testing and inspections for your work. Owner will provide an inspection agency to do the testing. If testing fails, contractor will pay for additional testing.

R. Provide 3" pipe stud at cold formed framed half wall locations and coordinate with metal stud/drywall contract.

S. Provide steel for roof mechanical screens. Louvered panels provided by Contract No. 6 Carpentry & General Works.

T. Provide architecturally exposed structural steel.

U. Provide all complete selective demolition of joist, decking, railings, stairs, miscellaneous steel, ladders and structural steel. Provide the temporary shoring that may be necessary to remove existing steel that is replaced or modified for the new addition or the renovation of the existing.

V. Temporary Shoring has been avoided to the greatest extent possible with the current details. Any temporary shoring that is required is a delegated design item and the design and implementation of the shoring is the esponsibility of the contractor.

W. The AISC Certified Erection requirement is waived for this project. The Special Inspections set forth in the IBC should be followed closely**.**

X. Provide an allowance of $20,000 for miscellaneous metals. This allowance is to be used by the discretion of the construction manager.

Y. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

Z. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

AA. See section 012300 Alternates and bid form for your responsibility for the alternates.

BB. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

CC. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK – Bid Pac A
CONTRACT NO. 6 CARPENTRY & GENERAL WORK

A. The administrative sections, prints, addendums, and technical specification sections 024119, 055800, 061053, 061600, 070150.19, 076200, 081113, 081416, 083113, 083513, 087100, 089119, 101100, 101416, 101419, 102113, 102600, 102800, 108200, 113113 & 142460.

B. Provide the installation and proper storage of all hollow metal frames furnished by Contract No. 8 Furnish Hollow Metal/Doors Hardware. These items will be tailgate delivery.

C. Provide the installation and the proper storage of all wood, fiberglass and hollow metal doors furnished by Contract No. 8 Furnish Hollow Metal/Doors Hardware. These items will be tailgate delivery.

D. Provide the installation and the proper storage of all hardware furnished by Contract No. 8 Furnish Hollow Metal/Doors Hardware. These items will be tailgate delivery.

E. Provide all toilet partitions and wood blocking required in walls to install the toilet partitions.

F. Provide all exterior building signage, plaques and cast letters complete.

G. Provide rigid vinyl sheet wall finish and all trims complete.

H. Provide fire extinguishers, AEDS, cabinets, and accessories including any wood blocking required to install the cabinets and extinguishers. Also, remove store and reinstall existing cabinets in new location if noted.

I. Provide all toilet accessories and mirrors including all concealed wood blocking to install the toilet accessories and mirrors or cutting of masonry to install toilet accessories. Contract No. 16 Mechanical will provide lavatory shields and shower seats at required locations.

J. Provide all miscellaneous specialties complete plus all suspension systems complete to install the miscellaneous items. The extent of miscellaneous specialties is indicated on the drawings, but are not limited to the following: display cases and audio visual equipment, dock bumpers, etc..

K. Provide all wood window stools complete plus any wood blocking required to install the stools.. Provide wall caps for intermediate height walls. Contract No. 6 Carpentry & General Works provides wood wall caps on half walls. P-lam or solid surface wall caps and sills provided by Contract No. 14 Casework.

L. Provide all wood trims and panels complete including blocking required. Provide wood wall caps as noted.

M. Provide all expansion, fire rated and architectural control joint covers assemblies as shown. Coordinate with other contracts involved. Roof joint covers provided by roofing contract.

N. Provide all plywood sheathing and wood framing required. Include all hurricane ties as shown. Provide fire rated plywood and lumber if noted in project documents. Provide wood blocking and furring for roof curbs. Provide plywood on stairs.

O. Provide all visual display boards, display cases, tack boards, glass marker boards, tack strips, tackable surfaces and tracks and wood blocking required.

P. Provide all wood blocking required on the project whether shown on the contract documents or not, including casework blocking.

Q. Provide all architectural louvers that are required other than the louvers required by the mechanical equipment provided by Contract No.15 Mechanical. Louvers that is required for mechanical systems to be provided by Contract No. 15 Mechanical Complete. Contract No. 6 Carpentry and General Work to provide all other louvers complete that are not required for mechanical equipment.

R. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

S. Provide all wood and metal storage shelving in closets and other areas. P-lam and melamine shelving provided by Contract No. 14 Casework.

T. Provide all wood blocking required at roofing locations so that the roofer can install his work. **NOTE**: all locations included but not limited to skylights, roof hatches, and other items. This includes rooftop mechanical items and wood roof curbs as required.

U. Provide wood plank wall finish on walls and all blocking and fasteners for a complete system.

V. Provide window roller shades and blinds ncluding electric roller shades at all windows noted.

W. Provide roof, wall and floor access doors or panels and materials to install compete. Mechanical, Sprinkler, and Electrical contractors to provide access panels or doors for their portion of work. All other panels or doors by this contract if shown on plans.

X. Provide projection screens including electric operating screens and all blocking and accessories for a complete system.

Y. Provide mechanical screen panels complete. Steel supports provided by Contract 5 Steel Work.

Z. Provide the patching as required where doors and jambs are removed.

AA. Provide knox box complete.

BB. Provide wood box planter at exterior courtyard.

CC. Provide display case and all glass, tracks, shelving, tack able surfaces and wood complete. Provide removal of existing display cases and salvage to owner.

DD. Provide decorative formed & metal closures, trims and all related items for complete systems. Also provide decorative formed metal closures and trims complete, fiberglass, ~~GFRG~~ and metal column covers complete.

FF. Provide all wood trims, wood door and window jambs, wood bases, azek, moldings, field built columns, FRP panels and blocking required complete. Also provide and replace existing moldings.

GG. Provide all wood framing for floor, walls, stairs, ceilings, wood treads, risers and roof. Provide fire rated wood framing and plywood as noted.

HH. Provide asphalt felt barrier between all treated wood blocking that comes in contact with steel or cold formed framing.

II. Provide all signage and cast letters, ADA signage, directories, site LED signs and plaques for a complete system including wood blocking. Provide pin mounted lettering and aluminum panel sign.

JJ. Provide the elevator systems complete. Coordination with the Concrete, Masonry, Mechanical and Electrical. During construction the owner will need use of the elevator for the placement of furniture and supplies. Contractor is to provide access and temporary wall protection. Warranty will start at substantial completion.

KK. Contract No. 17 Electrical will supply power to the elevator. Elevator contractor is to provide all other low voltage control work that pertains to the elevator installation.

LL. Furnish the elevator sill angles and fasteners to be installed by Contract No. 3 Concrete.

MM. Furnish the anchors for the elevator rail to be installed in the masonry walls by Contract No. 4 Masonry.

NN. No elevator equipment to be stored in building.

OO. Provide coordination of all trades for elevator installation and inspection.

PP. Provide residential appliances complete. Electrical and plumbing hook ups and venting by Contracts 15 and 17.

QQ. Provide impact wall protection and corner guards complete.

RR. Install steel plate and angles furnished by steel contract on top of parapet walls to fasten wood blocking.

SS. Provide removal of temporary closures installed by Contract B-3 Selective Demolition.

TT. Provide allowance of $20,000 for temporary enclosures as described in Section 015000 Temporary Construction Utilities, Facilities & Control Item 3.14Enclosures.

UU. Provide all wood framing testing, inspections and special inspections as noted in your related specifications or noted on drawings that relates to your scope of work. Contractor is to provide all testing and inspections whether noted otherwise in other locations in the documents.

VV. Provide folding panel partition and all associated fasteners, tracks and support system for a complete system.

WW. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

XX. Provide wall protection complete.

YY. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

ZZ. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

AAA. See section 012300 Alternates and bid form for your responsibility for the alternates.

BBB. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of for the project.

CCC. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK Bid Pac A
CONTRACT NO. 7 ROOFING

A. The administrative sections, prints, addendums, and technical specification sections 024119, 061600, 070150.19, 072200, 074113.16, 074213.23, 075200, 075323, 076262, 077100, 077200, 079200 & 086200.

B. Provide all roof membrane and all other roofing complete including all ridged insulation, nailable deck sheathing, tapered insulation, dens deck board and standing seam metal roofing..

C. Provide all flashing required to make a complete roof system including fiberglass and hypalon flashing. Also, include any flashing necessary for the waterproofing of new mechanical and electrical equipment. Provide EPDM flashing with termination bar and sealants as noted in the project documents. Also provide all roof expansion joint covers.

D. Provide all aluminum trim, parapet wall caps, roof accessories, traffic pads, copings, riglets, counter flashings, metal cornice system, walkways, ridge vent, gutters and downspouts, splash blocks, ice & water guards, roof hatches with safety rails, roof curbs and roof accessories as shown.

E. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

F. Provide all caulking sealants that are related to roofing that is provided under this contract. Provide reglets and counter flashings for all roof locations and Masonry Contract No. 4 will provide thru-wall flashings. Coordinate with Contract No. 4 Masonry for flashing compatibility.

G. Provide all flashing for prefabricated roof curbs and rails to make water proof.

H. Provide bituminous damp proofing and self adhering sheet waterproofing on roofing areas complete. Masonry Contract 4 will provide bituminous damp proofing applied to masonry and Contract No. 3 Concrete will provide waterproof barriers and composite waterproof membrane under concrete.

I. Provide the roof construction infill at all existing roof penetrations where mechanical or electrical items have been removed so that the new roofing can be installed.

J. This contract is responsible for all demolition that pertains to your scope of work. Provide demolition of copings, cornice, metal roof edge, metal flashings, sidings, roof hatch, roofing materials, etc.

K. Provide the removal of all existing roofing that must be removed for the installation of the new roofing system complete. Provide temporary protection of exposed surfaces after demolition of existing roofing.

L. Coordinate final connections of downspouts to underground piping with site contractor.

M. Carpentry contract to provide floor, wall and ceiling expansion joint covers. Roofing contract to provide roof expansion joint cover.

N. Provide the metal roof edge metals including all accessories for a complete system.

O. Provide existing skylight removal and infill of openings and the new skylight. Provide all new skylights complete.

P. Contract No. 7 Roofing will provide demolition of existing roofing product and wall panels at the time of installation of new roofing material. Provide temporary protection of exposed surfaces after demolition of existing roofing.

Q. Provide removal of existing gutters and downspouts if shown

R. Provide roof edge fall protection complete.

S. Provide the field measurements of roof, trims, sidings and copings. Field measure when each sections are ready for measurement. Do not wait for the entire building to be ready to field measure but when each section is ready. Any cost for manufacturer supplier or contractor to provide this service is to be included in base bid cost.

T. Provide of wood roof deck at time of removal of existing roof material. Provide a 25,000 allowance for replacement of damaged existing wood or metal roof decking.

U. Provide smoke vents complete unless connected to HVAC equipment. If vents are connected to mechanical equipment contract 15 Mechanical will provide.

V. Provide patching of damaged wood or metal decking after roofing has been removed.

W. Provide demolition of metal wall panels and insulation system to sheathing.

X. Provide demolition of existing siding for the installation of new sidings.

Y. Provide an allowance of forty (40) roof penetrations for a lightning protection system.

Z. Provide fire rated plywood, insulation, z girts and metal roofing for a complete system.

AA. Provide rainscreen system, facias and soffits complete.

BB. Provide metal wall panels and ACM wall panels, insulation and z girts and furring for siding. Also provide all trims and sill flashings for a complete system.

CC. Provide z furring and metal strapping for soffits and siding."

DD. Provide all caulking required for wall panels complete."

EE. Provide composite and metal material wall panels, soffit and fascia complete including all furring, hat channel, z grits and fasteners and trims. Provide rain screen system. Also include mineral wool.

FF. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

GG. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

HH. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

II. See section 012300 Alternates and bid form for your responsibility for the alternates.

JJ. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope for the project.

KK. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK Bid Pac A
CONTRACT NO. 8 FURNISH HOLLOW METAL/DOORS HARDWARE

A. The administrative sections, prints, addendums, and technical specification sections 081113, 081416, 083513 & 087100.

B. Furnish all hollow metal frames, hollow metal barrow lites, all steel windows, hollow metal doors, all wood doors, and all hardware complete. Furnish wood infill panels window and door and louvers mullions that are fastened in hollow metal frames. Contract No.6 is responsible to place material in their storage area. Contract No. 8 to tailgate deliver to storage area. All materials need to be properly marked and identified for installation by Contract No. 6 Carpentry and General Work. Develop a sign-off system so that both parties of Contract No. 6 Carpentry and General Work and Contract No. 8 Furnish Hollow Metal/Doors Hardware agree the correct amount of material has been delivered.

C. Provide all required hardware templates and reference material so that Contract No. 6 Carpentry may install the material. Contract No. 8 Furnish Hollow Metal/Doors Hardware will be responsible for providing and coordinating information with all other trades that interfaces such as Contract No. 6 Carpentry and General Work and Contract No. 9 Aluminum Storefront/Windows/Glass and Glazing and Contract No. 17 Electrical.

D. Furnish the hardware to Contract No. 9 Aluminum Storefront/Windows/Glass and Glazing Contractor to install.

E. Electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

F. Access control system is to be provided by owner, doors/frames are to be prepped for them under your contract. Provide all hardware accept card readers as noted in the hardware specifications.

G. Furnish fiberglass doors complete if noted.

H. Provide automatic door operators complete. Contract 6 Carpentry will install on all non-aluminum storefront doors and Contract 9 Aluminum Storefront contract is to install on any storefront doors. Contract 17 Electrical is to providepower and low voltage to operator.

I. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

J. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

K. See section 012300 Alternates and bid form for your responsibility for the alternates.

L. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

M. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK Bid Pac A
CONTRACT NO. 9 ALUMINUM STOREFRONT/WINDOWS/GLASS AND GLAZING

A. The administrative sections, prints, addendums, and technical specification sections 024119, 076200, 084113, 084229, 084326, 084326, 087100 & 088000.

B. Provide all aluminum entrances, storefront, spandrel glass, all glass storefront, aluminum windows, aluminum window sills, translucent wall assemblies, curtain walls, and doors complete. Provide all break metal around new windows and doors complete. Provide all window and door mullions that are attached to aluminum windows and doors. Also provide window panning, low pressure foam insulation around window units, and simulated divided lite with applied grids if shown.

C. Install all hardware for the aluminum doors. Coordinate with Contract No.8 Furnish Hollow Metal/Doors/Hardware.

D. Provide all glass and glazing. Include all doors and windows furnished by Contract No. 8 Furnish Hollow Metal/Doors/Hardware. Also include applied grids for simulated divided lite if shown. Provide structural silicone joints complete. Provide fire and insulated glazing and firerated aluminum door and window panels. Provide tinted stain glass complete. Provide all ballistic resistant glazing and aluminum frames complete.

E. Provide all caulking for new work provided by this contract including interior and exterior windows and storefront."

F. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

G. Electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source.

H. Provide cleaning of glass and frames at completion of installation.

I. Provide decorative surface applied film and ballistic film on glass if noted.

J. Provide all prefabricated canopies and all fasteners and hardware for a complete system.

K. Temporary closures may not be necessary during the period of construction. Once the interior finishes are to begin installation; temporary closures will be needed. If windows and doors are not available for installation when openings are ready; Contract No. 10 Aluminum Storefront is to provide temporary closures for the openings until finished windows and doors are installed.

L. Provide aluminum head and sill flashings and all other associated flashings for your product for a complete system. Provide self adhering flashing around windows and doors.

M. Provide fire rated joint system for aluminum entrances, curtain wall and storefront complete.

N. Provide sliding glass storefront operative glass wall system complete.

O. Provide demolition of existing glass and glazing for the replacement of new glass.

P. Provide aluminum fin curtain wall sun shades complete.

Q. Provide safety and security films complete.

R. Provide automatic door operators attachd to storefront doors.

S. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

T. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

U. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

V. See section 012300 Alternates and bid form for your responsibility for the alternates.

W. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

X. **It is this contracts responsibility to review all other contract scopes of work.**

SCOPE OF WORK Bid Pac A
CONTRACT NO. 10 DRYWALL/METAL STUD

A. The administrative sections, prints, addendums, and technical specification sections 054000, 061600, 072200, 072500, 076200, 079200, 083113, 092216, 092900 & 098100.

B. Provide all batt insulation (walls and ceilings). Provide all rigid and spray foam insulation that attaches to all metal framing and masonry walls. Provide mineral wool board insulation. Provide structural nailable insulated sheathing and parapet sheathing. Provide transition membrane around window and doors, etc...

C. Provide all metal stud, framing, furring and drywall work complete. Provide slide clips on structural beams for metal stud wall support. Provide metal furring whether shown or not on drawings at all locations including masonry walls for attachment of substrates. Provide all tile backer board complete. Provide sealants to top and bottom of partitions and at penetrations to seal. Provide infill framing at existing walls ad openings. Provide slide clip that attach to metal stud and structural steel. Provide girts and hat channels complete. Provide gypsum wall board on metal furring at wall and ceiling locations.

D. Provide all metal blocking required.

E. Coordinate with Contract No. 6 Carpentry so that they can install any wood blocking required in the metal stud walls.

F. Provide all bulkhead, soffit framing, parapet wall framing and framing for cants at roof complete.

G. Provide all gypsum sheathing work complete, including all vapor barrier, weather bariers and air infiltration barriors and building wrap or building paper. This contractor is responsible for maintaining the proper attachment of the barriers and building paper to the building until the final veneer covers the area.

H. Provide all drywall suspended ceilings, walls, shaft walls, fascias and soffits called for on the prints complete including all framing required. Coordinate with Contract No. 15 Mechanical, No. 16 Sprinkler System and No. 17 Electrical. Provide framing for access panels supplied by this contract. Wrap steel columns with drywall.

I. Provide all expansion control required for drywall and all gypsum board moldings and Z reveal trim. Provide sealant and caulk for the Z reveal trim.

J. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

K. Provide fire protection for metal stud walls or ceilings as shown including fire safing mineral wool insulation and fire or acoustical sealant. Provide fire safing and smoke sealant between floors and curtain wall assemblies. Provide acoustical and fire rated insulation in deck flutes where walls intersect.

L. Provide all hurricane ties and clips complete that are fastened to cold form framing.

M. As part of the warranty portion. Provide an inspection of drywall and plaster with the owner after 1 year of substantial completion and identify locations to be re pointed due to flaws and cracks in the drywall and plaster. Repair all areas and repaint as needed. Any defect caused by abuse will be charged to the owner.

N. Provide wall labeling for smoke and fire walls for drywall/metal stud walls or ceilings.

O. Provide all cold formed metal framing testing, inspections and special inspections as noted in your related specifications or noted on drawings that relates to your scope of work. Contractor is to provide all testing and inspections whether noted otherwise in other locations in the documents.

P. Provide insulated air barrier system to the complete exterior of the building including masonry and metal framed wall systems. Also include spray foam insulation with intumessant coating complete if noted.

Q. Provide plaster, gypsum plaster, spray acoustical plaster and all related accessories for a complete system including repair of existing. Provide acoustic plaster ceiling and all framing and tracks for a complete system. Note: light monitor locations.

R. Provide modifications and relocation of metal framing for windows and door opening. Include patching and infill of metal framing and drywall where new and existing windows are to be located.

S. Provide all sealant or elastomeric spray as noted where walls meet metal deck as shown on contract documents. Provide for metal stud and masonry walls complete.

T. Provide all spray applied cellulosic and polyurethane foam insulation complete.

U. Provide wall tile cement backer board in areas where tile wainscot is shown.

V. Provide spray fire resistant materials and all associated accessories as noted in the project documents. Coordinate with other trades that have attachments to this location.

W. Provide abuse resistant gypsum board and gypsum liner panles complete.

X. Provide the insulation of all cold formed headers complete.

Y. Provide all bullet resistant panels as shown on project documents.

Z. Provide sprayed acoustical insulation and prep of surface to receive coating.

AA. Provide metal stud infill at renovated areas of construction.

BB. Provide all in tumescent coatings complete.

CC. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

DD. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

EE. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

FF. See section 012300 Alternates and bid form for your responsibility for the alternates.

GG. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of for the project.

HH. **It is this contracts responsibility to review all other contract scopes of work.**

SCOPE OF WORK Bid Pac A
CONTRACT NO. 11 ACOUSTICAL WORK

A. The administrative sections, prints, addendums, and technical specification sections 095113, 095113.01, 095423, 095436 & 098400.

B. Provide all the new acoustical and lay-in ceilings required including the hangers for a complete system. Also include all acoustical wall and ceiling panels, suspended decorative grid, clouds, wood panel ceilings and specialty ceilings. Provide aluminum fascias and trims as noted.

C. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

D. Provide all insulation if shown above the acoustical ceilings.

E. Provide metal lay in ceilings and egg create panels complete if noted in project documents.

F. Provide specialties ceilings, wood, metal blade, metal linear, plank, baffle and linear ceiling, metal panel ceilings, blade system complete.

G. Provide tackable fabric wrapped panels complete.

H. Provide sound absorbent wall units complete.

I. Provide suspended wood ceiling and linear metal ceilings complete.

J. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

K. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

L. See section 012300 Alternates and bid form for your responsibility for the alternates.

M. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

N. It is this contracts responsibility to review all other contract scopes of work

SCOPE OF WORK Bid Pac A
CONTRACT NO. 12 FLOOR COVERINGS

A. The administrative sections, prints, addendums, and technical specification sections 093000, 096513, 096519, 096623 & 096813.

B. Provide all preparation of walls and floors to receive the new base and floor tile.

C. Provide all base complete except the wood bases. Provide rubber profile base and millwork resilient base complete.

D. Provide all resilient tile flooring complete including the concrete floor preparation and patching to receive the new material. This includes all VCT, rubber, luxury vinyls and VSF flooring.

E. Refer to the Finish Schedule for the scope of work.

F. Provide all carpet and carpet tile complete and all floor preparation and patching to receive the new material.

G. Provide all rubber floor, rubber treads and risers for all stairs and landings as shown.

H. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

I. Provide vinyl tile, walk off mats, and ceramic, porcelain and quarry tile and all associated accessories for a complete system. Include floor preparation and patching to receive the new material.

J. Provide resilient sheet flooring and all associated materials including floor prep for a complete system. Provide seamless flooring complete. Provide static control tile complete.

K. Provide all preparation of walls and floors to receive the new base, floor tile, and carpet after the existing materials have been removed. The debris can be placed in the jobsite dumpster. **NOTE:** Site visit is essential to determine your floor preparation.

L. Provide final cleaning, waxing and sealing of all floor coverings furnished by this contract per manufacturers' recommendations and project specifications. Provide protection of finished floor coverings until completion of the project.

M. Provide resinous flooring and base complete including preparation of sub base.

N. Provide new terrazzo flooring and all associated products for a complete system. Provide pre-cast terrazzo stair risers and treads complete.

O. Provide all transitions for all the flooring types needed for the project complete.

P. Provide schluter systems metal edge guards at all outside wall corners of ceramic tile walls as noted in documents.

Q. Provide abrasion nosing on first and last tread of all stairs as noted on the documents.

R. Provide all preparation of walls and floors to receive the new wall and floor tile.

S. Provide flooring in elevator.

T. Provide wood flooring complete. Also provide wood flooring for benches complete.

U. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

V. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

W. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

X. See section 012300 Alternates and bid form for your responsibility for the alternates.

Y. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

Z. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK Bid Pac A
CONTRACT NO. 13 CAULKING/PAINTING

A. The administrative sections, prints, addendums, and technical specification sections 079200, 097200 & 099100.

B. Provide all exterior and interior caulking required except the caulking required by Contract No. 9 Aluminum Storefront/Windows/Glass and Glazing, Contract No. 2 Sitework, Contract No. 3 Concrete Work and Contract 4 Masonry work. Prepare the surfaces to receive the new caulking. Also, include any location where dissimilar materials meet not covered in above contracts. Provide caulking for all other areas of construction except those contracts listed above.

C. Provide all exterior and interior painting including the preparation of new and existing surfaces to receive the new paint. Provide painted graphics as noted in project documents. **NOTE:** Special attention needs to be given for existing surface preparation. Paint all new and existing walls, ceilings, trims, frames, etc..

D. Provide the sanding, cleaning and painting of all exterior lintels, steel rails and other metals including bollards and exposed ceilings.

E. Reference the finish schedules for the scope of work as well as the prints.

F. Provide all epoxy, high performance coatings, painting, concrete sealer paint and exposed ceiling painting including the preparation of the areas to receive painting. See the finish schedule.

G. Painters option to apply finish coat of paint after all finishes are installed or be responsible for ALL touch up necessary.

H. Electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

I. Provide all caulking that is required where casework meets walls, floors or ceilings if required. Also provide caulking of drywall trim/block interface as noted on the reveal details on the project documents. Provide caulking at all trims, moldings.

J. Provide interior caulking to **all** windows and door frames. Drywall returns, sills and etc. would be the responsibility of this contract to caulk. Caulk between the top of wood base and wall.

K. Provide the painting of exposed conduit, sprinkler, plumbing and mechanical piping and duct work. Painting Contractor shall coordinate work with Sprinkler, Mechanical and Electrical Contractors.

L. Provide all necessary wall prep as per specification 099100 – Paint and as noted on plans.

M. Provide staining and varnishing of job site finished wood products include prep of material complete except wood flooring.

N. Provide wall coverings including preparation of walls for a complete system.

O. Provide exterior painting of all unfinished products.

P. Provide interior painting of all unfinished surfaces.

Q. Included in all prep of surfaces is the light sanding of surface and filling of nail and screw holes.

R. Provide painting of exposed fire sprinkler piping and connections.

S. Paint mechanical screen steel complete.

T. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

U. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

V. See section 012300 Alternates and bid form for your responsibility for the alternates.

W. The intent of the scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

X. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK Bid Pac A
CONTRACT NO. 14 CASEWORK

A. The administrative sections, prints, addendums, and technical specification section 064023 & 064116.

B. Provide all casework in the office area, work room, library, bathrooms, reception desk, circulation desk, library shelving, and other areas noted on drawings. Provide all wood work and trim that is attached to casework.

C. This Contract is responsible to have personnel on the jobsite to receive material being shipped to the jobsite, and climate controlled storage units for temporary storage.

D. Provide and coordinate all casework that required mechanical and electrical connection and cut outs with Contract No. 15 Mechanical and Contract No. 17 Electrical.

E. Provide all counters for casework and stationary counters as shown. Provide metal counter supports as shown.

F. Provide all casework and counter tops and p-lam and solid surface wall caps that are noted in section 064023 and in the drawings. This contract to provide cut outs of all sinks, faucets and accessories. Templates to be provided by associated contractors. Wood, stained or painted, wall caps to be provided by Contract No. 6 Carpentry & General Work.

G. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

H. Provide all solid surface counter tops, wall caps, window sills and benches complete.

I. Provide any bath accessories that are built in to casework.

J. Provide p-lam shelving in closets and all other shelving, casework and counters for this project. Also provide melamine shelves complete.

K. Provide manufactured laminate and wood casework, mail and literature distribution equipment, media shelving and casework including all accessories and connections complete.

L. Provide bullet proof panels behind casework as noted.

M. Carpentry Contract No. 6 to provide wood shelving in closets only. All other shelving, casework and counters by this contract.

N. Provide all modular casework and all fixtures as noted in the specification section.

O. Provide plam or solid surface window sills and aprons complete. Also provide all p-lam and solid surface trims, and any other items noted on documents.

P. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

Q. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

R. See section 012300 Alternates and bid form for your responsibility for the alternates.

S. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

T. It is this contracts responsibility to review all other contracts scopes of work.

SCOPE OF WORK – Bid Pac A
CONTRACT NO. 15 MECHANICAL

A. The administrative sections, prints, addendums and technical specification sections 019113, 019114, 019115, 024119, 033000, 078413, 089119, 113113, 142460, 220500, 220505, 220701, 224000, 224005, 230500, 230505, 230548, 230593, 230600, 230701, 230900, 230923 & 233000. Technical specifications are noted on mechanical and plumbing contract drawings. Also, refer to electrical drawings for any mechanical or plumbing equipment.

B. Provide all plumbing complete including hook up to residential and commercial equipment including trench drains. Also provide caulking of plumbing fixtures to countertops, walls or other surfaces. Provide lavatory shields complete.

C. Provide all testing and permits for the plumbing work. Provide chlorination on all water lines.

D. Provide all HVAC work complete including all required louvers for the mechanical work. Contract No. 6 Carpentry and General Work is responsible for other louvers. Provide fire dampers as required by all codes that apply.

E. Provide all testing and balancing of the HVAC system.

F. Provide Fire stopping and patching of wall and ceiling areas that require mechanical penetration. Coordinate with other trades. Provide access panels and doors as required. This contract to install the access doors.

G. Provide the cutting of roof areas where mechanical penetration is required. If any framing or modification is required for the opening, it is the responsibility of this Contract to provide. Also provided all roof curbs for all mechanical items.

H. Provide all final connections from 5’outside of building to building for all site utilities. Includes water, sewer, and storm sewer.

I. It is the responsibility of the mechanical contractor to coordinate and inspect at the time of pour all imbedded mechanical items in concrete or masonry units for proper elevations and locations.

J. This contract is responsible to restore sub-grade to within 1”+ / - of final grade. Provide compaction and testing as required.

K. This contract is responsible for all temporary heat as needed through duration of construction. See allowances.

L. Temporary electrical service to your construction trailer to be provided by this contract. A localized electrical panel will be provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

M. Provided all roof curbs and rails for all mechanical items. Provide metal and gypsum chimney stack liners complete.

N. Provide gas piping and final connections and all related items. Provide piping and hook-up to generator.

O. Provide coordination of all mechanical penetrations with all trades involved. Hammer penetrations will not be tolerated. All wall penetrations to be patched prior to painting or cost for touch up paint to be deducted from contract.

P. Provide all concrete housekeeping pads for mechanical and plumbing equipment as required.

Q. Provide duct mounted smoke and heat detectors including all control wiring as needed for a complete system as required by all codes that apply.

R. Provide the cutting, demolition and repair of all concrete floors and walls required to install new mechanical items. Also after the installation of work, repair and patch all concrete floors. Refer to Division 9 Flooring Sections in reference to floor finish tolerances. Provide the cutting demolition and repair of all walls required to install new mechanical items. After the installation of work, repair and patch all walls to match finish conditions.

S. Coordinate the hook up with the storm water system provided by Contract No. 2 Site Work. Provide all final connections from 5'outside of building to building for all site utilities. Includes water, sewer, and storm sewer. Contract No. 2 Site Work will provide rain water conductor and cast iron rainwater boots.

T. Provide the allowance of $50,000 in the contract for temporary heat fuel cost. Cost of work to be determined by fuel company receipts with amount of fuel and cost per gallon. All equipment and labor for temporary heat is part of the contract. This allowance is for fuel cost only.

U. Provide capping of all the utilities so Contract No. 1 Demolition can remove. It is this contracts responsibility to coordinate and mark all mechanical and plumbing items that are not to be demolished by Contract No. 1 Demolition.

V. Provide all mechanical and plumbing for elevator, shafts and vertical platform lifts that pertain to your scope of work.

W. Provide exterior ductwork and exterior duct penetrations including waterproofing of penetration.

X. Provide painting of roof top equipment if noted.

Y. Provide rooftop units, acoustical package, inertia pads, fire and smoke dampers, intake hood, blower coil unit, fan coil unit, boiler, heat pumps, electric heat, energy recovery ventilation, make-up air unit, ductless split system, fans, cabinet heaters, pumps, unit heaters, sound attenuating unit, and all other mechanical equipment complete.

Z. Provide the mechanical controls system complete including low voltage wiring. Electrical contractor will provide power only.

AA. In regards to coordination drawings, the mechanical contractor has the responsibility to coordinate all the trades and producing a coordination drawing showing all trades.

BB. Mechanical contract is to provide demolition and installation of new concrete floor pads where mechanical items are relocated, demolished, or added new.

CC. Provide elevator sump pumps and piping and connections complete.

DD. Provide all sleeves for piping and ductwork complete.

EE. Provide smoke vents complete if connected to HVAC system.

FF. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

GG. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

HH. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

II. See section 012300 Alternates and bid form for your responsibility for the alternates.

JJ. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

KK. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK Bid Pac A
CONTRACT NO. 16 SPRINKLER SYSTEM

A. The administrative sections, prints, addendums, and technical specifications sections 024119, 033000, 078413, 142460, 210500, 210505 & 211003. Technical specifications are noted on the mechanical and plumbing contract drawings. Also, refer to electrical drawings for any sprinkler equipment.

B. Provide any fire stopping required where your work penetrated walls. Provide access panels and doors as required. This contract is to install their own panels.

C. Provide all fire sprinkler/protection including, but not limited to, backflow preventers, sprinkler heads, piping, fittings, standpipe, fire department connection and fire pumps.

D. Submit all required calculations and applications for review and approval by Sussex County and State of Delaware Fire Marshals Office.

E. Provide all required flow switches, alarms, tamper switches, alarm clock valves, pipe, hangers, inserts, valves, fittings, fire department hose valves, access panels and access doors associated with your scope of work.

F. Coordinate with all effected trades', provide coordination information to other contracts.

G. Fire sprinkler contractor shall pick up all new water services from a flange 8" above finish floor in the fire pump room and other locations throughout the building.

H. Temporary electrical service to your trailer to be provided by this contract. A localized electrical panel will provided for your power source. Removal of temporary electric is the responsibility of this contract at completion of job.

I. Provide flushing for all interior and exterior fire water lines complete, including site for water lines installed by site work contractor.

J. Provide coordination of all sprinkler penetrations with all trades involved. Hammer penetrations will not be tolerated. All wall penetrations to be patched prior to painting or cost of touch up painting to be deducted from contract. Provide sleeves as required.

K. Provide any demolition of existing walls required to install piping. Patch and repair as necessary. Provide any fire stopping required where your work penetration walls.

L. Provide the cutting and patching of the concrete flooring to hook system to the waterlines. Patch concrete floors in a proper manner.

M. Provide coordination and marking of all items that are not to be demolished by Contract No. 1 Demolition.

N. Provide for sprinkler work for elevator and shaft complete including attics.

O. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

P. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

Q. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

R. See section 012300 Alternates and bid form for your responsibility for the alternates.

S. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

T. It is this contracts responsibility to review all other contract scopes of work.

SCOPE OF WORK Bid Pac a
CONTRACT NO. 17 ELECTRICAL

A. The administrative sections, prints, addendums, and technical specification sections 019113, 019116, 024119, 033000, 078413, 087100, 113113, 142460, 260500, 260503, 260519, 260526, 260529, 260533, 260543, 260553, 260573, 260923, 260943, 262413, 262416, 262726, 262813, 262816, 262913, 264113, 264300, 265100, 265600, 270536, 271000, 271323, 284600 & 284621. Technical specifications are noted on the electrical contract drawings. Also, refer to mechanical and plumbing drawings for any technical equipment.

B. Provide temporary lighting as required for all areas of construction. Provide temporary electric service to all construction managers' office trailers. Trench wire in ground. Remove temporary service at completion of job.

C. Provide the patching and fire stopping required for any electrical penetration thru walls, ceilings and floors. Provide access doors and panels as required. This contract is to install their own panels.

D. Provide all rough-in and final electrical connections to the commercial and residential equipment and mechanical equipment including elevator system.

E. Provide all equipment, material, testing, permits, and inspections required for a complete electrical system for the entire project.

F. Provide all concrete work for the installation of all electrical equipment.

H. Electrical contractor shall provide line power to fire alarm system as required by code.

I. Electrical contractor shall provide power to all electric door hardware. This shall include wall boxes and conduit where necessary. Electrical contractor shall coordinate with Hardware contract and alarm company. This shall include wall boxes, conduit and installation of control boxes. Low voltage wiring by others; electrical contractor is to provide line voltage to all electric door hardware.

J. Provide temporary distribution panel with six (6) 60-amp, 120/240 volt, single phase, 3-wire power for construction trailers for other contractors. Electrical hook-up, including conduit and wiring to trailer location shall be the responsibility of the Contractor requesting power not the Electrical Contract.

K. This contract is responsible to restore sub-grade to within 1" + / - of final grade.

L. If the Electrical contractor requires power for his construction trailer, he shall provide power to his trailer from the temporary distribution panel provided. Electrical contractor is responsible for all material, labor, and equipment necessary to extend power from panel to electrical site trailer. Electrical contractor shall make connection to panel

M. Provide all heat and smoke detector power wiring per all codes that apply.

N. Provide electrical connections for owner purchased equipment.

O. Provide final connection of all power wiring from building to the utility company connection point including all generator and equipment and pads. Provide a complete generator system.

P. Provide all conduits, wire and all related material to install all underground electric utilities complete.

Q. Provide all site lighting complete including concrete bases, conduit, wire and fixtures.

R. Provide proper compaction and testing of all trenches associated with electrical work.

S. Provide coordination of all electrical penetrations with all trades involved. Hammer penetrations will not be tolerated. All wall penetrations to be patched prior to painting or cost of touch up painting to be deducted from this contract.

T. Provide lightning protection system complete.

U. Provide heat terminals complete.

V. Provide the demolition, patching and fire stopping required for any electrical penetration thru walls. Also provide the patching of areas where existing electrical penetrations are removed due to demolition.

W. Provide the saw cutting, demolition and repair for any floor areas required to run electrical work. Refer to Division 9 Flooring Sections in reference to floor finish tolerances.

X. Provide the demolition and revisions required for the site lighting to be revised, also provide demolition and revisions required for the utility pole systems.

Y. Provide disconnecting and capping of all electrical systems that are to be demolished by Contract No. 1 Demolition. It is this contracts responsibility to coordinate and mark all electrical items that are not to be demolished by Contract No. 1 Demolition.

Z. Provide the patching and fire stopping required for any electrical penetration thru walls.

AA. Provide pathways, conduit, boxes, raceways, cable trays, floor boxes, distribution backboards, electrical protection, bonding and grounding and power supplies only for Telecommunication system, structured cabling, audio visual and sound systems and secondary systems. Also provide site conduit and pull boxes for technology and communications systems. Structured Cabling, and Security systems provided by this contract.

BB. Provide underground and overhead exterior electrical work including conduit, manholes and hand holes complete.

CC. Provide owners interactive display devices electrical requirements complete.

DD. Provide the fire alarm system and all hardware for a complete system.

EE. Provide analysis and coordination study of electrical system.

FF. Provide electrical power to electric hand dryers.

GG. Provide all lighting for project including bollard lights.

HH. Provide area rescue system complete.

LL. Provide structured cabling including all hardware and devices for a complete system.

MM. Provide the electrical telecom and alarm grounding and bonding system complete.

NN. In regards to coordination drawings, the electrical contractor has the responsibility to coordinate all the trades and producing a coordination drawing showing all trades.

OO. Provide all lighting complete including the testing of lighting and control systems.

PP. Provide heat trace system complete.

QQ. Provide Electrical power to projector screens and roller shades complete.

RR. Provide Electrical power and lighting to all canopies complete.

SS. Provide Provide an Allowance of $25,000 in you price for short circuit analysis gear revisions.

TT. Provide all concrete housekeeping pads for electrical equipment required.

UU. Provide all electrical and lighting for elevator and shafts that pertain to your scope of work.

VV. Provide an allowance of $25,000 in your cost for selective demolition of the existing building.

WW. Include the lump sum of the following amount $20,000 in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager.

XX. This contract is to provide payment to construction manager for any fines this contract or its subcontractors receive for OSHA violations where the construction manager is fined from OSHA due to your company or subcontractor creating the infraction.

YY. All scope items listed in Section 011100 Summary of Work supersedes all scope related items noted on the project documents.

ZZ. See section 012300 Alternates and bid form for your responsibility for the alternates.

AAA. The intent of this scope is **NOT** to denote every minute detail but to create an awareness of the scope of work for the project.

BBB. It is this contracts responsibility to review all other contract scopes of work.

END OF SECTION 011100

SECTION 011200 – MULTIPLE CONTRACT SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes certain responsibilities of the Contractors. These instructions shall be strictly followed unless more stringent requirements are contained within other Specification sections or written directions from the Construction Manager state otherwise.

Protection of Existing Conditions
Project Supervision
Project Coordination
Protection of Existing Conditions
Systems Coordination Drawings
Field Engineering
Testing
Fees, Licenses, and Permits
Sleeves, Hangers, and Inserts
Chases and Recesses
New and Existing Openings
Penetrations
Fireproof Repair
Equipment Foundations
Cutting and Patching
Access Doors and Panels
Touch-up Painting
Starters and Disconnects
Final Cleaning

1.2 PROTECTION OF EXISTING CONDITIONS

A. Existing finished surfaces to remain in place in the existing site, shall be protected by the Trade Contractor performing the work in that area, by whatever materials and means are required to prevent any damage. Other surfaces shall be protected with tarpaulins, drop cloths, and similar coverings, as required.

B. At the completion of the work, or when protection is no longer required, temporary enclosures, tarpaulins, building paper, drop cloths and other temporary materials, shall be removed and existing work and finishes in altered portions of the existing site shall be cleaned and left in condition acceptable to the Owner, Architect, and the Construction Manager.

1.3 PROJECT SUPERVISION

A. Every Trade Contractor shall be responsible for the supervision of their work. Adequate supervision as required to maintain the progress schedule, shall be required within the scope of work within the contracts. When more than one major building phase is being constructed at different locations on the project site, separate supervision must be assigned to each phase when work of that contract is being performed. When performing construction work to maintain the

progress schedule requires extended hours, multiple shifts, and/or additional work days, adequate separate supervision shall be required for each Trade Contractor during these times. The competence level and ability of supervisory personnel must be adequate to perform the construction activities involved.

B. Although these various second level supervision personnel may be reassigned from time to time, each contractor shall retain one superintendent with full responsibility while performing work on the project.

C. The Construction Manager shall have the authority to direct the Trade Contractor to assign additional supervisory personnel to ensure compliance with the contract schedule and quality requirements at no addition to the contract price.

1.4 PROJECT COORDINATION

A. Every Trade Contractor shall be responsible for the coordination of the progress of their work with the progress of all other Trade Contractors work.

B. Inasmuch as Project completion within the time limit is dependent upon cooperation of those engaged therein, it is imperative that each Trade Contractor perform his work at such time and in such a manner as not to delay or otherwise interfere with work progress of other Trade Contractors. If any Trade Contractor's work depends upon proper execution or results of another Trade Contractor's work, the former shall inspect the work and report any defects therein to the Construction Manager.

C. Trade Contractors shall afford each other every reasonable opportunity for installation of their work, and shall work in conjunction with each other in order to facilitate proper and intelligent execution of work.

D. Plans are generally diagrammatic, and each Trade Contractor shall coordinate his work with the work of others, so that interference between mechanical, electrical, architectural and structural work does not occur. Each Trade Contractor shall furnish and install offsets, bends, turns, and the like in connection with his work to avoid interference with work of other Trade Contractors, to conceal work where required, and to secure necessary clearance and access for operation and maintenance. In case of interference or lack of clearance and access, the Construction Manager will be notified immediately, and shall, in turn, notify the Architect. The Architect will decide which work shall be relocated, regardless of which was installed first.

E. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

F. Verify utility requirements and characteristics of operating equipment are compatible with utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.

G. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

H. After Owner occupancy, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.5 FIELD ENGINEERING

H. Inspection:

1. Each Trade Contractor shall confirm locations of survey control points prior to starting work. Promptly notify Construction manager of any discrepancies discovered.

2. The Trade Contractor shall verify all measurements of the site and shall be responsible for the correctness of same. No extra charge or compensation will be allowed on account of differences between actual dimensions and the measurements indicated on the Drawings; any difference which may be found should be submitted to the Architect for consideration before proceeding with the work.

I. The Owner shall secure a professional engineer or surveyor licensed in the State of Delaware to perform the following:

1. Provide benchmark elevation to serve as the basis for the construction layout of the project.

J. Construction Layout:

1. The Sitework Trade Contractor shall be responsible to perform the layout and elevations required to complete his work.

2. The Site Concrete Work Trade Contractor shall layout to complete the scope of their work.

3. Each Trade Contractor shall layout the remainder of his own work and be responsible for all lines, levels, grades, elevations, and measurements.

1.6 TESTING

A. The owner shall employ and pay for the services of a testing agency to perform the required construction material testing for specification divisions 1 through 3. Refer to section 014000 Quality Control for testing agency qualifications and test reporting requirements.

1.8 FEES, LICENSES, AND PERMITS

A. The following permits shall be purchased by the Owner:

1. Building Permit

B. All remaining fees, licenses, and permits shall be obtained and paid for by the trade contractor requiring them at no additional cost to the Owner to complete their work.

1. All Trade Contractors are advised that the Owner has reached an agreement with the County of Kent and the City of Dover to pay for the following permit fees: Building Construction.
2. Each respective contractor will still be required to obtain license from the County of Sussex and the City of Rehoboth Beach.

3. Additionally, all contractors are still responsible to coordinate required applicable inspections.

1.9 SLEEVES, HANGERS, AND INSERTS

A. Each Trade Contractor shall furnish sleeves and inserts required to accommodate his work, together with instructions regarding their placement and location in the structure. Sleeves and inserts shall be furnished promptly in accordance with the established construction schedule so that they may be built-in as construction progresses.

B. Trade Contractors to furnish all embeds, sleeves, inserts, etc., that are to be cast in concrete or built in masonry to the appropriate Trade Contractor for installation.

C. Each Trade Contractor shall furnish and install hangers required to accommodate his work.

1.10 CHASES AND RECESSES

A. Each Trade Contractor shall provide all blockouts shown on the Contract Documents and having either or both dimensions greater than 10" to the appropriate Trade Contractor for installation into his work. Any openings with dimensions smaller than 10" or not shown on drawings but required by a Trade Contractor shall be furnished and installed by the Trade Contractor requiring the same.

B. It is the responsibility of the Trade Contractors requiring openings, chases, etc., to furnish information regarding size and location promptly in accordance with the established construction schedule, so that they may be built-in as construction progresses and avoid delays. Failure to provide the information promptly will result in the responsible Trade Contractor incurring any cost associated with the delay and the installation.

C. Trade Contractors shall cooperate fully with each other in the performance of above work, as cutting and patching of new work is neither contemplated nor will it be tolerated.

1.11 NEW AND EXISTING OPENINGS

A. Upon removal of existing work, which penetrates floors, walls, or ceilings, openings shall be immediately closed with material matching that adjacent to the opening. This shall include whatever structural support is required. The closing of existing openings shall be performed by the Trade Contractor who is responsible to perform this work as if it is new construction.

B. Each Trade Contractor shall be responsible to install any new openings required to install his works in any existing construction and to furnish and install any additional structural support. All cutting and patching must be performed by journeymen or master trade mechanics for the trade work of the cutting/patching. Costs for all patching work are the responsibility of the trade contractor requiring the new opening.

C. This structural support shall maintain the structural integrity of the building.

D. Prior to cutting or drilling of any new openings that require additional structural support, the

contractor shall submit a shop drawing to the Construction manager for review and acceptance by the Architect prior to demolition.

E. Openings required by any Trade Contractor in new construction shall be coordinated with the Trade Contractor(s) performing adjacent work.

1.12 PENETRATIONS

A. Each Trade Contractor shall be responsible to seal his own penetrations in walls, floors, and ceilings, using fire resistant materials, as required.

B. All roofing work shall be performed by the Roofing Trade Contractor, including patching penetrations made by the other Trade Contractors. Unless assigned specifically in section 011100 the cutting of roof openings, structural reinforcement, roof curbs, and counter flashing, shall be provided and installed by each Trade Contractor whose work penetrates the roofing surface, including all additional blocking associated with penetration.

1.13 FIREPROOF REPAIR

A. Existing and new spray-on fireproofing which is damaged by Trade Contractors shall be repaired by the Trade Contractor who caused the damage. The repair work shall be performed by tradesman qualified and certified to perform the repair.

1.14 EQUIPMENT FOUNDATIONS

B. The Concrete Work Trade Contractor shall provide all interior foundations and housekeeping pads indicated on the Contract Documents. The Sitework Concrete Contractor shall place all exterior equipment foundations and housekeeping pads indicated on the Contract Documents. All other foundations, equipment, and housekeeping pads not shown, but required, shall be by the Trade Contractor requiring the same.

C. Each Trade Contractor shall furnish anchor bolts and other accessories required to anchor his equipment in place, together with instructions regarding their placement and location in the foundation. Anchor bolts and other accessories shall be furnished promptly in accordance with the established construction schedule so that they may be built-in as construction progresses.

1.15 CUTTING AND PATCHING

A. Responsibility: A Trade Contractor requiring the cutting of openings in new work, or in the existing work installed by others shall have such openings cut and patched by the trade which installed the original work and such cutting and patching shall be at the expense of the Trade Contractor requiring the opening.

B. Approval: Approval to do such cutting and patching shall be received from the Architect through the Construction Manager prior to proceeding with the work. Approval of any structural cutting must be received from the structural engineer and architect before proceeding.

C. Inspection:

1. Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
2. After uncovering, inspect conditions affecting performance of work.
3. If, in the course of cutting and patching the existing building for alteration work, a material is uncovered which appears to contain asbestos, the Contractor shall immediately notify the Construction Manager. Contractors shall perform other construction activities until the area in question can be cleared.

D. Preparation:

1. Provide supports to assure structural integrity of surroundings, devices, and methods, to protect other portions of Project from damage.
2. Provide protection from elements for areas which may be exposed by uncovering work.

E. Performance:

1. Execute work by methods to avoid damage to other work and which provide proper surfaces to receive patching and finishing.
2. Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements and sight-exposed surfaces.
3. Restore work with new products in accordance with requirements of Contract Documents.
4. Fit work tightly to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
5. At penetrations of fire-rated wall, ceiling or floor construction, completely seal voids with fire-resistant materials as required to achieve fire-rating indicated.
6. Where fire protection materials are damaged or removed, reapply fire protection materials to achieve a rating equivalent to existing construction or as noted.
7. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

1.16 ACCESS DOOR AND PANELS

A. Access doors and panels, shown on architectural drawings, shall be furnished and installed by each Trade's Contractor whose product needs to be accessible.

B. Access doors and panels shall be furnished by the trade contractor requiring access and delivered to the Drywall and Metal Studs Trade Contractor for installation.

1.17 FINAL CLEANING

A. Trade Cleaning: Each contractor is responsible for final cleaning their own work as outlined in Section 011100 - Summary of Work. This initial cleaning must be completed before requesting inspection for Certification of Substantial Completion. This cleaning shall include, but not be limited to:

1. Clean surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned. Comply with Product manufacturer instruction and recommendations.
3. Within limits of Contract, clean site, sweep paved areas, rake clean landscaped surfaces.

4. Provide additional cleaning as required within individual Specification sections.
5. Remove waste and surplus materials, rubbish and construction facilities from the site. Dispose of in a legal manner.
6. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
7. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
8. Wipe down all walls, equipment, fixtures, casework and shelving to a dust-free sanitary condition.
9. Sweep, vacuum and mop all floors.
10. Clean all windows, glass and glazing.

1.18 TOUCH-UP PAINTING

A. The Caulking and Painting Contractor shall coordinate and schedule his final coat as directed by the Construction Manager to reduce the amount of touch-up painting required.

B. After the final coat has been applied, all touch-up paint and patching required to repair damage caused by other trade shall be reviewed by the Construction Manager and paid for from the construction contingency or back charged to the Trade Contractor who the Construction Manager determines is responsible.

1.19 STARTERS AND DISCONNECTS

A. The Electrical Contractor shall furnish and install starters, power and starter control wiring per the electrical drawings and the specifications. The Electrical Contractor shall furnish and install starters in the motor control center.

B. Individual starters and disconnects shown on other drawings and specifications shall be furnished by that Trade Contractor and will be installed and connected by the Electrical Contractor.

END OF SECTION 011200

SECTION 011216 – WORK SEQUENCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Products and installation for patching and extending work.

B. Transition and adjustments.

C. Repair of damaged surfaces, finishes, and cleaning.

1.2RELATED SECTIONS

A. Section 013100 – Project Management and Coordination: Work sequence, owner occupancy, maintenance of utility services.

B. Section 017329 - Cutting and Patching: Cutting and patching.

C. Section 015000 – Temporary Construction Facilities and Temporary Controls: Temporary enclosures, protection of installed work, and cleaning during construction.

D. Section 024119 – Selective Demolition

PART 2 - PRODUCTS

2.1 PRODUCTS FOR PATCHING AND EXTENDING WORK

A. New Materials: As specified in product sections; match existing Products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing Products where necessary, referring to existing Work as a standard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that demolition is complete and areas are ready for installation of new Work.

B. Beginning of restoration Work means acceptance of existing conditions.

3.2 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

B. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and

deteriorated masonry and concrete. Replace materials as specified for finished Work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Prepare surface and remove surface finishes to provide for proper installation of new work and finishes.

E. Close openings in exterior surfaces to protect existing work and salvage items indicated from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

3.3 INSTALLATION

A. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate Owner occupancy.

B. Remove, cut and patch work in a manner to minimize damage and to provide a means of restoring Products and finishes to original condition in accordance with Section 024500.

C. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes in accordance with Section 024500.

D. Project, Designated Areas, Rooms and Spaces, and Finishes: Complete including operational mechanical and electrical work.

E. In addition to specified replacement of equipment and fixtures, restore existing plumbing, heating, ventilation, air conditioning, electrical, and other systems to full operational condition.

F. Re-cover and refinish work that exposes mechanical and electrical work exposed accidentally during the work.

G. Install Products as specified in individual sections.

3.4 TRANSITIONS

A. Where new work abuts or aligns with existing, perform a smooth and even transition. Patch Work to match existing adjacent work in texture and appearance.

B. When finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect/Engineer.

3.5 ADJUSTMENTS

A. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

B. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a

smooth transition for Architect/Engineer review.

C. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.

D. Fit work at penetrations of surfaces as specified in Section 01045.

3.6 REPAIR OF DAMAGED SURFACES

A. Patch or replace portions or existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

B. Repair substrate prior to patching finish.

3.7 FINISHES

A. Finish surfaces as specified in individual Product sections.

B. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.8 CLEANING

A. In addition to cleaning specified in Section 015000, clean Owner occupied areas of work.

END OF SECTION 011216

SECTION 011400 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Owner Occupancy: Allow for Owner occupancy of site.

2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.3 OCCUPANCY REQUIREMENTS

A. Partial Owner Occupancy: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011400

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment criteria applicable to portions of the Work performed under a unit price payment method.

B. Defect assessment and non-payment for rejected work.

1.2 AUTHORITY

A. Measurement methods delineated in the individual specification sections complement the criteria of this section.

B. Take all measurements and compute quantities. The Construction Manager will verify measurements and quantities.

C. Assist by providing necessary equipment, workers, and survey personnel as required.

1.3 UNIT QUANTITIES SPECIFIED

A. Quantities indicated in the Bid Form as defined in individual Specification sections are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Construction Manager shall determine payment.

B. If the actual Work requires more or fewer quantities than those quantities indicated, provide the required quantities at the unit sum/prices contracted.

C. If the actual Work requires a 10 percent or greater change in quantity than those quantities indicated, the Owner may claim for a Contract Price adjustment.

1.4 MEASUREMENT OF QUANTITIES

A. Measurement Devices:

1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
3. Metering Devices: Inspected, tested and certified by the applicable State department within the past year.

B. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.

C. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

D. Measurement by Area: Measured by square dimension using mean length and width or radius.

E. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.

F. Stipulated Sum/Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.

1.5 PAYMENT

A. Payment Includes: Full compensation for all required labor, Products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item or the Work; overhead and profit.

B. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the Architect/Engineer multiplied by the unit sum/price for Work which is incorporated in or made necessary by the Work.

1.6 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Architect, it is not practical to remove and replace the Work, the Architect will direct one of the following remedies:

1. The defective Work may remain, but the unit sum/price will be adjusted to a new sum/price at the discretion of the Architect.
2. The defective Work will be partially repaired to the instructions of the Architect, and the unit sum/price will be adjusted to a new sum/price at the discretion of the Architect.

C. The individual specification sections may modify these options or may identify a specific formula or percentage sum/price reduction.

D. The authority of the Architect to assess the defect and identify payment adjustment is final.

1.7 NON-PAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the lines and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.

1.8 SCHEDULE OF UNIT PRICES

N/A

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

END OF SECTION 012000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing allowances. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements due to unknown conditions or to defer selection of actual materials and equipment and/or installation to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.

B. Types of allowances include the following:

1. Lump-sum allowances.
2. Unit-cost allowances.
3. Quantity allowances.
4. Contingency allowances.
5. Testing and inspecting allowances.

C. Related Sections include the following:

1. Division 1 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
2. Division 1 Section "Unit Prices" for procedures for using unit prices.
3. Division 1 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
4. Divisions 2 through 35 Sections for items of Work covered by allowances.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

B. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

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

1.6 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials selected by Architect or specified herein and shall include taxes, freight, and delivery to Project site.

B. Related costs for Supervision, field operation and temporary facilities; general overhead; profit; bond premiums; and taxes. costs are part of the Contract Sum.

1.7 TESTING AND INSPECTING ALLOWANCES

A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.

B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.

C. Costs of services not required by the Contract Documents are not included in the allowance.

D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.8 UNUSED MATERIALS

A. Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, prepare unused material for storage by Owner when it is not economically practical to return the material for credit. If directed by Architect, deliver

unused material to Owner's storage space. Otherwise, disposal of unused material is Contractor's responsibility.

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

Contract No. 1 Demolition
1 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 2 Sitework
2 - Include the lump sum of the following amount **$10,000** in the contract for exterior temporary fence. See Section 012100 Allowances.

Contract No. 5 Steel Work
3 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 6 Carpentry & General Works
4 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 6 Carpentry & General Works
5 - Include the lump sum of the following amount **$20,000** in the contract for temporary closures during construction for the exterior wall construction. See Section 012100 Allowances.

Contract No. 7 Roofing Work
6 - Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 9 Aluminum Storefront/Windows/Glass & Glazing
7 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 10 Drywall/Metal Studs
8 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 12 Floor Covering Work
9 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 15 Mechanical
10 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 15 Mechanical
11 – Include the lump sum of the following amount **$50,000** in the contract for the temp heat fuel cost. Cost of work to be determined by fuel company receipts with the amount of fuel and cost per gallon. All equipment and labor for temp heat is part of the contract. This allowance is for fuel cost only. See Section 012100 Allowances.

Contract No. 16 Sprinkler System
12 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 17 Electrical
13 – Include the lump sum of the following amount **$20,000** in the contract for unforeseen conditions that may arise during construction to be used at the discretion of the Construction Manager. See Section 012100 Allowances.

Contract No. 17 Electrical
14 – Include the lump sum of the following amount **$25,000** in the contract for short circuit analysis gear revisions. See Section 012100 Allowances.

Contract No. 17 Electrical
15 – Include the lump sum of the following amount **$25,000** in the contract for selective demolition of the existing building See Section 012100 Allowances.

END OF SECTION 012100

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

This Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

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

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
2. Include as part of each alternate all costs of related coordination, modification or adjustment.

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

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

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. One - Outdoor Gathering Space (patio)
1. Base Bid: Sod turf replacement at disturbed area with 1'-0" mow strip at building edge.
2. Alternate: New Specialty stamped concrete with brick knee wall & mounted ornamental site fencing. New sidewalk connector to existing sidewalk.

B. Alternate No. Two: Interior Library/Learning Commons, Lounge and Circulation Corridor Floor Finishes – 50% Carpet / 50% Terrazzo at first floor & Second Floor.
1. Base Bid: As noted on floor plans (Terrazo)
2. Alternate: As noted on floor plans. (LVT)

C. Alternate No. Three: Terrazzo Flooring in Main Connector Corridor.
1. Base Bid: As noted on plans – Provide Terrazzo in C100 where noted on plans.
2. Alternate: Provide LVT in C100 where noted on plans.

D. Alternate No. Four: ATC System by Siemens
1. Base Bid: Provide ATC Controls by any listed ATC vendor.
2. Alternate: Provide additional costs, if any, for ATC system by Siemens as specified in specifica tion section 230900 "Instrumentation and Controls of HVAC and Plumbing Systems." If Siemens is the low cost ATC subcontractor, then the alternate value on the big form shall be listed as $0.

E. Alternate No. Five – Glass Backed Markerboards
1. Base Bid: No markerboards to be provided.
2. Alternate: Provide Glass Backed Markerboards (4'-0" W x 2'-0") at locations noted on floor plans

F. Alternate No. Six – Hybrid Thermoplastic Membrane Roofing
1. Base Bid: Provide EPDM membrane roofing as noted on plans.
2. Alternate: Provide Hybrid Thermoplastic membrane Roofing per 075200, in lieu of EPDM membrane roofing.

END SECTION 012300

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SECTION 012500 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.

1. Multiple Prime Contracts: Provisions of this Section apply to the construction activities of each prime contractor.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
2. Division 1 Section "Submittals" specifies requirements for submitting the Contractor's Construction Schedule and the Submittal Schedule.
3. Division 1 Section "Materials and Equipment" specifies requirements governing the Contractor's selection of products and product options.

1.3 DEFINITIONS

A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.

B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:

1. Substitutions requested during the bidding period, and accepted by Addendum prior to award of the Contract, are included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
2. Revisions to the Contract Documents requested by the Owner or Architect.
3. Specified options of products and construction methods included in the Contract Documents.
4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

A. Substitution Request Submittal: The Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received more than 60 days after commencement of the Work may be considered or rejected at the discretion of the Architect.

1. Submit 3 copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for change-order proposals.
2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

    a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate contractors that will be necessary to accommodate the proposed substitution.
    b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
    c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
    d. Samples, where applicable or requested.
    e. A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
    f. Cost information, including a proposal of the net change, if any in the Contract Sum.
    g. The Contractor's certification that the proposed substitution conforms to requirements in the Contract Documents in every respect and is appropriate for the applications indicated.
    h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

4. Architect's Action: If necessary, the Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Architect will notify the Contractor of acceptance or rejection of the substitution within 2 weeks of receipt of the request, or one week of receipt of additional information or documentation, whichever is later. Acceptance will be in the form of a change order.

    a. Use the product specified if the Architect cannot make a decision on the use of a proposed substitute within the time allocated.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: The Architect will receive and consider the Contractor's request for substitution when one or more of the following conditions are satisfied, as determined by the Architect. If the following conditions are not satisfied, the Architect will return the requests without action except to record noncompliance with these requirements.

    1. Extensive revisions to the Contract Documents are not required.
    2. Proposed changes are in keeping with the general intent of the Contract Documents.
    3. The request is timely, fully documented, and properly submitted.
    4. The specified product or method of construction cannot be provided within the Contract Time. The Architect will not consider the request if the product or method cannot be provided as a result of

failure to pursue the Work promptly or coordinate activities properly.

5. The request is directly related to an "or-equal" clause or similar language in the Contract Documents.
6. The requested substitution offers the Owner a substantial advantage, in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Owner must assume. The Owner's additional responsibilities may include compensation to the Architect for redesign and evaluation services, increased cost of other construction by the Owner, and similar considerations.
7. The specified product or method of construction cannot receive necessary approval by a governing authority, and the requested substitution can be approved.
8. The specified product or method of construction cannot be provided in a manner that is compatible with other materials and where the Contractor certifies that the substitution will overcome the incompatibility.
9. The specified product or method of construction cannot be coordinated with other materials and where the Contractor certifies that the proposed substitution can be coordinated.
10. The specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provides the required warranty.
11. Where a proposed substitution involves more than one prime contractor, each contractor shall cooperate with the other contractors involved to coordinate the Work, provide uniformity and consistency, and assure compatibility of products.

B. The Contractor's submittal and the Architect's acceptance of Shop Drawings, Product Data, or Samples for construction activities not complying with the Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 012500

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 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Sections include the following:

1. Division 1 Section "Unit Prices" for administrative requirements for using unit prices.
2. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.

2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.5 CHANGE ORDER PROCEDURES

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

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Sections include the following:

1. Division 1 Section "Unit Prices" for administrative requirements governing use of unit prices.
2. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 SCHEDULE OF VALUES

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

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

   a. Application for Payment forms with Continuation Sheets.
   b. Submittals Schedule.

2. Submit the Schedule of Values to Architect through the construction manager at earliest possible date but no later than 14 days before the date scheduled for submittal of initial Applications for Payment.

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

1. Identification: Include the following Project identification on the Schedule of Values:

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

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value.

        1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.

    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702/CMa and AIA Document G703 Continuation Sheets as form for Applications for Payment.

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

    1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.

2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit 4 signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

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

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

1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.

    a. Submit final Application for Payment with or proceeded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.

5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Products list.
5. Submittals Schedule (preliminary if not final).
6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.

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

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

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 012973 – SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-0 Specification Sections, apply to this section.

1.2 CONTRACT SUM BREAKDOWN

A. Within ten (10) days of receipt of Contract, each Trade Contractor shall submit to the Construction Manager for review a Contract Sum Breakdown, the total of which shall be equal to the initial contract sum.

B. The General Trade Contractor shall list quantities and unit prices that correspond to the activities he is responsible for. All unit prices should include labor, tools, equipment, overhead, and profit required to perform a complete installation.

1.3 FORM AND CONTENT

A. The breakdown shall be prepared on the forms provided with this Section. The schedule shall also indicate:

1. Title of project and location
2. Architect's name
3. Name and address of Contractor
4. Date of submission

B. Provide a separate line item for General Conditions which would include home office support, bonds, insurance premiums, mobilization, field supervision, temporary construction utilities, facilities, and controls.

1. Contractor must include line item amounts for General Condition Requirements as follows:

   Submittals
   Progress Meetings
   Clean up
   Progress Schedule Development
   Coordination Drawing
   Project Record Drawings

2. Breakdown of major construction activities shall be submitted per building wing, per floor, separating labor and material values.

END OF SECTION 012973

SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Coordination.
B. Field engineering.
C. Preconstruction meeting.
D. Site mobilization meeting.
E. Progress meetings.
F. Preinstallation meetings.
G. Examination.
H. Preparation.

1.2 RELATED SECTIONS

A. Section 011200 – Multiple Contract Summary
B. Section 013113 –Project Coordination
C. Section 017329 – Cutting and Patching

1.3 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify utility requirements and characteristics of operating equipment are compatible with utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

E. Coordinate completion and clean up of work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

F. After Owner occupancy, co-ordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.4 FIELD ENGINEERING

A. Contractor to locate and protect survey control and reference points.

B. Control datum for survey is that established by Owner and shown on drawings.

C. Verify set-backs and easements, confirm drawing dimensions and elevations.

D. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

1.5 PRECONSTRUCTION MEETING

A. Construction Manager will schedule a meeting after Notice of Award.

B. Attendance Required: Owner, Architect/Engineer, Contractors.

C. Agenda:

1. Submission of executed bonds and insurance certificates.
2. Distribution of Contract Documents.
3. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule not previously required.
4. Designation of personnel representing the parties in contract, Architect and other Consultants.
5. Procedures and processing of field decisions, submittals, substitutions, Applications for Payments.
6. Scheduling.
7. Scheduling activities of inspection and testing service.

D. Construction Manager will record minutes and distribute copies within two days after meeting to participants, with copies to those affected by decisions made.

1.6 SITE MOBILIZATION MEETING

A. Construction Manager shall schedule a meeting at the project site prior to Contractor occupancy.

B. Attendance Required: Owner, Architect/Engineer, Special Consultants, Contractor, Contractors Superintendent, major Subcontractors, and other parties as required.

C. Agenda:

1. Use of premises by Owner and Contractor.
2. Owner’s requirements and occupancy.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and layout.
6. Security and housekeeping procedures.
7. Schedules.
8. Procedures for testing.
9. Procedures for maintaining record documents.
10. Requirements for start-up of equipment.
11. Inspection and acceptance of equipment put into service during construction period.

D. Construction Manager shall record minutes and distribute copies within two days after meeting to participants, with copies to Architect/Engineer, Owner, participants, and those affected by decisions made.

1.7 PROGRESS MEETINGS

A. Construction Manger shall schedule and administer meetings throughout progress of the work at weekly intervals unless otherwise required by the work.

B. Construction Manger shall make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Job superintendents, Prime Trade Contractors, Owner, Architect/Engineer, Special Consultants as required and parties as appropriate to agenda topics for each meeting.

D. Agenda

1. Review minutes of previous meetings.
2. Review work progress.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Current safety changes.
14. Other business relating to Work.

E. Construction Manager shall record minutes and distribute copies within two days after meeting to participants, with copies to Architect / Engineer, Owner, participants, and those affected by decisions made

1.8 PREINSTALLATION MEETING

A. When required in individual specification sections, the respective Contractor shall convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting or affected by, work of the specific section.

C. Notify Architect, Owner and Construction Manager four days in advance of meeting date.

D. Contractor shall prepare agenda and preside at meeting:

1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within five days after meeting to participants, with copies to Architect, Owner, Construction Manager, participants, and those affected by decisions made.

1.9 ADDITIONAL MEETING

A. The Construction Manager may conduct additional meetings as required by the Project conditions or changes. All contractors must attend these meetings at no additional cost to the Owner.

B. Daily Coordination meeting of approximately 15 minute duration will be conducted by the Construction Manager for all Contractor's superintendents on site.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specifications sections.

D. Verify that utility services are available, of the correct characteristics, and in the correct location.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply any manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION 013100

SECTION 013113- PROJECT COORDINATION

PART I - GENERAL

1.1 SECTION INCLUDES

A. Project coordination by the Project Coordinator.
B. Construction Mobilization.
C. Schedules.
D. Submittals.
E. Coordination drawings.
F. Closeout procedures.

1.2 RELATED SECTIONS

A. Document 007226- General Conditions – AIA G232-2009 CM/A: Duties of the Construction Manager.

B. Document 007300- Supplementary Conditions of the Contract.

C. Section 011100 - Summary of Work: Work covered by each Contract. Work sequence. Owner occupancy.

D. Section 013100 – Project Management and Coordination: Project meetings. Pre-construction Meetings. Progress meetings.

F. Section 013300 - Submittals: Submittal procedures.

F. Section 017700- Contract Closeout: Contract Closeout Procedures.

1.3 PROJECT COORDINATOR

A. Project Coordinator: Construction Manager.

1.4 CONSTRUCTION MOBILIZATION

A. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field office and
sheds, for construction and Owner access, traffic, and parking facilities.

B. During construction, coordinate use of site and facilities through the Project Coordinator.

C. Comply with Project Coordinator’s procedures for intraproject communications; submittals, reports and records, schedules, coordination drawings and recommendations; and resolution of ambiguities and conflicts.

D. Comply with instructions of the Project Coordinator for use of temporary utilities and

construction facilities.

F. Coordinate field engineering and layout work under instructions of the Project Coordinator.

1.5 SCHEDULES

A. Submit preliminary manpower loaded bar chart schedule in accordance with Section 01310.

B. After review, revise and resubmit schedule to comply with revised Project schedule.

C. During progress of work, revise and resubmit with Applications for Payment or as directed.

1.6 SUBMITTALS

A. Provide submittals to Project Coordinator for review and transmittal to Architect / Engineer.

B. Submit requests for interpretation of Contact Documents, and obtain instructions through the Project Coordinator.

C. Process requests for substitutions, and change orders, through the Project Coordinator.

D. Deliver closeout submittals for review and preliminary inspection reports, for transmittal to

I .7 COORDINATION DRAWINGS

A. Provide information required by Project Coordinator for preparation of coordination drawings.

B. Systems Coordination Drawings are required from the Mechanical, Electrical, Plumbing and General
Trade Contractors with the lead role assigned to the Mechanical Trade Contractor.

C. The Mechanical Trade Contractor shall prepare 1/4” = 1 ft. scale Reproducible Systems Drawings for all areas with piping and ductwork. Drawings to indicate spatial relationship HVAC piping and ductwork.

D. The Mechanical Trade Contractor shall prepare and submit to the Construction Manager a regularly updated schedule indicating the development and review of these drawings with other Trade Contractors. The drawing development and review schedule must follow the project construction schedule.

E. The Mechanical Trade Contactor shall provide the Reproducible Systems Coordination the other Trade Contractors for their input and review. The routing is as follows: HVAC

Ductwork / Piping, Plumbing, General Trades with the drawings being reamed to be Contractor.

F. Each Trade Contractor will add the work of his Contract on the Systems Coordination Drawings to -avoid interferences. All piping, equipment, light fixtures and in-ceiling equipment, such as rolling gates, must be shown on these drawings to include elevations and dimensions.

G. Prior to forwarding the Systems Coordination Drawings to the next Trade Contractor, an approval stamp, initialed and dated, should be affixed by the reviewing Trade Contractor. This approval by the reviewing Trade Contractor will install his work accordingly.

H. During the Systems Coordination Drawing process, the Construction Manager will conduct regularly scheduled meetings. Each Trade Contractor is required to attend these meetings. The Construction Manager is responsible for recording and distributing meting minutes to all Trade Contractors and the Architect / Engineer. The purpose of the meetings will be to review and discuss interferences and conflicts as well as any modifications to the Systems Coordination Drawings, All resolutions of interferences and conflicts which required modifications shall be initiated by the appropriate Trade Contractors on the Systems Coordination Drawings. At each meeting, the General Trade Contractors will review and update the Systems Coordination Drawing Schedule.

I. Once reviewed and approved by each General Trade Contractor, the Mechanical Trade Contract will prepare the Final Reproducible Systems Coordination Drawings with the work of all trades included. Submit the Reproducible Drawings along with two (2) prints to the Construction Manager who will forward to the Architect for his review.

J. The Mechanical Trade Contractor shall indicate any unresolved conflicts or interferences on the Systems Coordination Drawings. Those should be delineated by clouding, numbering and referencing to he affected contract drawings,

K. Review drawings prior to submission to Architect / Engineer.

L. The Architect will review and return drawings to the Construction Manager. The Construction Manager will distribute the number of drawings to the Trade Contractors for installation of their work.

M. The Systems Coordination Drawings DO NOT REPLACE any fabrication and layout drawings required by individual Specification Sections.

1.8 CLOSEOUT PROCEDURES

A. Notify Project Coordinator when work is considered ready for Substantial Completion. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in Contractors Notice of Substantial Completion.

B. Comply with Project Coordinator's instructions to correct items of work listed in executed Certificates of Substantial Completion and for access to Owner occupied areas.

C. Notify Project Coordinator when Work is considered finally complete. Accompany Project Coordinator on preliminary final inspection.

D. Comply with Project Coordinators instructions for completion of items of Work determined by Architect / Engineers final inspection.

PART 2 - PRODUCTS – (NOT USED)

PARTS - EXECUTION— (NOT USED)

END OP SECTION 013113

SECTION 013216 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Scheduling requirements and coordination.

B. Construction Phasing Plans

C. Construction Milestone Schedules (by Phase and by Trade)

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this section.

1.3 DEFINITIONS

A. Activity: An activity is any single identifiable step in the Project. It depends upon preceding and succeeding activities.

1.4 CONSTRUCTION SCHEDULE

A. The Construction Schedule, as reviewed by the Construction Manager and Owner, will be an integral part of the Contract, and will establish interim work completion dates for the various activities. Each Trade Contractor shall be responsible to achieve Starting Dates, Milestones or Target Dates, and Completion Dates established for each Phase of the overall Project.

B. The Construction Schedule may vary in accordance with construction conditions. Each Contractor shall delay or expedite material and equipment deliveries, and modify the required labor forces to accommodate these varying conditions.

C. This is a phased project. Multiple trips may be required to complete this Project.

D. Within fifteen (15) days after receipt of Notice of Intent to Award, each Contractor shall submit a preliminary Construction Schedule, in accordance with the milestone construction schedule included in these documents under the summary of work, to the Construction Manager. The schedule will include breakdowns of total man days of field labor into major categories of work, time estimates of various categories of work, crew size for each category, and quantity and type of equipment to be utilized.

E. Each Contractor shall provide to the Construction Manager a separate list of critical submittal dates for Shop Drawings, Product Data, and Samples, indicating delivery dates/lead times that may impact the construction schedule or completion of the Work. The critical submittal list shall accompany the Preliminary Submittal List as identified in Section 013300 - Submittals.

F. Each Contractor shall organize his Construction Schedule per Phase, Building, Wing, Floor, and Area as required by the Construction Manager.

G. The Construction Manager shall schedule a meeting with the Contractors, to review the contents of each Contractor's preliminary Construction Schedule, review the sequence of Work, and make all revisions required. The Construction manager shall have the final authority concerning the sequence of Work and durations of each activity. Each Contractor shall revise his schedule in accordance with that meeting and submit his schedule to the Construction Manager for review. The Construction Manager will then develop the Project Construction Schedule. Each Contractor shall schedule and perform his work in compliance with the Construction Manager's Project Construction Schedule.

H. The Schedule shall be the basis for the dates to start and complete Work for the various portions of each Contract, and to complete Work (including changes) for the Project. IT shall be the duty of the Contractor to conform to the current Schedule and to arrange his work in such a manner that it will be installed in accordance with the Schedule.

I. Each Contractor shall submit two (2) copies of a monthly updated Construction Schedule comparing the original schedule to actual work in progress and project work along with the Application for Payment.

J. As required, a representative of each Contractor shall meet with the Construction Manager and furnish to him information necessary for such re-evaluating and updating of the Project schedule. Information with regard to changes in the work and the Contractor's proposed effort to overcome any delays incurred shall be provided (in writing) to the Construction Manager.

K. Two (2) days after the Contractor has failed to Start on Schedule, Meet Assigned Milestone or Target Dates, or Completion of items such as Shop Drawing Submissions, Material - Equipment Deliveries, or Tasks according to the Master Construction Schedule or Revised Master Construction Schedule, the Construction Manager will forward a letter of Non-Conformance, via Facsimile Transmission and/or forward a letter of Non-Conformance, via Facsimile Transmission and/or Express Mail, to the Contractor and a copy to the Owner. Upon receipt of this notice, the Contractor is required to execute whatever measures as so directed by the Contract Manager including, but not specifically, assigning additional labor, shifts, overtime, materials, expediting of submittals or deliveries, equipment, scaffold, or any combination of these as deemed appropriate and necessary by the Construction Manager to return the above referenced activities back on schedule, without additional compensation to the Contractor.

L. Costs incurred by the Construction Manager in connection with maintaining the Construction Schedule, caused by the Contractor's noncompliance with the scheduling requirements, shall be reimbursed to the Construction Manager by the Contractor.

M. It is expressly understood and agreed that failure by the Construction Manager to exercise the option to either order the Contractor to expedite work, or to expedite the work by other means, shall not be considered precedent-setting for any other activities.

1.5 SCHEDULE COMPUTERIZATION

A. All Trade Contractors shall provide all their scheduling information via a computer assisted scheduling program, acceptable to the Construction Manager. Format to be Bar Chart.

B. All schedule information and updates for the above Contractors shall be provided to the Construction Manager on 3.5" diskettes in format and density as required.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION – NOT USED

PART 4 – SCHEDULE

Construction starts July 15, 2026. Project has to be finished by January 15, 2028. Please provide sufficient manpower in your cost to meet the completion date of January 15, 2028.

END OF SECTION 013216

SECTION 013233 – PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Field condition reports.
6. Special reports.
7. Construction photographs.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.

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

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

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

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

D. Fragment: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

E. Major Area: A story of construction, a separate building, or a similar significant construction element.

F. Milestone: A key or critical point in time for reference or measurement.

G. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.4 SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" Article and in-house scheduling personnel to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect's and Construction Manager’s final release or approval.

C. Preliminary Construction Schedule: Submit three printed copies.

D. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.

E. Daily Construction Reports: Submit two copies at weekly intervals.

F. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

G. Special Reports: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:

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

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

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

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

D. Each trade contractor is to submit preliminary manpower loaded bar chart schedule in accordance with section 013100.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead-time for manufacture or fabrication.

    a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

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

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

1. Activity Duration: Define activities so no activity is longer than 120 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than 7 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect and Construction Manager’s administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Startup and placement into final use and operation.

5. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Permanent space enclosure.
    c. Completion of mechanical installation.
    d. Completion of electrical installation.
    e. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.

1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragments to demonstrate the effect of the proposed change on the overall project schedule.

H. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within 14 days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60

days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.5 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Meter readings and similar recordings.
10. Emergency procedures.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Construction Change Directives received.
14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial Completions and occupancies.
17. Substantial Completions authorized.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.6 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, and response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013233

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SECTION 013319 FIELD TEST REPORTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work on this section.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition. Alternate methods and/or materials may be submitted to the Architect for consideration. Those judged to be equal to that specified will receive written approval.

C. Delaware Department of Transportation Specifications for Road and Bridge Construction, August 2001 and as amended.

D. Delaware Department of Natural Resources and Environmental Control (DNREC) Sediment and Stormwater Regulations.

1. 2 SUMMARY

Work included: Provided at the Contractor's expense, such field engineering services as are required for proper completion of the Work including, but not necessarily limited to:

A. The Contractor shall be responsible for all stakeouts and elevation checks required for construction. All such Work shall be performed by a professional land surveyor. The surveyor shall verify adequacy of benchmarks before starting construction.

B. Before the start of any building construction, the Contractor shall have a professional land surveyor locate and stake building corners, driveway entrances, driveways, parking areas and playfields. If there are any discrepancies between the actual layout and the project site plan, they shall be brought to the attention of the Architect and resolved before Work proceeds. A building and site stake out drawing stamped and signed by a professional land surveyor may be submitted in lieu of this preliminary stake out.

C. After the corners of the exterior walls have been started, the Contractor shall obtain a wall check survey certificate made by a professional land surveyor. This survey shall show the accurate location of the building with reference to property lines.

D. After the first sections of slab-on-grade have been placed in the building, the Contractor shall have a professional land surveyor verify and record the finish floor elevations on the wall check survey.

E. At the end of the project, the Contractor shall have a professional land surveyor prepare and certify an as-built survey showing the accurate horizontal and vertical locations of all building corners, paved areas, sidewalks, utilities (including inverts), fencing, site walls, etc. located within the project area.

F. As-Built survey shall be included in a standard C.A.D. format such as AutoCad and/or MicroStation and shall include 2-foot contours within the project limits.

G. A complete stormwater management as-built shall also be completed in accordance with DNREC's Standard Stormwater Management checklist. The Contractor's shall have a professional land surveyor prepare and certify an interim and final as-built, and the testing and inspection agent shall have a professional engineer certify the construction checklist at the interim and final stages of stormwater management facility construction.

H. The contractor will be responsible for preparing and submitting to the project engineer five (5) copies of the interim and final stormwater management facility as-built, and additional facility information in accordance with the requirements set forth by DNREC.

1.3 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

B. Additional requirements for field engineering also may be described in other Sections of these Specifications.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 SUBMITTALS

A. Comply with pertinent provisions of Section 013300-Submittals.

B. Upon request of the Architect, submit;

1. Data demonstrating qualifications of persons proposed to be engaged for field engineering services.

2. Documentation verifying accuracy of field engineering work.

3. Certifications, signed by the Contractor's retained field engineer, certifying that elevations and locations of improvements are in conformance with requirements of the Contract Documents.

4. All certifications and surveys described in the Summary section of this specification.

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1.6 PROCEDURES

A. In addition to procedures directed by the Contractor for the proper performance of the Contractor's responsibilities:

1. Locate and protect control points before starting Work on the site.

2. Preserve permanent reference points during process of the Work.

3. Do not change or relocate reference points or items of the Work without specific approval from the Architect.

4. Promptly advise the Architect when a reference point is lost or destroyed, or requires relations because of other changes in the Work.

a) Upon direction of the Architect, require the field engineer to replace reference stakes or markers.

b) Locate such replacements according to the original survey control.

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

Not Applicable

END OF SECTION 013319

SECTION 013500 – SPECIAL PROCEDURES

1.1 SAFETY REQUIREMENTS

A. All work shall be performed in accordance with rules, regulations, procedures and safe practices and/or OSHA and all other Government agencies having jurisdiction over the project.

1.2 SAFETY PRECAUTIONS AND PROGRAMS:

A. Each Contractor shall be responsible for initiating, maintaining and supervising safety precautions and programs in connection with the work. The name of the safety officer for each contractor shall be provided to the Construction Manager.

B. All Contractors shall comply with the provisions of the "Occupational Safety and Health Act" and Federal, State and local requirements.

C. If a Contractor fails to maintain the safety precautions required by law or directed by the Construction Manager, the Construction Manager may take such action as necessary and charge the Contractor therefore. The failure of the Construction Manager to take any such action shall not relieve the Contractor of his obligations.

D. The Contractor individually shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods and for any damage which may result from their failure or their improper construction, maintenance or operation.

E. Prior to mobilizing to the job, the Contractor shall submit to the Construction Manager in writing, a description of his safety program for review and comment. Failure of the Construction Manager to make any changes shall not relieve the contractor of his obligations. During the conduct of the work, the Contractor shall immediately notify the Construction Manager in writing of all accidents and shall submit a written report describing in detail the circumstances of each accident within 24 hours of its occurrence.

F. All Contractors shall notify the Construction Manager of any flammable, combustible and/or toxic materials intended for use on the project and shall furnish the Construction Manager with literature pertinent to the use and control of all materials, including, but not limited to M.S.D.S. sheets.

G. Each Contractor shall delegate one representative who shall be responsible to maintain all safety requirements of the Contractor, and shall attend all project meetings scheduled by the Construction Manager.

1.3 SAFETY OF PERSONS AND PROPERTY:

A. The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage or loss to:

1. All Capital School District personnel and all other persons who may be affected

thereby.

2. All the work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-Subcontractors.

3. Other property at the site or adjacent thereto, including but not limited to trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction and underground property.

B. The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority, including the Owner's requirements bearing on the Safety of persons or property or their protection from damage, injury or loss.

C. The Contractor shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection, including danger signs and other warnings against hazards. He shall comply with safety regulations and notify the Construction Manager, until he is in compliance.

D. The Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by the Contractor, his Subcontractors, his Sub-Subcontractors, or anyone directly employed by any of them, or by anyone for whose acts any of them be liable.

E. The Contractor shall not load or permit any part of the work to be loaded so as to endanger its integrity and safety.

F. Contractors using a method of blasting to perform work on the project shall use all proper methods, including adequate safety matting and/or overburden, progressive time sequences and scaled distances, in accordance with all governmental regulations.

G. The use of audio equipment and headsets will not be permitted on the construction site.

1.4 PERSONAL PROTECTION REQUIREMENTS

A. All persons entering the project shall wear hard hats in good condition and meet ANSI Z89.1-1981 and ANSI Z89.2-1971. The hats shall be worn in the proper manner.

B. All persons entering the project shall wear proper work boots, clothing attire including long trousers and shirts.

C. All job site personnel are expected to strictly adhere to the following rules and regulations:

1. Use of approved eye protection by all Company personnel shall be required during all types of percussions and reciprocating work or when owner requirements govern.

2. Approved respiratory equipment shall be worn by all personnel exposed to hazardous volumes of toxic or noxious dusts, fumes, mists, or gases. Check M.S.D.S. if not sure.

3. Personal protective equipment is to be used under unusual conditions, such as high temperature work, handling caustic or corrosive liquids, or molten metals.

4. When lifting material, keep back straight, bend knees, and lift with your legs. Get help if the load is too heavy.

5. Work clear of suspended loads. If a load is moved above where your are working or walking, stand clear until it has passed.

6. Unless it is part of your regular work, do not attempt to repair or adjust any electrical equipment.

7. Kill any circuit before attempting to work on it. Even voltages lower than 110 will cause death under certain conditions.

8. Treat all electric wires as live. Do not touch exposed wires. Report them immediately to your supervisor.

9. The Contractor is responsible for providing safety training to all of his employees.

10. All shipments to the site shall have the required documentation and labels attached and the documentation and labels shall be maintained while the material is on site.

11. As defined in the occupational Safety & Health Act, safety belts, complete with lanyards, or parachute-style harness, complete with lanyard, are to be used where there is a danger of falling.

1.5 HOUSEKEEPING

A. Materials and equipment must be piled up or stored in a safe manner. Aisles must be kept clear.

B. All drop cables/extension cords shall be elevated above the ground or protected in such a way to allow traffic to pass.

C. Smoking will only be permitted in designated areas.

D. Consumption of food and beverages in other than Company-designated areas and at specified times.

E. Glass-bottled refreshments will not be allowed in the workplace.

F. Graffiti will not be tolerated on the jobsite.

G. All compressed gas cylinders must be stored in an upright position and tied off with the cap placed on top.

H. The cords and connections at temporary panels must be maintained in an orderly fashion at all times to prevent tripping.

I. Welding stubs and shells from explosive activated tools shall be collected and properly disposed of by Contractor.

J. Nails are to be bent over and/or removed from wood.

K. Aisles and stairwells as well as base areas of ladders are to be kept clear at all times.

1.6 M.S.D.S.-CONTROLLED PRODUCTS

A. The Contractor is responsible for notifying R.Y. Johnson & Son, Inc of any controlled products that they bring or cause to have brought onto the site. The Contractor shall provide R.Y. Johnson & Son, Inc. with a copy of the Material Safety Data Sheet (M.S.D.S.) for the controlled product, and the Contractor shall retain a copy of the M.S.D.S. on site for their reference. The legal storage, use, and disposal of any controlled product is the responsibility of the Contractor.

B. The Contractor shall comply with OSHA Communications' Standards 29 CFR 1910-1200 for hazardous materials. The Contractor shall maintain a Material Safety Data Sheet on file at the jobsite for each chemical brought to the site. M.S.D.S. sheets shall be submitted to R.Y. Johnson & Son, Inc. for record purposes.

C. Temporary storage of hazardous materials shall be located in containment dikes provided by the Contractor requiring same in area identified by the Construction Manager. All tanks, drums, and containers are to be labeled with appropriate warnings (i.e., flammable, no smoking). Periodic inspections for leakage shall be the responsibility of the Contractor. Final cleanup and removal shall be by the Contractor.

1.7 EMERGENCIES

A. In any emergency affecting the safety or persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss and shall immediately notify the Construction Manager of such emergency conditions. Any claims made by the Contractor for additional compensation or extension of time on account of emergency work shall be processed in accordance with Article 7, of the Supplementary Conditions.

1.8 ACCIDENT INVESTIGATION AND REPORTING

A. All accident/incidents shall be reported.

B. The Contractor shall submit an accident/incident report to R.Y. Johnson & Son, Inc. no later than 10 hours on the working day following the incident. A detailed report is to follow within 24 hours.

1.9 FIRST AID PROCEDURE

A. The Contractor is to provide his own First Aid service.

B. Each Contractor shall supply to R.Y. Johnson & Son, Inc. a list of their qualified First Aid personnel. Each Contractor is to have a minimum of one full-time qualified First Aid personnel on site. Contractor First Aid certificates shall be posted in the Contractor's site office and photocopies supplied to R.Y. Johnson & Son, Inc.

1.10 INDEMNIFICATION

A. Contractors shall indemnify and hold harmless the Owner, the Construction Manager and the Architect/Engineer, all municipal authorities, and their agents and employees from and against all claims, damages, losses, and expenses including, but not limited to attorney's fees arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other work than the work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not is caused in part by a party indemnified hereunder.

B. In any and all claims against the Owner, the Construction Manager or the Architect/Engineer or any of their agents or employees by any employee of a Contractor, and Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this paragraph shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the type of damages, compensation or any Subcontractor under workmen's compensation acts, disability benefit acts or other employee benefit acts.

C. To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Construction Manager, the Owner, and the Architect and their agents and employees from and against all claims, including citations and penalties imposed by the Occupational Safety and Health Administration, damages, losses, expenses and judgments including, but not limited to attorneys' fees, arising out of or resulting from performance of the work in an area which is unsafe, harmful, dangerous, or hazardous and which is caused in whole or in part by any act or omission of the Contractor, anyone directly or indirectly employed by it, or anyone for whose acts it may be liable, regardless of whether the claim, citation, penalty, damage, loss, expense or judgment results from unsafe, harmful, dangerous, hazardous or toxic materials or substances or whether from any other unsafe, harmful, dangerous or hazardous conditions.

D. The obligations of the Contractor under this paragraph shall not extend to the liability of the Architect/Engineer or the Construction Manager, his agents or employees arising out of (1) the preparation or approval of maps, drawings, opinions, reports, surveys, design or specifications, or (2) the giving of or the failure to give directions or instructions by the Architect/Engineer of the Construction Manager, their agents or employees provided such giving or failure to give is the primary cause of the injury or damage.

E. No provision of this Subparagraph shall give rise to any duties on the part of the Architect or the Construction Manager not otherwise provided for by contract or by law.

F. In the event that any party is requested but refuses to honor the indemnity obligations hereunder, then the party refusing to honor such requests shall, in addition to all other obligations, pay the cost of bringing any such action, including attorney's fees to the party requesting indemnity.

END OF SECTION 013500

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality-control services.

B. Quality-control services include inspections, tests, and related actions, including reports performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by Architect.

C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

D. Requirements of this Section relate to customized fabrication and installation procedures, not production of standard products.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

E. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Cutting and Patching" specifies requirements for repair and restoration of construction disturbed by inspection and testing activities.
2. Division 1 Section "Submittals" specifies requirements for development of a schedule of required tests and inspections.

1.3 RESPONSIBILITIES

A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.

1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are

included in the Contract Sum.

B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.

1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.

C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:

1. Provide access to the Work.
2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
4. Provide facilities for storage and curing of test samples.
5. Deliver samples to testing laboratories.
6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
7. Provide security and protection of samples and test equipment at the Project Site.

D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.

1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
3. The agency shall not perform any duties of the Contractor.

E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.4 SUBMITTALS

A. Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.

1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.

2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:

    a. Date of issue.
    b. Project title and number.
    c. Name, address, and telephone number of testing agency.
    d. Dates and locations of samples and tests or inspections.
    e. Names of individuals making the inspection or test.
    f. Designation of the Work and test method.
    g. Identification of product and Specification Section.
    h. Complete inspection or test data.
    i. Test results and an interpretation of test results.
    j. Ambient conditions at the time of sample taking and testing.
    k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
    l. Name and signature of laboratory inspector.
    m. Recommendations on retesting.

1.5 QUALITY ASSURANCE

A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.

    1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 014000

SECTION 014100- REGULATORY REQUIREMENTS

PART I - GENERAL

1.1 SECTION INCLUDES

A. Safety and Health Regulations.

B. Housekeeping.

C. M.S.D.S. Controlled Products.

D. Emergencies.

E. Employment Policy.

F. Environmental Statutes and Regulations.

G. Miscellaneous Regulations.

I. Standard of Quality.

I.2 RELATED SECTIONS

A. General and Supplementary Conditions of the Contract.

I.3 SAFETY AND BEALTH REGULATIONS

A. These Contract Documents and the joint and several phases of construction hereby contemplated are to be governed, at all lines by applicable provisions of the Federal law(s), including but not limited to, the latest amendments of the following:

1. Williams-Steiger Occupational Safely and Health Act of 1970, Public Law 91-596,
2. Part 1910 - Occupational Safety and Health Standards, Chapter XIII of Title 29, Code of Federal Regulations.

B. Nothing contained in these Contract Documents for construction shall be construed by the Contractor as relieving him in any way of his responsibility for strict compliance with the rules and regulations contained in the above mentioned Occupational Safety and Health Act.

C. The use of products containing asbestos will not he permitted.

D. All work shall be performed in accordance with rules, regulations, procedures and safe practices and/or OSHA

and all other Government Agencies having jurisdiction over the project.

E. Each Contractor shall be responsible for initiating, maintaining and supervising safety precautions and programs in connection with the work. The name of the safety officer for each contactor shall be provided to the Construction Manager.

F. All Contractors shall comply with the provisions of the Occupational Safety and Health Act and Federal, State and local requirements.

G. If a Contractor fails to maintain the safety precautions required by law or directed by the Construction Manager, the Construction Manager may take such action necessary and charge the Contractor therefore. The failure of the Construction Manager to take any such action shall not relieve the Contractor of his obligations.

H. The Contractor individually shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods and for any damage which may result from their failure or their improper construction, maintenance or operation.

I. Prior to mobilizing to the job, the Contractor shall submit to the Construction Manager in writing, a description
of his safety program for review and comment. During the conduct of the work, the Contractor shall immediately notify the Construction Manager in writing of all accidents and shall submit a written report describing in detail the circumstances of each accident within 24 hours of its occurrence.

J. All Contractors shall notify the Construction Manager of any flammable, combustible and/or toxic materials intended for use on the project and shall famish the Construction Manager with literature pertinent to the use and control of all materials, including, but not limited to M.S.D.S sheets.

K. Each Contractor shall delegate one representative who shall be responsible to maintain all safety requirements of the Contractor, and shall attend all project meetings scheduled by the Construction Manager.

L. The Contractor shall take all reasonable precautions for the safety of, and shall provide all reasonable protection to prevent damage or loss to: -

1. All school personnel, employees on the work site and all other persons who may be affected thereby.
2. All the work and all materials and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or
Sub-Subcontractors.
3. Other property at the site or adjacent thereto, including but not limited to trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction and underground property.

M. The Contractor shall give all notices and comply with all applicable laws, ordinances, rules, regulations and lawful orders of any public authority, including the Owner's requirements bearing on the Safety of persons or property or their protection from damage, injury or loss.

N. The Contractor shall erect and maintain, as required by existing conditions and progress of the work, all reasonable safeguards for safety and protection, including danger signs and other warnings against hazards. He shall comply with safety regulations and notify the Construction Manager, until he is in compliance.

O. The Contractor shall promptly remedy all damage or loss to any property caused in whole or in part by the Contractor, his Subcontractors and his Sub-Subcontractors or anyone directly employed by any of them, or by anyone for whose acts any of them be liable.

P. The Contractor shall not load or permit any part of the work to be loaded so as to endanger its
integrity and safety.

Q. Contractors using a method of blasting to perform work on the project shall use all proper

R. The use of audio equipment and headsets will not be permitted on the construction site.

S. All persons entering the project shall wear hard hats in good condition and meet ANSIZ89.1-1981 and
ANSI Z89.2-1971. The hats shall be worn in the proper manner.

T. All persons entering the project shall wear proper work boots, clothing attire including long trousers and shirts.

U. All job site personnel are expected to strictly adhere to the following rules and regulations:

I. Use of approved eye protection by all company personnel shall be required during all types of percussions and reciprocating work or when owner requirements govern.
2. Approved respiratory equipment shall be worn by all company personnel exposed to hazardous volumes of toxic or noxious dusts, fumes, mists, or gases. Check M.S.D.S. if not sure.
3. Personal protective equipment is to be used under usual conditions, such as high temperature work, handling caustic or corrosive liquids or molten metals.
4. When lifting material, keep bask straight, knees bent, and lift with your legs. Get help if the load is
too heavy.
5. Work clear of suspended loads. If a load is moved above where you are working or walking, stand clear until it has passed.
6. Unless it is part of your regular work, do not attempt to repair or adjust any electrical equipment.
7. Kill any circuit before attempting to work on it. Even voltages lower than 110 will cause death under certain conditions.
8. Treat all electric wires as live. Do not touch exposed wires; report them

immediately to your supervisor.

9. The Contractor is responsible for providing safety training to all of his employees.
10. All shipments to the site shall have the required documentation and labels attached and the documentation and labels shall be maintained while the material is on site.
11. As defined in the Occupational Safety & Health Act, safety belts, complete with lanyards or
parachute style harness, complete with lanyards, are to be used where there is a danger of falling.

1.4 HOUSEKEEPING

A. Materials and equipment must be piled up or scored in a safe manner. Aisles must be kept clear.

B. All drop cables/extension cords shall be elevated above the ground or protected in such a way to allow traffic to pass.

C. Smoking will only he permitted in designated areas.

D. Consumption of food and beverages in other than Company-designated areas and at specified times are prohibited.

E. Glass-bottled refreshments will not be allowed in the workplace.

F. Graffiti will not be tolerated on the job-site.

G. All compressed gas cylinders must be stored in an upright position and tied off with the cap placed on top.

H. The cords and connections at temporary panels must be maintained in an orderly fashion at all times to prevent tripping.

I. Welding stubs and shells from explosive activated tools shall be collected and properly disposed of by the Contractor.

J. Nails are to be bent over and/or removed from wood,

K. Aisles and stairwells as well as base areas of ladders are to be kept clear at all times.

1.5 M.S.D.S.-CONTROLLED PRODUCTS

A. The Contractor is responsible for notifying R.Y. Johnson Construction Management of any controlled products that they bring or cause to have brought onto the site. The Contractor shall provide
RY. Johnson Construction Management with a copy of the Material Safety Sheet (M.S.D.S.) for the controlled product and the Contractor shall retain a copy of the M.S.D.S. on site for their own reference. The legal storage, use, and disposal of any controlled product is the responsibility of the Contractor.

B. The Contractor shall comply with OSHA Communication Standards 29 CFR 1910-1200 for hazardous materials. The Contractor shall maintain a Material Safety Data Sheet on file at the job-site for each chemical brought to the site, M.S.D.S. sheets shall be submitted to R.Y. Johnson Construction Management for record purposes

C. Temporary storage of hazardous materials shall be located in containment dikes provided by the Contractor requiring same in area identified by the Construction Manager. All tanks, drums, and containers are to be labeled with appropriate warnings (i.e., flammable, no smoking). Periodic inspections for leakage shall he the responsibility of the Contractor. Final clean-up and removal shall be by the Contractor.

1.6 EMERGENCIES

A. In any emergency affecting the safety or persons or property, the Contractor shall act, at his discretion, to prevent threatened damage, injury or loss and shall immediately notify the Construction Manager of such emergency conditions. Any claims made by the Contractor for additional compensation or extension of time on account of emergency work shall be processed in accordance with Article 7, of the Supplementary Conditions.

I.7 EMPLOYMENT POLICY

A. Acceptance of a contract based on these specifications constitutes agreement by the Contractor to comply with State Policy as established by joint Resolution No. 16 of the General Assembly of l958, which is: That on all public works being paid for in whole or in part with State or other public funds, preference shall be given to available persons who have been residents of Delaware for a period of at least six (6) months immediately prior to availability of positions for employment of laborers, mechanics and others, not including supervisor personnel not to exceed ten percent (10%) of the total working force.

B. Competent Workmen: No person shall be employed to perform any work under the Contract who is not a competent and first-class workman or mechanic, as applicable. For purposes of this section, no workman or mechanic, as applicable, shall be regarded as competent and first class unless he shall be duly skilled in the applicable branch of labor and shall be paid not less than such rates of wages and for such hours work as shall be established and current rates of wages paid for such hours by employers of organized labor in performance of similar work in the locality where the work is to be performed.

C. It is understood that the provisions of Title VI of the Civil Rights Act 1964 are hereby included in this contract to the end that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or otherwise subjected to discrimination under this Agreement.

The Contractor agrees to make such reports and to maintain and make available, such records as may be required to ensure compliance with ART.38, par. b and c. - this means permitting access by appropriate State or Federal officials during

normal business hours to such facilities, records and other sources of information as may be pertinent to ascertain compliance with the regulations.

D. All Contractors shall be subject to, and responsible for all costs relating to Contractor licensing ordinances and regulations.

1.8 ENVIRONMENTAL STATUES AND REGULUATIONS

A. Contractor shall comply with all applicable provisions of federal and state laws dealing with the prevention of environmental pollution and the preservation of natural resources, including but not limited to Act No 247 approved October 26, 1962; the Federal Air Quality Act of 1967; the Clean Air Act; the Clean Water Restoration Act; the Water Pollution Control Act Amendments of 1956; the Water Quality Act of 1965; the Water Quality Improvement Act of 1970; The Water Pollution Control Act Amendments of 1972; The Water Facilities Act (see Consolidated Farmer's Home Administration Act of 196l); the Watershed Protection and Flood Prevention Act; the Pennsylvania Air Pollution Control Act; the Clean Streams Law; the Solid Waste Management Act; the Municipal Waste Planning, Recycling and Waste Reduction Act; A.H.E.R.A.; and all rules and regulations there under, including, but not limited to, those formulated by the United States Environmental Protection Agency, the Pennsylvania Department of Environmental Resources and the Department of Environmental Protection. Nothing contained in the Contract shall be construed as relieving Contractor in anyway of Contractors
responsibility for strict compliance with all governmental requirements pertaining to environmental protection.

B. These Contact Documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of Federal and State Law(s) dealing with the prevention of environmental pollution and the preservation of public natural resources, including but not limited to the latest amendments of the following:

1. Act No. 247 of the General Assembly oft he Commonwealth of Pennsylvania relating to the prevention of environment pollution and the preservation of public natural resources in construction projects, enacted October 26, 1972.

C. Pursuant to Act No. 247 of the 1972 Pennsylvania General Assembly, all proposals will be subject to all the provisions of all Federal and State statutes dealing with the prevention of pollution and preservation of public natural resources including, but not limited to; the Federal Air Quality Actor 1967; Clean Air Act, as amended: Clean Water Restoration Act; Water Pollution Control Act Amendments of 1956, Water Quality Act or 1965, Water Quality improvement Act of 1970. and Water Pollution Control Mt Amendments of 1972; the Water Facilities Act (see Consolidated Farmers Home Administration Act of 1961); the Watershed Protection and Flood Prevention Act; the Pennsylvania Air Pollution Control Act; Clean Streams Law; Solid Waste Management Act; Sewerage Facilities Act; and all rules and regulations there under including, but not limited to, those formulated by the United States Environmental Protection Agency and the Pennsylvania Department

of Environmental Resources.

D. Act No. 247 provides that if the successful bidder must undertake additional work due to enactment of new or the amendment of existing statues, rules or regulations occurring after the submission of the successful proposal, the Authority shall issue a change order setting for the additional work that must be undertaken, which shall not invalidate the contract. The cost of such a change order to the Authority shall be determined in accordance with the provisions of the contract for change orders or force accounts, or if n such provision is set forth in the contract, then the cost to the Authority shall be the contractors costs for wages, labor costs other than wages, wage taxes, materials,
equipment rentals, insurance and subcontractors attributable to the additional activity plus a reasonable sum for overhead and profit; provided however, that such additional costs to undertake work not specified in the invitation for proposal shall not be approved unless written authorization is given the successful bidder prior to his undertaking such additional activity. In the event of a dispute between the Authority and the successful bidder, arbitration procedures maybe commenced under the applicable
terms of the construction contract, or, if the contract contains no such provision for arbitration, the then obtaining rules of the American Arbitration Association. I

E. Nothing contained in the Contract Documents for construction shall be construed by the Contractor as relieving him in any way of his responsibility for strict compliance with the statutes, rules and regulations contained in the above mentioned Environmental Protection Act.

l.9 MISCELLANEOUS REGULATIONS

A. Standard of Quality: The various materials and products specified in the specification by name or description are given to establish a standard of quality and of cost for bid purposes. It is not the intent to limit the acceptance to any one material or product specified, but rather to name or describe it as the absolute minimum standard that is desired and acceptable. A material or product of lesser quality would not be acceptable. Where proprietary names are used, whether or not followed by the words Approved equal®, they shall be subject to equals only as approved by the Architect and /or Engineer.

PART 2 -~ PRODUCTS (NOT USED)

PART 3- EXECUTION (NOT USED)

END OF SECTION 014100

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": The term "approved," when used to convey Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.

D. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.

E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": The term "install" describes operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, and protecting, cleaning, and similar operations.

H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.

I. "Installer": An installer is the Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

J. The term "experienced," when used with an entity, means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

K. "Project site" is the space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source and make them available on request.

E. Abbreviations and Acronyms for Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

F. Abbreviations and Acronyms for Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl1@dom1

AA	Aluminum Association, Inc. (The) www.aluminum.org	(202) 862-5100
AAADM	American Association of Automatic Door Manufacturers www.taol.com/aaadm	(216) 241-7333
AABC	Associated Air Balance Council www.aabchq.com	(202) 737-0202
AAMA	American Architectural Manufacturers Association www.aamanet.org	(847) 303-5664
AAN	American Association of Nurserymen (See ANLA)	
AASHTO	American Association of State Highway and Transportation Officials www.aashto.org	(202) 624-5800
AATCC	American Association of Textile Chemists and Colorists (The) www.aatcc.org	(919) 549-8141
ABMA	American Bearing Manufacturers Association www.abma-dc.org	(202) 429-5155
ACI	American Concrete Institute/ACI International www.aci-int.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
ADC	Air Diffusion Council	(312) 201-0101
AEIC	Association of Edison Illuminating Companies, Inc. (The) www.aeic.org	(205) 257-2530
AFPA	American Forest & Paper Association (See AF&PA)	
AF&PA	American Forest & Paper Association www.afandpa.org	(800) 878-8878 (202) 463-2700
AGA	American Gas Association www.aga.org	(202) 824-7000
AHA	American Hardboard Association www.ahardbd.org	(847) 934-8800

AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(606) 288-4960
AIA	American Institute of Architects (The) www.aiaonline.org	(202) 626-7300
AISC	American Institute of Steel Construction, Inc. www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction	(303) 792-9559
ALA	American Laminators Association (See LMA)	
ALCA	Associated Landscape Contractors of America www.alca.org	(800) 395-2522 (703) 736-9666
ALSC	American Lumber Standard Committee	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANLA	American Nursery & Landscape Association (Formerly: AAN - American Association of Nurserymen) www.anla.org	(202) 789-2900
ANSI	American National Standards Institute www.ansi.org	(212) 642-4900
AOSA	Association of Official Seed Analysts www.zianet.com/AOSA	(402) 476-3852
APA	APA-The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(941) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800

ASCA	Architectural Spray Coaters Association www.ascassoc.com	(856) 848-6120
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	American Society for Testing and Materials www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industries International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (See WCMA)	
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association www.awpa.com	(817) 326-6300
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 661-4261
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BIFMA	BIFMA International	(616) 285-3963

	(Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	
CCC	Carpet Cushion Council www.carpetcushion.org	(203) 637-1312
CCFSS	Center for Cold-Formed Steel Structures www.umr.edu/~ccfss	(573) 341-4471
CDA	Copper Development Association Inc. www.copper.org	(800) 232-3282 (212) 251-7200
CEA	Canadian Electricity Association (The) www.canelect.ca	(613) 230-9263
CFFA	Chemical Fabrics & Film Association, Inc. www.taol.com/cffa	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 412-0900
CGSB	Canadian General Standards Board www.pwgsc.gc.ca/cgsb	(819) 956-0425
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.com (under construction)	(301) 596-2584
CPA	Composite Panel Association (Formerly: National Particleboard Association) www.pbmdf.com	(301) 670-0604
CPPA	Corrugated Polyethylene Pipe Association Division of Plastics Pipe Institute www.cppa-info.org	(800) 510-2772 (419) 241-2221
CRI	Carpet and Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute	(847) 517-1200

	www.crsi.org	
CSA	CSA International (Formerly: IAS - International Approval Services) Division of Canadian Standards Association www.iasapprovals.org	(216) 524-4990
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 462-8961
CTI	Cooling Tower Institute www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA/TIA	Electronic Industries Alliance/Telecommunications Industry Association www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association www.eifsfacts.com	(800) 294-3462 (770) 968-7945
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
FCI	Fluid Controls Institute www.fluidcontrolsinstitute.org	(216) 241-7333
FGMA	Flat Glass Marketing Association (See GANA)	
FM	Factory Mutual System (See FMG)	
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmglobal.com	(401) 275-3000
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America (Formerly: FGMA - Flat Glass Marketing Association) www.glasswebsite.com/gana	(785) 271-0208
GRI	Geosynthetic Research Institute	(610) 522-8440

	www.drexel.edu/gri	
GTA	Glass Tempering Division of Glass Association of North America (See GANA)	
HI	Hydraulic Institute	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute Division of Gas Appliance Manufacturers Association www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association Division of National Association of Architectural Metal Manufacturers (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc.	(410) 838-6550
IAS	International Approval Services (See CSA International)	
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(508) 394-4424
ICRI	International Concrete Repair Institute www.icri.org	(703) 450-0116
IEC	International Electro technical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America (The) www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 938-7444
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
IRI	HSB Industrial Risk Insurers www.industrialrisk.com	(800) 520-7300 (860) 520-7300

ITS	Intertek Testing Services www.itsglobal.com	(800) 345-3851 (607) 753-6711
IWS	Insect Screening Weavers Association (Now defunct)	
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LGSI	Light Gage Structural Institute www.loseke.com	(972) 625-4560
LMA	Laminating Materials Association (Formerly: ALA - American Laminators Association) www.lma.org	(201) 664-2700
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864 (847) 577-7200
LSGA	Laminated Safety Glass Association (See GANA)	
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association www.maplefloor.org	(847) 480-9138
MFMA	Metal Framing Manufacturers Association	(312) 644-6610
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(614) 228-6194
ML/SFA	Metal Lath/Steel Framing Association (See SSMA)	
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry, Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NAAMM	North American Association of Mirror Manufacturers (See GANA)	

NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(281) 228-6200
NAIMA	North American Insulation Manufacturers Association (The) www.naima.org	(703) 684-0084
NAMI	National Accreditation and Management Institute, Inc.	(304) 258-5100
NAPM	National Association of Photographic Manufacturers (See PIMA)	
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(414) 248-9094
NCTA	National Cable Television Association www.ncta.com	(202) 775-3669
NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	International Electrical Testing Association www.electricnet.com/neta	(303) 697-8441
NFPA	National Fire Protection Association www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-6372
NGA	National Glass Association www.glass.org	(703) 442-4890

NHLA	National Hardwood Lumber Association www.natlhardwood.org	(901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NPA	National Particleboard Association (See CPA)	
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(301) 587-1400
NSA	National Stone Association www.aggregates.org	(800) 342-1415 (202) 342-1100
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NTMA	National Terrazzo & Mosaic Association (The) www.ntma.com	(800) 323-9736 (703) 779-1022
NWWDA	National Wood Window and Door Association (See WDMA)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting and Decorating Contractors of America www.pdca.com	(800) 332-7322 (703) 359-0826
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (508) 230-3516
PGI	PVC Geomembrane Institute/Technology Program University of Illinois-Urbana Champaign //pgi-tp.ce.uiuc.edu	(217) 333-3929
PIMA	Photographic & Imaging Manufacturers Association (Formerly: NAPM - National Association of Photographic Manufacturers) www.pima.net	(914) 698-7603

RCSC	Research Council on Structural Connections c/o AISC www.boltcouncil.org	
RFCI	Resilient Floor Covering Institute	(Contact by mail only)
RIS	Redwood Inspection Service Division of the California Redwood Association www.calredwood.org	(888) 225-7339 (415) 382-0662
RMA	Rubber Manufacturers Association www.rma.org	(800) 220-7620 (202) 682-4800
SAE	SAE International www.sae.org	(724) 776-4841 (724) 776-4960 (publications)
SDI	Steel Deck Institute www.sdi.org	(847) 462-1930
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabfurn.com	(843) 689-6878
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 938-7444
SIGMA	Sealed Insulating Glass Manufacturers Association www.sigmaonline.org/sigma	(312) 644-6610
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SPI	The Society of the Plastics Industry, Inc. www.plasticsindustry.org	(202) 974-5200
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPI/SPFD	The Society of the Plastics Industry, Inc. Spray Polyurethane Foam Division	

	(See SPI)	
SPRI	SPRI (Single Ply Roofing Institute) www.spri.org	(781) 444-0242
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSMA	Steel Stud Manufacturers Association (Formerly: ML/SFA - Metal Lath/Steel Framing Association) www.ssma.com	(312) 456-5590
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(800) 837-8303 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing & Restoration Institute www.swrionline.org	(816) 472-7974
TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TPI	Truss Plate Institute	(608) 833-5900
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 705-9898
UFAC	Upholstered Furniture Action Council www.ufac.org	(336) 885-5065
UL	Underwriters Laboratories Inc. www.ul.com	(800) 704-4050 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association //members.aol.com/unibell	(972) 243-3902
USG	United States Gypsum Company A Subsidiary of USG Corporation www.usg.com	(800) 874-4968 (312) 606-4000
USITT	United States Institute for Theatre Technology, Inc. www.culturenet.ca/usitt	(800) 938-7488 (315) 463-6463
USP	U.S. Pharmacopeia	(800) 822-8772

	www.usp.org	(301) 881-0666
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (Formerly: AWCMA - American Window Covering Manufacturers Association) www.windowcoverings.org	(212) 661-4261
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WIC	Woodwork Institute of California www.wicnet.org	(916) 372-9943
WMMPA	Wood Molding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

G. Abbreviations and Acronyms for Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl2

BOCA	BOCA International, Inc. www.bocai.org	(708) 799-2300
CABO	Council of American Building Officials (See ICC)	
IAPMO	International Association of Plumbing and Mechanical Officials (The) www.iapmo.org	(909) 595-8449
ICBO	International Conference of Building Officials www.icbo.org	(800) 284-4406 (562) 699-0541
ICC	International Code Council (Formerly: CABO - Council of American Building Officials) www.intlcode.org	(703) 931-4533
SBCCI	Southern Building Code Congress International, Inc.	(205) 591-1853

www.sbcci.org

H. Abbreviations and Acronyms for Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

PRIVATE tbl3@dom1

CE	Army Corps of Engineers CRD Standards	(601) 634-2355
CFR	Code of Federal Regulations www.access.gpo.gov/nara/cfr	(202) 512-1800
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-0990
DOC	Department of Commerce www.doc.gov	(202) 482-2000
DOD	Department of Defense DOD Specifications and Standards //astimage.daps.dla.mil/online	(215) 697-6257
EPA	Environmental Protection Agency www.epa.gov	(202) 260-2090
FAA	Federal Aviation Administration Department of Transportation www.faa.gov	(202) 366-4000
FCC	Federal Communications Commission www.fcc.gov	(202) 418-0190
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
FED-STD	Federal Standard (See FS)	
FS	Federal Specification (Available from DOD, GSA, and NIBS)	
FTMS	Federal Test Method Standard (See FS)	
GSA	General Services Administration www.gsa.gov	(202) 708-5082 (202) 619-8925 (Federal Specifications)

HUD	Department of Housing and Urban Development www.hud.gov	(202) 401-0388
LBL	Lawrence Berkeley Laboratory (See LBNL)	
LBNL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-5605
MILSPEC	Military Specification and Standards (See DOD)	
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-2000
OSHA	Occupational Safety & Health Administration (See CFR 29) www.osha.gov	(202) 219-5000
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2933
USDA	Department of Agriculture www.usda.gov	(202) 720-8732
USPS	Postal Service www.usps.gov	(202) 268-2000

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 014219 – REFERENCE STANDARDS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Specification Format.

B. Specification Language and Form.

1.2 RELATED SECTIONS

A. The specifications have been arranged in accordance with CSI / CSC "masterformat" master list of titles and numbering system.

1.3 FORMAT

A. The imperative language of the technical sections of the specifications is directed to the Contractor unless specifically noted otherwise.

B. Portions of the specifications have been derived from an automated master specification production system and may include minor deviations from traditional writing forms. Such deviations must be recognized as a normal result of this production technique and no other meaning will be implied or permitted.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 014219

SECTION 015000 -TEMPORARY FACILITIES & CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies requirements for temporary construction, utilities, facilities, and controls required to support the successful construction of the project and maintain services until the permanent utilities, facilities, and controls are complete. They shall be installed, maintained, and removed subject to the Construction Manager's approval.

TABLE OF PARTS

PART 1 - General
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1.4 Project Conditions
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PART 2 - Products
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3.2 Temporary Utility Installation
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3.4 Water Service
3.5 Electrical Power
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3.21 Barricades, Warning Signs, and Lights
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3.23 Building Security, Enclosure, and Lockup

3.24 Environmental Protection, NPDES, and PPC
3.25 Workday
3.26 Lunch Wagon
3.27 Erosion Control
3.28 Excavation
3.29 Blasting
3.30 Material Inventories
3.31 Deliveries
3.32 Operation, Termination, and Removal
3.33 Snow Removal

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:

Municipal and Labor & Industry Building Code requirements
Health and safety regulations
Utility company regulations
Police, Fire Department and Rescue Squad rules
Environmental protection regulations

B. Inspections: Arrange for authorities, having jurisdiction, to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

A. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site. They shall be removed, relocated as required by the progress of the work, or directed by the Construction Manager.

1.5 EXISTING UTILITIES AND SYSTEMS

A. Precaution must be taken to protect existing sanitary sewer, electrical, water and gas lines that cross the site. All existing building utility systems such as electrical, water, gas will be demolished and reconstructed during this project.

B. Trade Contractors interrupting services due to their construction operations shall provide temporary utility lines, as required, to maintain services.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Provide new materials; if acceptable to the Construction Manager, undamaged, previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Lumber and Plywood: Comply with requirements in Division-6 Section "Rough Carpentry."

C. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride fire retardant tarpaulins.

D. Water: Provide potable water approved by local health authorities.

E. Open-Mesh Fencing: Provide 11-gauge, galvanized two (2) inch, chain link fabric fencing, six (6) feet high with galvanized steel pipe posts, 1-1/2" I.D. for line posts and 2-1/2" I.D. for corner posts. Drive posts 30" into the ground at no less than 15' spacing.

2.2 EQUIPMENT

A. General: Provide new equipment; if acceptable to the Construction Manager, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light, for connection of power tools, equipment, and GFI breakers.

D. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress.

E. Electrical Welding Outlets: These will not be provided. Each Trade Contractor will be responsible for his own welding power.

F. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

G. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.

H. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

I. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber, reinforced polyester shell or similar nonabsorbent material.

J. First Aid Supplies: Comply with governing regulations.

K. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

Comply with NFPA 10 classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 EXECUTIONS

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Obtain easements to bring temporary utilities to the site, where the Owner's easements cannot be used for that purpose.

3.3 USE CHARGES

A. Cost for temporary facilities are to be paid by the Trade Contractor requiring or providing the temporary facility unless noted otherwise.

B. Owner will pay utility consumption costs during construction.

3.4 WATER SERVICE

A. The Plumbing Contractor shall install water service and distribution piping of sizes and pressures adequate for construction. As a minimum, provide a manifold pipe with two 3/4" hose bibs at the building water riser point of entrance until portions of the permanent piping system can be used to support construction activities. Water service may be run from a temporary or permanent source. Coordinate needs with Construction Manager.
1. Sterilization: Sterilize temporary water piping prior to use.
2. Protect system from freezing.
3. Utilize City water pressure.

3.5 ELECTRICAL POWER

A. After start of work at project site, when requested by the Construction Manager, the Electrical Contractor shall provide a temporary electrical power distribution system sufficient to accommodate temporary lighting and construction operations, including the use of power tools, and start-up of specified building equipment which must be tested, started or placed into use prior to completion of its permanent power connections. Provide weatherproof, grounded wiring with overload protection; with direct wired connections, where feasible, and for voltages up to 220/208 volts. Locate multiple outlets for 120 volt power, not less than 4 gang, at each story of construction, spaced so that the entire area of construction can be reached by power tools on a single extension cord of 100' maximum length. Maximum 20 Amp circuit breaker, four (4) receptacles per circuit breaker.

B. The Electrical Trade Contractor shall provide and pay for all maintenance, servicing, operation, and supervision of lines installed.

C. Provide service with ground fault circuit interrupter feature, as per NEC and OSHA requirements. The Electrical Trade Contractor shall have a cord inspection program in place. He shall maintain the inspection records on site.

D. As permanent power distribution system is accepted as substantially complete, either entire system or usable portions thereof, the Electrical Trade Contractor shall make suitable provisions for temporary use thereof, and remove unused portions of temporary system.

E. If required, provide meters for electrical power.

F. When temporary electrical lines are no longer required, they shall be removed by the Electrical Trade Contractor and any part, or parts, of the grounds or buildings disturbed or damaged shall be brought back to their original condition.

G. Electricity from existing lines may be used at no charge to the Trade Contractor, except for heating units, temporary offices, or storage. Each trade shall provide extension cords from the existing facilities, as required, for the execution of the Work. Electrical power for

welding equipment will not be available.

H. The Electrical Trade Contractor shall maintain and operate permanent electrical supply and distribution system until time of final acceptance and transfer of operation to Owner's personnel.

I. The Electrical Trade Contractor shall install switching controls for all lighting which will enable turning off temporary lighting during off-construction hours. The Electrical Trade Contractor shall provide manpower to control light switching and be responsible for it.

J. Temporary power supplies to the Construction Manager's Office Conference/Office Complex shall be installed with service connection by the Electrical Trade Contractor.

K. The Electrical Trade Contractor will provide power for oil or gas fired temporary heaters, if required by the Construction Manager. It will be connected so that it can remain "live" when the lighting has been turned off.

L. The Electrical Trade Contractor will provide 24-hour temporary power to any heat tape (installed by others) on temporary water and/or fire line. All temporary heat work will comply with existing OSHA requirements.

M. Construction circuits shall be separate and independent from temporary lighting.

N. The Electrical Trade Contractor will extend a temporary electrical service and provide a termination box in the Trade Contractor's office trailer area for hook-up of the Trade Contractor's trailers. Cost for individual Trade Contractor trailer hook-up will be born by the Trade Contractor requiring this service. Use of electric heaters in those trailers and shanties will not be permitted.

3.6 LIGHTING

A. Whenever overhead floor or roof deck has been installed, the Electrical Trade Contractor shall provide temporary lighting with local switching.
The Electrical Trade Contractor shall provide sufficient temporary lighting to ensure proper workmanship everywhere; by combined use of daylight and general lighting as stated below:

1. Provide uniformly spaced general lighting utilizing one (1) 150 watt incandescent lamp equivalent to 1.0 watts/sq. ft. of floor areas, and one (1) 100 watt lamp per 50' of corridor or per flight of stairs. General lighting to have a minimum of 5' candles measured at floor level.

2. Limit lighting installations to intensities which will accommodate normal access and workmanship requirements, recognizing that each entity performing work requiring higher intensity lighting will provide supplementary plug in temporary lighting and localized areas where such work is in progress.

3. As permanent lighting system is substantially complete for each story or usable portion thereof, the Electrical Trade Contractor shall make suitable provisions for temporary use thereof and remove unused portions of temporary lighting system.

4. The Electrical Trade Contractor shall maintain and operate permanent lighting system until time of final acceptance and transfer of operation to Owner's personnel, including turning off lighting during off-construction hours.

5. The Electrical Trade Contractor shall replace bulbs that are burned out or substantially dimmed by substantial hours of use.

6. Special lighting required for construction activities shall be provided by contractor requiring it.

7. The Electrical Trade Contractor shall provide safety lighting in the stairways, hallways, and exterior security lighting on a 24-hour basis.

8. Furnish and install dusk to dawn type security lights on poles as shown on the site construction staging plan.

9. If more lighting is necessary to install finishes, drywall, painting, etc., the contractor needing the extra lighting will provide.

3.7 TELEPHONES

A. The Construction Manager shall be responsible to provide telephone service to a demarcation point in the Trade Contractor office trailer area. Temporary phone service must support 10 office trailers that require phone and/or fax service. Cost for individual hook ups, telephones, and use fees, shall be the responsibility of each Trade Contractor.

B. The Construction Manager shall make arrangements for one (1) public telephone to be installed on the site and include monthly service cost for the duration of the project.

3.8 SANITARY FACILITIES

A. The Construction Manager shall provide temporary toilets. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.

Provide toilet tissue for each facility.

B. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted. Provide means of locking facilities when construction is not in progress.

Provide one unit for use of Construction Manager=s office/conference meeting complex.

C. Drinking Water Facilities: Each trade contractor shall provide drinking water for it=s own personnel.

3.9 STORM SEWERS

A. If storm sewers are available, the Sitework Trade Contractor shall provide temporary

connections to remove effluent that can be discharged lawfully. If sewers are not available, or cannot be used, the Sitework Trade Contractor shall provide drainage ditches, dry wells, stabilization ponds and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off the site in a lawful manner.

B. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.

C. Comply with the soil erosion and sedimentation control plan and local authorities having jurisdiction.

3.10 DEWATERING FACILITIES

A. For temporary drainage and dewatering facilities, and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division-2 Sections. Where feasible, utilize the same facilities. The Sitework Trade Contractor shall be responsible to maintain the site, excavations and construction free of water.

B. In the event that storm drain piping is not completed when needed for roof drain tie in, then the Plumbing Trade Contractor shall provide temporary storm water drainage from the building, and the Sitework Trade Contractor shall control roof drainage from building onto the site.

C. Sitework Trade Contractor shall be responsible to drain or pump water and remove debris from the site so as not to delay his continuous work or progress. This shall include operating pumps during second shift in order to facilitate next-day continuation of work.

D. Sitework Trade Contractor shall excavate in a manner that prevents all surface water from flowing into the building area. Sitework Trade Contractor shall be responsible to remove any runoff water or debris which enters the building area.

E. Sitework Trade Contractor shall continue to drain site and remove debris until designed grades are obtained.

F. Once building excavation grades are complete, the Concrete Work Contractor shall be responsible to remove all water and debris to install and backfill the building foundations.

G. Upon completion of building foundations, each Trade Contractor shall be responsible to remove water and debris required to complete his work.

3.11 HEATING AND VENTILATION

A. Temporary heating shall be provided and maintained by the Trade Contractor performing the work if the outside temperature falls below 40E F at anytime during the day or night for all exterior work or work performed prior to the building being enclosed by walls and roof.

B. The Trade Contractor shall furnish temporary heat by acceptable means to provide sufficient heat to maintain a temperature of 55E F, 24 hours a day throughout the entire

area of the work for which the Trade Contractor is responsible prior to the building being enclosed by walls and roof.

C. Except where use of the permanent system is authorized, provide vented, self-contained LP gas or fuel oil heaters with individual space thermostatic control. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited. Temporary heating may not be provided using electrical heating equipment if using electrical power supplied by the Owner.

D. As soon as the building, or portions thereof, is generally enclosed with walls and roof and temporary heat is required for scheduled work, or required to facilitate proper workmanship, and permanent heating system is not yet operable or authorized for use, the HVAC Contractor shall arrange and provide temporary heat service for every entity authorized to do work at the project site. The HVAC Contractor shall maintain temperatures as indicated
by other Specification Sections for each type of work to be performed. The Construction Manager shall be the sole arbiter of when the building is considered generally enclosed.

E. Refer to paragraph 3.14 in section 01500 for responsibilities to install, maintain, and remove temporary enclosure of windows and doors until the permanent materials are in place.

F. After the conditions of construction require continuous 24 hour heat in the building, the HVAC Contractor shall provide, operate, and maintain temporary radiation or unit heaters to provide required temperatures (minimum 55E F) for the conduct of work. This service shall be continued until the permanent heating system has been completely installed and is in operation. The HVAC Contractor shall furnish and pay for all fuel as required for providing temporary heat after the building is generally enclosed.

G. As permanent heating/cooling system is substantially complete and operational for each story or usable portion thereof, the HVAC Trade Contractor shall make suitable provisions for use thereof in temporary heating and cooling. The HVAC Trade Contractor shall maintain and operate permanent system for temporary heating/cooling purposes, including service to occupied areas, if any, until time of final acceptance or transfer of operation to Owner's personnel, for major parts of system if not for entire heating system and air conditioning. The Owner shall pay for all fuel costs incurred by the permanent HVAC systems after acceptance of systems.

H. Warranty: The warranty as required by the contract specifications will not begin until final acceptance of the system has been given by the architect for all or part of a system. The warranty period does not start with the use of the equipment for temporary heating and cooling.

I. All permanent heating and air conditioning equipment used to supply temporary heat and air conditioning shall be completely cleaned and reconditioned by the HVAC Trade Contractor prior to final acceptance. Radiator traps and valves used in the heating system during the period of its operation to supply temporary heat shall not be reinstalled in the permanent system. Install new disposable filters and clean non-disposable filters prior to final acceptance. Replace significantly worn parts and parts that have been subject to unusual operating conditions.

J. PARAGRAPH OMITTED

K. Temporary Ventilation: A Trade Contractor requiring ventilation for work shall provide fans or other necessary equipment to condition air, provided prior approval has been obtained from the Construction Manager.

L. Humidification: Where control of ambient humidity is required for proper performance of the work, or for curing/drying of installed work or for protection of installed work from deterioration due to variations in ambient conditions, each Trade Contractor shall provide his own temporary humidification or dehumidification equipment to maintain the required conditions. Coordinate the use of the equipment with temporary heating to produce the required conditions with a minimum overall use of energy.

M. Permanent electrical power needed to operate permanent heating system must be provided by the Electrical Trade Contractor in conjunction with building enclosure, or the Electrical Trade Contractor shall furnish adequate temporary power to operate permanent heating system.

N. In the event of permanent installed equipment failure, repairs or alternate equipment must be in place within 24 hours of failure or the Construction Manager will take action necessary to restore the heat to the design temperature and will deduct any and all charges from the HVAC Contractor.

O. If additional heating above 55 degrees F or cooling below 80 degrees F is required by a Contractor to properly install and maintain his work, he shall be responsible to provide the additional heating and cooling.

P. Connections for temporary electric to the temporary heat will be provided by the Electrical Contractor.

3.12 FIELD OFFICES

A. Trade Contractors shall provide offices for their own personnel. All type and location of jobsite offices and equipment will be approved by the Construction Manager.

B. Storage and Fabrication Sheds: Each Trade Contractor shall provide storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces. All steps and platforms connected to shelters must be per OSHA regulations.

C. All offices and sheds must have the Trade Contractor's identification on them.

3.13 ROADS AND PARKING

A. Sitework Trade Contractor shall construct and maintain temporary roads, construction parking and paving to adequately support the indicated loading and to withstand exposure to traffic during the construction period, in conjunction with the site logistics plan bound into this specification. Locate temporary paving for roads, storage areas and parking where

the same permanent facilities will be located.

B. Sitework Trade Contractor shall be responsible for providing stable parking area for all construction personnel on the jobsite by use of crushed stone/binder paving, including permanent parking areas.

C. The Sitework Trade Contractor shall maintain truck tire wash facility at the construction entrance.

D. Snow removal will be performed by the Sitework Contractor.

3.14 ENCLOSURES

A. All temporary enclosures required for protection of exterior construction in progress and completed from exposure, bad weather, other construction operations, and similar activities and to maintain the progress schedule, shall be provided by each contractor as necessary to protect their work.

B. General Trades Contractor shall provide temporary building enclosure for protection of construction in progress, and completed, from exposure, foul weather, other construction operations, and similar activities. The extent of temporary enclosures will be as necessary to maintain the progress schedule.

C. Where heat is needed and the permanent building enclosure is not complete, the General Trades Contractor shall provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

The Aluminum, Storefront, Windows, Canopies, Glass and Glazing Trade Contractor shall be responsible to remove the temporary entrance enclosures and install the permanent entrances or reinstall parts of the temporary enclosures in such a manner that the building security is maintained at the end of each workday shift.

The Aluminum, Storefront, Windows, Canopies, Glass and Glazing Trade Contractor shall be responsible to provide temporary window enclosures, in the event that aluminum window rough openings are fully prepared to receive finish window installation and the finish materials are not ready for prompt installation to maintain the construction schedule.

The General Trade Contractor shall furnish and install temporary entrance doors and maintain them until such time the permanent entrances are installed.

D. Install tarpaulins securely with noncombustible wood framing and other materials. Close openings of 25 sq. ft. or less with plywood or similar materials.

E. Dust partitions and enclosures if indicated on the drawings shall be constructed, maintained, and removed by the General Trades Contractor.

F. Each Trade Contractor is required to construct, maintain, and remove dust partitions required to prevent dust from entering occupied areas due to the performance of his work.

3.15 LIFTS AND HOISTS

A. Lifting and hoisting of all materials and equipment will be the responsibility of each Trade Contractor.

B. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and shall be provided by contractor requiring same.

C. Each Trade Contractor shall be responsible to provide all site and subsurface modification preparation and replacement required to use his lifting and hoisting equipment.

3.16 ELEVATORS

A. Existing Elevator to be demolished.

3.17 PROJECT IDENTIFICATION

A. The Construction Manager shall prepare project identification and other signs, as approved by the Owner, of the size indicated; install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood or steel. See attached sketches at end of this section.

B. The Construction Manager shall provide one (1) sign erected on the site, where directed, to identify the project. Sign shall include Project name, Owner's name, Architect's name, and Construction Manager's name. Size shall be 4' x 8'; color and lettering style shall be as designed by the Architect.
See attached sketches at end of this section.

C. Engage an experienced sign painter to apply graphics.

D. Temporary Signs: The Construction Manager shall prepare signs to provide directional information to construction personnel and visitors as required by the Construction Manager. See attached sketches at end of this section.

E. No other signs allowed on site unless approved by the Construction Manager.

3.18 WASTE DISPOSAL AND CLEANUP

A. The construction manager shall provide trash collection containers for construction debris, exclusive of roofing tear off debris, rock, earth, site work demolition waste, masonry and concrete debris and pay for all debris disposal cost for them. Each trade contractor on the project will be required to clean up and deposit in the dumpster, all debris generated by his trade contract work on a daily basis. Roofing contractor, Site work contractor, Masonry contractor and Concrete contractor must pay their own solid waste removal costs. All other contractors will be provided with collection containers for their use at no cost to the contractor.

This requirement shall be enforced by the Construction Manager and will result in cost

assessment against a Trade Contractor who fails to perform daily clean-up within 48 hours of verbal or written notice from the Construction Manager. Each Trade Contractor will be responsible for flattening or crushing all trash as necessary when placed into the dumpster. Hazardous material shall not be placed in the collection container.

B. Contractors may be required to place salvageable and recyclable materials and debris in separate designated dumpsters or dispose of properly for their own salvage value.

C. All Contractors are to participate in a monthly eight (8) hour general clean up which will be coordinated by the Construction Manager. Each Contractor shall provide a minimum of on (1) clean-up person for every 15 or less people on the Contractor's average work force for the month with the appropriate brooms, shovels, and wheel barrows. Clean up will be supervised by the Construction Manager.

D. The Trades Contractors shall be responsible for weekly broom cleaning of all floor surfaces, for dust, dirt and general trash.

E. The Construction Manger will be responsible for providing trash receptacles, "55 gallon capacity". Emptying them with weekly cleanup or when filled to capacity, shall be done by the Contractors performing the work in that area.

F. The General Trades Contractor shall determine with the Construction Manager, a location for an enclosed trash chute to control dust for debris from second floor levels to the dumpster container. General Trades Contractor shall also erect a dimensional lumber guard railing around the trash chute to prevent jobsite personnel from exposure to falling debris.

3.19 CONSTRUCTION AIDS AND PROTECTION

A. The General Trades Contractor shall provide wood handrails and barricades on all stairs and landings, according to OSHA regulations. Provide barricades at all elevator shafts.

B. The Steel Work Trades Contractor shall furnish, install and remove at completion, all perimeter guard rails for elevated surfaces.

C. The General Trades Contractor shall install safety coverings, handrail around all recessed areas and openings on all floors. Building perimeters, roof, wall, or shaft openings shall have perimeter protection as required by OSHA. This work shall comply with all OSHA requirements and remain in place until permanent construction fills those openings.

D. The Roofing Trades Contractor shall install roof edge perimeter protections and guard rails or coverings, at all roof openings.

E. Each Trade Contractor, upon working in any of the areas named in the above paragraph, shall remove the safety covering and handrail to perform his work. Upon completion of his work for the day, lunch, or breaks, or any time when the individual Trade Contractor is not working in that opening, the safety covering and handrail must be replaced by the Trade Contractor removing it. At the end of each day, the General Trades Contractor will inspect the site and install all safety coverings and handrails. He shall report to the Construction Manager if coverings and handrails are not being reinstalled by other contractors.

At the end of the project, or in order to install permanent construction, the General Trades Contractor shall remove all coverings and handrails.

F. The Trade Contractors requiring access to above grade work are responsible for providing ladders, scaffolding and appropriate methods to access their work. Trade Contractor desiring use of in place above grade work platforms must arrange directly with the party that owns the equipment and make all rental and insurance arrangements directly with that party.

G. All work platforms, scaffolding, etc., on the project shall be available for access by the Owner, Architect, Municipal Authority, Testing Agency and/or Construction Manager.

3.20 FIRE SAFETY

A. Existing fire protection shall be maintained in place until permanent sprinklered fire protection system is available for use. The Sprinkler System Trades Contractor shall provide the permanent sprinkler fire protection system for use at the earliest possible date after building enclosure and 55° F temperatures are maintained to protect the building structure.

B. The Construction Manager shall provide fire extinguishers, as required by OSHA standards or other codes.

C. Each Contractor shall store combustible materials in containers in fire-safe locations.

D. Each Contractor shall maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

E. Each Contractor shall provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

F. The Construction Manager shall provide the local fire company with a set of site and floor plans. He shall invite the local fire company to visit the project site and plan emergency response.

3.21 BARRICADES, WARNING SIGNS, AND LIGHTS

A. All trade contractors requiring barricades, warning signs and lights shall comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against.

3.22 SITE ENCLOSURE FENCE

A. The Construction Manager shall perform all temporary fencing work as indicated on the site logistics drawing. This work shall be done immediately upon mobilizing for Work at the beginning of the Project.

B. The Sitework Contractor shall maintain permanent chain link fencing and fabric fencing

throughout the duration of the Project, particularly maintaining security function of gate devices.

3.23 BUILDING SECURITY, ENCLOSURE, AND LOCKUP

A. The General Trades Contractor shall install substantial temporary enclosure of partially completed areas of construction. Provide and maintain locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

B. Each Trade Contractor is responsible for the secure storage of their own material and equipment on and off the site.

3.24 ENVIRONMENTAL PROTECTION, NPDES, AND PPC

A. To the fullest extent permitted by law, the Trade Contractor shall indemnify and hold harmless the Owner and Construction Manager, their employees and agents, from claims, losses, damage, and expenses including, but not limited to, attorney's fees arising out of performance of the work as it relates to any type of pollution related situations. This would apply to bodily injury, sickness, disease or death, or to damages or destruction or contamination of tangible property arising out of the acts or omission of the Trade Contractor or the joint negligent acts of the Owner or Construction Manager, or anyone for whose acts the Trade Contractor may be liable.

B. Each Trade Contractor, prior to construction, must comply with the National Pollution Discharge Elimination System (NPDES) and submit and State and Local Preparedness, Prevention and Contingency Plans (PPC) to the Construction Manager before the start of work.

Each Trade Contractor must construct, operate and maintain storage of materials to provide protection for each individual worker, as well as the protection of property or real estate of the construction site and environment.

C. Each Trade Contractor shall provide protection, operate temporary facilities, and conduct construction in ways and methods that comply with all environmental regulations, and minimize the possibility that air, water, and soil from becoming contaminated or polluted as a result of work or storage of supplies and materials, or equipment usage.

D. Each Trade Contractor will designate and train a responsible employee in environmental contamination procedures, including, but not limited to, emergency responses, material and waste inventories, spills and leak precautions and responses, inspections, housekeeping, security, and external factors.

E. Open burning will not be permitted.

3.25 WORKDAY

A. The workdays for the project are defined as 7:00 a.m. to 3:30 p.m., Monday through Friday, with lunch period from 12:00B12:30 p.m. The progress schedule may require contractors to perform work other than the normal workday and in addition to the normal workday to meet milestones in the progress schedule for the project, or to make up time

previously lost to regain the progress schedule requirements or to prevent interruption of the Owner's ongoing operations at no additional cost to the Owner.

B. Working times other than the normal workday or in addition to the normal work day, must be arranged in advance with the Construction Manager.

C. Trade Contractors who require additional workday hours to regain work time previously lost to meet the requirements of the project schedule shall be assessed for all costs including Construction Manager Supervision and other Trade Contractor cost necessary for the performance of their work.

3.26 LUNCH WAGON

A. Lunch wagons, catered events or other non-construction related functions shall not be permitted on the project site, except by the written permission of the Owner and Construction Manager.

B. No alcoholic beverages or controlled substances shall be allowed on the project at any time.

3.27 EROSION CONTROL

A. The Sitework Trade Contractor shall employ all methods required to comply with local regulatory authorities requirements to control erosion from the project site, including drainage control ditches, sediment basins, straw bale dikes, silt fencing and whatever procedure necessary to comply with requirements.

B. The Sitework Trade Contractor shall maintain these controls throughout the duration of the project.

3.28 EXCAVATION

A. Any Trade Contractor performing excavation shall protect all excavated materials from moisture, freezing and drying, so that the same materials excavated can be utilized for backfill.

B. Any Trade Contractor performing excavation shall have an OSHA trained person on site during all excavation operations. This person shall evaluate soil types and conditions to determine the required shoring and excavation methods.

3.29 BLASTING

A. Blasting is not permitted.

3.30 MATERIAL INVENTORIES

A. Contractors shall coordinate the delivery and storage on the jobsite of all significant materials.

B. Each Trade Contractor shall be responsible for the proper location, secure, and weather resistant storage as required of all materials. This includes placement of materials not to

obstruct passage on site or within building structures or in any way which causes impediment or obstruction to other Trade Contractors.

C. All material inventories must be stored by the Trade Contractor to avoid excessive loads on building structure.

D. When directed by the Construction Manager, a Trade Contractor shall remove or relocate material inventories as required for the progress of the project.

3.31 DELIVERIES

A. All contractors are required to properly instruct material suppliers and vendors to address deliveries to them specifically by named responsible party at the jobsite and require advance notice.

B. All deliveries addressed to the project in general, the Owner, Architect or Construction Manager, will be refused and returned to shipper.

C. The Owner will not be responsible for receipt, handling, or loss of any materials which are shipped to the Owner in error and received unknowing of relationship to the project.

D. Contractor receiving materials at the jobsite shall be responsible for prevention of any mud or other deposits on public roadways or other areas outside project limit lines, which may result due to methods of material delivery. Trade Contractor shall instruct delivery conveyor to take appropriate measures to prevent depositing mud or other construction deposits outside of contract limit lines. Total responsibility of cleanup of mud or other construction deposit outside of contract limit lines will be the responsibility of the Trade Contractor receiving the delivery.

E. Each Contractor shall provide his superintendent with a telephone pager to enable locating the superintendent on and off site.

3.32 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.
2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Construction Manager requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or not later than Substantial Completion. Complete

or, if necessary restore, permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the Trade Contractor. The Owner reserves the right to take possession of Project identification signs.

2. The Sitework Trade Contractor shall remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt, and other petrochemical compounds, and other substances which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances, as required by the governing authority.

3.33 SNOW REMOVAL

A. Snow removal for roads, building exterior, contractor parking, contractor office, staging, and Construction Manager's office area access will be performed by the Sitework Contractor.

B. The General Trades Contractor shall be responsible for snow removal from within the building, maintaining safe walkway, stair traffic areas and building corridors, using anti-skid methods for snow, mud and/or ice removal, to provide safe usage.

C. All snow and ice removal required to perform contractor specific tasks on floors, roof, work stages, etc., shall be performed by each Contractor.

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

1. Multiple Prime Contracts: Provisions of this Section apply to the construction activities of each prime contractor.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Reference Standards and Definitions" specifies the applicability of industry standards to products specified.
2. Division 1 Section "Submittals" specifies requirements for submittal of the Contractor's Construction Schedule and the Submittal Schedule.
3. Division 1 Section "Substitutions" specifies administrative procedures for handling requests for substitutions made after award of the Contract.

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, which is current as of the date of the Contract Documents.

b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.

2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise

fabricated, processed, or installed to form a part of the Work.

3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 SUBMITTALS

A. Product List: A list of products required is included at the end of this Section. Prepare a schedule in tabular form showing each product listed. Include the manufacturer's name and proprietary product names for each item listed.

B. Product List: Prepare a list showing products specified in tabular form acceptable to the Architect. Include generic names of products required. Include the manufacturer's name and proprietary product names for each item listed.

1. Coordinate product list with the Contractor's Construction Schedule and the Schedule of Submittals.
2. Form: Prepare product list with information on each item tabulated under the following column headings:

    a. Related Specification Section number.
    b. Generic name used in Contract Documents.
    c. Proprietary name, model number, and similar designations.
    d. Manufacturer's name and address.
    e. Supplier's name and address.
    f. Installer's name and address.
    g. Projected delivery date or time span of delivery period.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit 3 copies of an initial product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.

    a. At the Contractor's option, the initial submittal may be limited to product selections and designations that must be established early in the Contract period.

4. Completed List: Within 60 days after date of commencement of the Work, submit 3 copies of the completed product list. Provide a written explanation for omissions of data and for known variations from Contract requirements.

5. Architect's Action: The Architect will respond in writing to Contractor within 2 weeks of receipt of the completed product list. No response within this period constitutes no objection to listed manufacturers or products but does not constitute a waiver of the requirement that products comply with Contract Documents. The Architect's response will include a list of unacceptable product selections, containing a brief explanation of reasons for this action.

1.5 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.

1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each prime contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate contractors.
2. If a dispute arises between prime contractors over concurrently selectable, but incompatible products, the Architect will determine which products shall be retained and which are incompatible and must be replaced.

C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:

1. No available domestic product complies with the Contract Documents.
2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.

D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
   a. Name of product and manufacturer.
   b. Model and serial number.
   c. Capacity.
   d. Speed.
   e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.

1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of

construction spaces.

2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.

1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:

1. Proprietary Specification Requirements: Where Specifications name only a single product or manufacturer, provide the product indicated. No substitutions will be permitted.
2. Semi proprietary Specification Requirements: Where Specifications name 2 or more products or manufacturers, provide 1 of the products indicated. No substitutions will be permitted.

    a. Where Specifications specify products or manufacturers by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

3. Nonproprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.

5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated.
   a. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.

6. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.

7. Visual Matching: Where Specifications require matching an established Sample, the Architect's decision will be final on whether a proposed product matches satisfactorily.
   a. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.

8. Visual Selection: Where specified product requirements include the phrase "... as selected from manufacturer's standard colors, patterns, textures ..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Architect will select the color, pattern, and texture from the product line selected.

9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 1 for allowances that control product selection and for procedures required for processing such selections.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.

   1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 016000

SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS

1.1 RELATED SECTIONS

A. General and Supplementary Conditions.
B. Section 013300 - Submittal Procedures for closeout documents submittals.
C. Section 015000 - Construction Facilities and Temporary Controls: Progress cleaning.
D. Section 017500 - Starting of Systems: System start-up, testing, adjusting, and balancing.

1.2 CLOSEOUT PROCEDURES

A. Completion of the Work specified herein is a condition precedent to issuance of the Final Certificate of Payment by Construction Manager and Architect.

B. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect review.

C. Provide submittals to Architect through Construction Manager that is required by governing or other authorities.

D. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

E. Owner will occupy portions of the site as specified in Section 013100.

1.3 HAZARDOUS-FREE MATERIALS CERTIFICATION

A. Upon completion of this project, the Contractor shall deliver to the Architect three (3) copies of a notarized letter addressed to the Owner certifying that to the best of the Contractor's knowledge all products provided by them for incorporation into this project do not contain any hazardous materials exceeding current EPA guidelines.

B. It is the responsibility of the Contractor to review "Manufacturer's Safety Data Sheets" (MSDS) on all products to ascertain compliance with EPA guidelines prior to shop drawing submission to the Architect. Incorporation of products into the project without the submission of shop drawings or samples to the Architect will indicate that the Contractor has ascertained that the products meet EPA limits.

C. It is the responsibility of the Contractor to notify the Architect in writing of the lack of compliance of a product with EPA guidelines prior to ordering or incorporating any products into this project.

1.4 OPERATION AND MAINTENANCE DATA

A. Submit data on 8-1/2 x 11 inch text pages, bound in three D side ring binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE

INSTRUCTIONS" and title of Project.

C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, typed on white paper, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers. Include for all mechanical and electrical equipment a compilation of the nameplate data for equipment; name, address and phone number of nearest distributor; name, address and phone number of nearest service organization.

2. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component.
    d. Operating instructions.
    e. Maintenance instructions for equipment and systems.
    f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents. Include videotapes of training sessions.
    g. (1) 8x10 photograph of each piece of equipment.
    h. Name and telephone number of service representative.
    i. Test results/reports.
    j. Certified performance curves.
    k. Re-order information.
    l. Catalog, model, serial number.
    m. Wiring diagrams.
    n. Assembly drawings.
    o. Schedule
    p. Charts
    q. Nameplate data.

3. Part 3: Project documents and certificates, including the following:

    a. Shop drawings and product data.
    b. Air and water balance reports.
    c. Certificates.
    d. Photocopies of warranties and bonds.

E. Submit 1 draft copy of completed volumes 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of all document sets as required prior to final submission.

F. Submit three copies of revised final volumes, within 10 days after final inspection.

1.5 WARRANTIES

A. Provide triplicate notarized copies.

B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in three D side ring binder with durable plastic cover.

D. Submit prior to final Application for Payment.

E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.6 FINAL SUBMISSIONS

A. Submit Consent of Surety to Final Payment.

B. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

C. Submit a certified copy of the Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance and the list has been endorsed and dated by the Architect.

D. Affidavit of payment of all claims against the work.

1.7 PROJECT RECORD DOCUMENTS

A. Trade contractors shall maintain on site, one set of the following record documents; record actual revisions to the Work:

1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Construction Manager and Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

   1. Measured depths of foundations in relation to finish floor.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract Drawings.

G. Remove Architect seal from all documents.

H. Submit documents to Architect with final Application for Payment.

I. Submit a final liquidated damages settlement statement.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed extra materials and parts as indicated within the respective specification sections; obtain receipt from Owner upon delivery and placement and prior to final payment.

END OF SECTION 017000

SECTION 01 73 29 – CUTTING & PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Divisions 02 through 07 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety. Operating elements include the following: List below is an example only. Revise to suit Project's operating systems. With advice of counsel, delete below if Architect's approval is not required. If list is deleted, delete option in paragraph above.

1. Fire-suppression systems.
2. Mechanical systems piping and ducts.
3. Control systems.
4. Communication systems.
5. Conveying systems.
6. Electrical wiring systems.

C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 73 29

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SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodeling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.

B. Salvage: Recovery of materials for on-site reuse, sale or donation to a third party.

C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Crushing or grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.

D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.

E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.

F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.

G. Approved Recycling Facility: Any of the following:

1. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.

2. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials.

1.3 SUBMITTALS

A. Contractor shall develop a Waste Management Plan: Submit 3 copies of plan within 14 days of date established for the **Notice to Proceed**.

B. Contractor shall provide Waste Management Report: Concurrent with each Application for Payment, submit **3** copies of report.

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1.4 PERFORMANCE REQUIREMENTS

A. General: Divert a minimum of **75%** CDL waste, by weight, from the landfill by one, or a combination of the following activities:

1. Salvage
2. Reuse
3. Source-Separated CDL Recycling
4. Co-mingled CDL Recycling

B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:

1. Acoustical ceiling tiles
2. Asphalt
3. Asphalt shingles
4. Cardboard packaging
5. Carpet and carpet pad
6. Concrete
7. Drywall
8. Fluorescent lights and ballasts
9. Land clearing debris (vegetation, stumpage, dirt)
10. Metals
11. Paint (through hazardous waste outlets)
12. Wood
13. Plastic film (sheeting, shrink wrap, packaging)
14. Window glass
15. Wood
16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.4 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED Accredited Professional, certified by the USGBC as waste management coordinator.

B. Regulatory Requirements: Conduct construction waste management activities in accordance with hauling and disposal regulations of all authorities having jurisdiction and all other applicable laws and ordinances.

C. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.

1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.

a. Owner
b. Architect

c. Contractor's superintendent
d. Major subcontractors
e. Waste Management Coordinator
f. Other concerned parties.

2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:

a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
b. Review requirements for documenting quantities of each type of waste and its disposition.
c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
e. Review waste management requirements for each trade.

3. Minutes: Record discussion. Distribute meeting minutes to all participants. Note: If there is a Project Architect, they will perform this role.

1.5 WASTE MANAGEMENT PLAN – Contactor shall develop and document the following:

A. Develop a plan to meet the requirements listed in this section at a minimum. Plan shall consist of waste identification, waste reduction plan and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight throughout the plan.

B. Indicate anticipated types and quantities of demolition, site-cleaning and construction waste generated by the project. List all assumptions made for the quantities estimates.

C. List each type of waste and whether it will be salvaged, recycled, or disposed of in an landfill. The plan should included the following information:

1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.

2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:

a. Contracting with a deconstruction specialist to salvage materials generated,
b. Selective salvage as part of demolition contractor’s work,
c. Reuse of materials on-site or sale or donation to a third party.

3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:

a. Requiring subcontractors to take their CDL waste to a recycling facility;
b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility;

c. Processing and reusing materials on-site;
d. Self-hauling to a recycling or material recovery facility.

4. Name of recycling or material recovery facility receiving the CDL wastes.

5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on project site where materials separation will be located.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in hauling and tipping fees by donating materials.
7. Savings in hauling and tipping fees that are avoided.
8. Handling and transportation costs. Including cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

A. Provide containers for CDL waste that is to be recycled clearly labeled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.

B. The collection containers for recyclable CDL waste must contain no more than 10% non-recyclable material, by volume.

C. Provide containers for CDL waste that is disposed in a landfill clearly labeled as such.

D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.

E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.

F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

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A. General: Contractor shall separate recyclable materials from CDL waste to the maximum extent possible.

Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water and to minimize pest attraction. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

REMOVAL OF CONSTRUCTION WASTE MATERIALS

A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.

B. Transport CDL waste materials off Owner's property and legally dispose of them.

C. Burning of CDL waste is not permitted.

END OF SECTION

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WASTE MANAGEMENT PROGRESS REPORT				
	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	**DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE**		
MATERIAL CATEGORY		Recycled	Salvaged	Reused
1. Acoustical Ceiling Tiles				
2. Asphalt				
3. Asphalt Shingles				
4. Cardboard Packaging				
5. Carpet and Carpet Pad				
6. Concrete				
7. Drywall				
8. Fluorescent Lights and Ballasts				
9. Land Clearing Debris (vegetation, stumpage, dirt)				
10. Metals				
11. Paint (through hazardous waste outlets)				
12. Wood				
13. Plastic Film (sheeting, shrink wrap, packaging)				
14. Window Glass				
15. Field Office Waste (office paper, aluminum cans, glass, plastic, and coffee cardboard)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL ABOVE VALUES – IN WEIGHT)		
		Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)	

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.
2. Project Record Documents.
3. Operation and maintenance manuals.
4. Warranties.
5. Instruction of Owner's personnel.
6. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
3. Divisions 2 through 33 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
7. Complete startup testing of systems.
8. Submit test/adjust/balance records.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

10. Advise Owner of changeover in heat and other utilities.
11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
12. Complete final cleaning requirements, including touchup painting.
13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or on additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Include space for sign off and acceptance of each item.

1.6 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect and Owner's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

    a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.
    b. Accurately record information in an understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    d. Mark Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. Mark important additional information that was either shown schematically or omitted from original Drawings.
4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one (1) set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Drawings, and Record Specifications, where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:

a. Emergency instructions and procedures.
b. System, subsystem, and equipment descriptions, including operating standards.
c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
d. Description of controls and sequence of operations.
e. Piping diagrams.

2. Maintenance Data:

a. Manufacturer's information, including list of spare parts.
b. Name, address, and telephone number of Installer or supplier.
c. Maintenance procedures.
d. Maintenance and service schedules for preventive and routine maintenance.
e. Maintenance record forms.
f. Sources of spare parts and maintenance materials.
g. Copies of maintenance service agreements.
h. Copies of warranties and bonds.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to

accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.8 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Provide instructors experienced in operation and maintenance procedures.
2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

3. Schedule training with Owner, through Architect, with at least seven days' advance notice.
4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.

B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:

1. System design and operational philosophy.
2. Review of documentation.
3. Operations.
4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.2 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances. Cut lawn and field areas.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction.
r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 017700

SECTION 017836 - WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1. Refer to the General Conditions for terms of the Contractor's period for correction of the Work.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Submittals" specifies procedures for submitting warranties.
2. Division 1 Section "Contract Closeout" specifies contract closeout procedures.
3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.
4. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

D. Separate Prime Contracts: Each prime contractor is responsible for warranties related to its own contract.

1.3 DEFINITIONS

A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

1.4 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the Owner reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS

A. Submit written warranties to the Architect prior to the date certified for Substantial Completion. If the Architect's Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Architect.

1. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect within 15 days of completion of that designated portion of the Work.

B. When the Contract Documents require the Contractor, or the Contractor and a subcontractor, supplier or manufacturer to execute a special warranty, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

C. Forms for special warranties are included at the end of this Section. Prepare a written document utilizing the appropriate form, ready for execution by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Submit a draft to the Owner, through the Architect, for approval prior to final execution.

1. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

D. Form of Submittal: At Final Completion compile 2 copies of each required warranty properly

executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

E. Bind warranties and bonds in heavy-duty, commercial-quality, durable 3-ring, vinyl-covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (115-by-280-mm) paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address, and telephone number of the Installer.

2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project title or name, and name of the Contractor.

3. When warranted construction requires operation and maintenance manuals, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 LIST OF WARRANTIES

A. Schedule: Provide warranties on products and installations as specified in individual specification sections.

END OF SECTION 017836

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. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. Related Sections include the following:

1. Division 01 Section "HVAC Commissioning Requirements" for specific requirements for commissioning HVAC systems.
2. Division 01 Section "Electrical Commissioning Requirements" for specific requirements for commissioning electrical systems.
3. Division 01 Section "Plumbing System Commissioning Requirements" for specific requirements for commissioning Plumbing systems.
4. Division 01 Section "Contract Closeout" for specific requirements for closeout at substantial and final completion.
5. Division 01 Section "Contract Closeout" for Specific Requirements for training and demonstration of systems to Owner.
6. Division 01 Section "Contract Closeout" for Specific Requirements related to the Preparation of systems operation and maintenance manuals.

1.3 DEFINITIONS

A. CxA: Commissioning Authority.

B. OPR: Owner's Project Requirements.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be

limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

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 SECTION

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DIVISION 01 SECTION 01 91 14
PLUMBING COMMISSIONING REQUIREMENTS
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SECTION 01 91 14 – PLUMBING COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for commissioning the plumbing system and its subsystems and equipment. This Section supplements the general requirements specified in Division 01 Section "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 01 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

C. The following systems and/or equipment shall be commissioned:

1. Backflow preventers.
2. Condensate Neutralizers.
3. Domestic Hot Water Expansion Tanks.
4. Domestic hot water heaters.
5. Domestic hot water re-circulating system.
6. Domestic water meters (including interlock to ATC system).
7. Domestic water pumps.
8. Elevator sump pump and controls.
9. Gas Pressure Regulators.
10. Makeup Water Meters. (Mechanical and ATC Type.)
11. Plumbing Fixtures.
12. Plumbing Pumps.
13. Pressure Reducing Valves.
14. Thermostatic mixing valves below hand sinks/lavs.
15. Trap priming stations.

1.3 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of plumbing systems, electrical, communications, controls for plumbing systems, and other related systems.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Contractor:

1. Attend procedures meeting for TAB Work.
2. Certify that TAB Work is complete.
3. Assist performing functional performance tests.

C. Mechanical Contractor:

1. Attend TAB verification testing.
2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.
3. Assist performing functional performance tests.
4. Assist testing flow rates of all plumbing fixtures and plumbing equipment.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the Contract Documents, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:
i. Accessibility of equipment and components required for TAB Work.
ii. Verify flush valve gallons per flush matches schedules/submittals.
iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
iv. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
v. Flow rates and aerations have been specified and compared to

central equipment output capacities.

b. Identify discontinuities and omissions in the Contract Documents.

c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

d. Assist performing functional performance tests.

2. Additional Responsibilities: Participate in tests specified in Division 23 Sections "Instrumentation & Controls of HVAC & Plumbing Systems."

F. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and plumbing systems, subsystems, and equipment.
2. Attend TAB verification testing.

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. Domestic water meter total volume in gallons.
    d. Elevator sump pump control and alarms.
    e. Flow rates for domestic re-circulating systems.
    f. Flow rates in gallons per minute for showerheads.
    g. Thermostatic mixing valve temperatures and water flow rates.
    h. Re-circ. pump pressures and flow rates.
    i. Trap priming station water discharge.
    j. Water heater temperatures and set points.
    k. Water meter flow rates and calibration.

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. Lead/lag operation where redundant equipment is indicated.
9. 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 of water at all trap priming stations.
6. Verify that all backflow preventers have been tested. Document in writing.
7. Test operation and interlock of all elevator sump pumps.
8. Test operation of all water meters.
9. Test domestic water heaters.
10. Test water meters and interlock with ATC system.
11. Test operation, set points, and safeties of water heaters.
12. Verify that backflow preventers have been tested.
13. Test discharge of water at all trap priming stations.
14. Test makeup water valve train flow meter.
15. Verify PRV setpoints.

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, trap priming stations, domestic pumps, elevator sump pumps and auxiliary equipment, domestic water meters, and thermostatic mixing valves. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings for each pipe section showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
3. Design and actual measurements for all equipment.

G. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

H. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

END OF SECTION

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SECTION 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. Air Flow Monitoring Stations.
2. Air Separators.
3. Automatic Temperature Control System.
4. Boiler alarms.
5. Boilers and burners.
6. Carbon Dioxide Sensors.
7. Chilled water system.
8. Condensate Block Switch Alarms (Condensing Boilers).
9. Condensate overflow alarms.
10. Condensate pumps.
11. Dampers.
12. Demand Meter/ATC Interface.
13. Differential Pressure Bypass Valves.
14. Duct smoke detectors.
15. Ductless heat pumps units.
16. Electric Heaters/Radiant Heat Panels.
17. Energy recovery ventilators (Including variable frequency drives).
18. Expansion tanks.
19. Fan coil units.
20. Finned Tube Radiation.
21. Flame Failure Alarms.
22. Flow measuring stations.
23. Flow Switches.
24. Freeze protection pumps.

25. Heat Pipes.
26. High and low temperature alarms.
27. Hydronic Unit Heaters.
28. Hot water systems.
29. HVAC controls and sequences of operation.
30. Intake Hood Dampers.
31. Lighting interface to ATC system.
32. Low Water Cut-Offs and Alarms.
33. Makeup water meter flow rates and alarms.
34. Minimum Flow Bypass Valves/Controls.
35. Monitoring of Electric Meters and Submeters.
36. Pressure Independent Control Valves.
37. Pumps.
38. Pump VFD Alarms.
39. Refrigerant Mitigation Controls.
40. Relative Humidity Sensors.
41. Supply air systems.
42. Temperature Sensors.
43. Unit Heaters.
44. Variable frequency drives.
45. Ventilation Fans.
46. Water meter/ATC interface.

1.3 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. CxA: Commissioning Authority.

C. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

D. TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 01 Section "General Commissioning Requirements."

B. Contractor:

1. Attend procedures meeting for TAB Work.
2. Certify that TAB Work is complete.
3. Assist performing functional performance tests.

C. Mechanical Contractor:

1. Attend TAB verification testing.
2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.
3. Assist performing functional performance tests.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the Contract Documents, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions. Assist with performing functional performance tests.

E. TAB Subcontractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

    a. Verify the following:
        i. Accessibility of equipment and components required for TAB Work.
        ii. Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
        iii. Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
        iv. Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
        v. Air 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 pump status alarms, pump operation, flow rates, and controls.
    b. All temperature alarms.
    c. Boiler temperatures, flow rates, low water cut-off interlock, flame failure interlocks, flow switches, and amperage.
    d. Differential bypass valves and transmitters.
    e. Duct Smoke detectors operation and interlocks with fire alarm system.
    f. Ductless heat pumps with air flow rates and temperatures.
    g. Electric heating equipment volts, amps, and temperature rise.
    h. Electric Radiant Heat Panel Temperature Sensors.
    i. Fan coil unit air/water flow rates and temperatures.

j. Finned tube radiation operation and control.
k. Flow switch equipment shutdown and alarm.
l. Freeze protection pump flow rate, pressure, amperage, cut-in/cut-out temperatures.
m. Head pressure controls for air cooled heat pump units.
n. Heat pipe temperatures and frost protection.
o. Hot water coils, airflow rates, pressure drops, temperatures, and fluid flow rate.
p. Hydronic unit heater/baseboard radiation temperature and flow rates.
q. Lighting interface and start/stop by ATC system.
r. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.
s. Monitoring of electric meters and submeters.
t. Operation of heat pump units in both heating and cooling cycles.
u. Operation/Accuracy of air and fluid flow measuring stations at various flow rates.
v. Pump flow rates, pressure and amperage at each operating mode.
w. Sequences of operation of all HVAC equipment.
x. Set point and operation of high temperature alarms.
y. Supply and return air flow rates for all HVAC equipment.
z. Supply, outside air, exhaust and return air flow rates for ERVs in each operating mode.
aa. Test and calibrate all static pressure sensors.
bb. Test all boiler flow switches including operation and alarms.
cc. Test boiler low water cut-off, condensate overflow switches, and flame failure alarms.
dd. Test freeze protection pumps.
ee. Total exhaust airflow and total outdoor-air intake.
ff. Unit heaters operation and control.
gg. Variable speed drive parameters at each operated mode.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:
    a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.
    b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 23 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load. Operational modes include the following:

1. Heating/Cooling Mode.
2. Occupied and unoccupied.
3. Warm up and cool down.
4. Emergency power supply.
5. Fluid flow rates, pressure, and temperatures for all hydronic equipment.
6. Life-safety and safety systems.
7. Duct detectors.
8. Fire safety.
9. Temporary upset of system operation.
10. Partial occupancy conditions.
11. Special cycles.
12. ERV Unit supply/exhaust air flow at partial CO2 levels.
13. Lead/lag/standby modes of operation where redundant equipment is indicated.
14. All alarms.
15. Flow switch shut-down and alarm.
16. Condensate overflow safety switch shut-down and alarm.
17. Condensate pump operation.
18. Test operation and accuracy of air/fluid flow measuring stations and make-up water meters.
19. Test refrigerant mitigation controls including fan interlocks, refrigeration system shutdown, and refrigerant leak detection sensors.

3.2 TAB VERIFICATION

A. TAB Subcontractor shall coordinate with CxA for work required in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing." TAB Subcontractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Contractor, HVAC Contractor, and CxA shall witness TAB Work.

C. TAB Preparation:

1. TAB Subcontractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 23 Section "Testing Adjusting & Balancing for HVAC & Plumbing."

    a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.
2. CxA shall notify TAB Subcontractor 10 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item is defined as follows:

    a. For all readings a deviation of more than 10 percent.

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

E. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

F. CxA shall certify that TAB Work has been successfully completed.

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, energy recovery ventilators, unit heaters, radiant heat panels, hydronic unit heaters, boilers, fan coil units, and finned tube radiation. 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, 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, and hydronic distribution systems, pumps, special exhaust, and ERV unit supply and exhaust, and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.
2. Tracking checklist for managing and ensuring that all pipe sections have been tested.
3. Equipment, air flow rates, air temperatures, fluid flow rates, safeties, freeze protection pump operation, and demand controlled ventilation.

K. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.
2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

L. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.
2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.
3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect, to determine corrective action. Deficiencies shall be corrected and test repeated.

END OF SECTION

SECTION 01 91 16 DIVISION 01
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 and exterior lighting and associated controls.

3. Electrical distribution system.

a. Main switchboard.
b. Distribution panelboards.
c. Motor starters.
d. Lighting contactors.
e. Plug-load controls.

1.3 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of 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 system being tested.
7. Check safety cutouts, alarms, and interlocks with [smoke control] 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 SECTION

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SECTION 02 41 19 - SELECTIVE DEMOLITION

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, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

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 Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

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.

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 Owner's 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 Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner 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. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. Furniture and Equipment.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. 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. Roofing Systems.

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.

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 Owner. Owner 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 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.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawing.

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 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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. 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.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

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. 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.

C. 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 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."

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 075323 – EPDM Membrane Roofing" 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 Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Transport demolished materials off Owner'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.

END OF SECTION 02 41 19

SECTION 03 05 16 - UNDER-SLAB VAPOR BARRIER

PART 1 – GENERAL

1.01 SECTION INCLUDES
A. Vapor Barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.

1.02 RELATED SECTIONS
A. Section 03 30 00 Cast-in-place Concrete

1.03 REFERENCES
A. American Society for Testing and Materials (ASTM)
1. ASTM E 1745-97(2004) Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
2. ASTM E 154-99(2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
3. ASTM E 96-05 Standard Test Methods for Water Vapor Transmission of Materials
4. ASTM E 1643-98(2005) Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
B. American Concrete Institute (ACI):
1. ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
2. ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.

1.04 ADMINISTRATIVE REQUIREMENTS
A. Preinstallation Meeting: Convene a preinstallation meeting two weeks before starting work of this section; require attendance by all relevant installers.
B. Refer to Section 01 30 00 - Administrative Requirements for additional information.

1.05 SUBMITTALS
A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Quality Control / Assurance
1. Submit Independent laboratory test results showing compliance with ASTM & ACI Standards.
C. Submit Manufacturer's samples and product data.
D. Submit Manufacturer's most current installation instructions for placement, seaming and pipe boot installation

PART 2 – PRODUCTS

2.01 MATERIALS
A. Vapor Barrier shall have all of the following qualities:
1. Maintain permeance of less than 0.01 Perms [grains/(ft2 * hr * inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).
2. Other performance criteria:
a. Strength: ASTM E1745 Class A.
b. Thickness: 15 mils minimum
3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1

B. Vapor Barrier Products: 15 mil plastic sheet - single ply vapor barrier.

1. Stego Wrap (15 mil) Vapor Barrier by STEGO INDUSTRIES LLC, San Clemente, CA (877) 464-7834 www.stegoindustries.com
2. Griffolyn 15 mil Green Vapor Barrier by Reef Industries, Inc.
3. VaporBlock 15 by Raven Industries, Inc.
4. Viper II by ISI Building Products.

C. ACCESSORIES

1. Seam Tape
   a. Tape must have the following qualities:
      1) Water Vapor Transmission Rate ASTM E 96: 0.3 perms or lower
2. Vapor Proofing Mastic
   a. Mastic must have the following qualities:
      1) Water Vapor Transmission Rate ASTM E 96: 0.3 perms or lower
3. Pipe Boots
   a. Provide manufacturer's supplied pipe boot system or construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 – EXECUTION

3.01 PREPARATION

A. Ensure that subsoil is approved by architect or geotechnical firm
   1. Level and tamp or roll aggregate, sand or tamped earth base.

3.02 INSTALLATION

A. Installation shall be in accordance with manufacturer's most current instructions and ASTM E 1643.
   1. Unroll Vapor Barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
   2. Clean the surface of the Vapor Barrier and the areas of adhesion to ensure the surfaces for adhesion are free from dust, dirt, moisture, frost and any other contaminant that may impair the sealing of the seam, and to allow maximum adhesion of the pressure sensitive seam tape or adhesive.
   3. Lap Vapor Barrier/Retarder over footings and seal to foundation walls.
   4. Overlap joints 6 inches and seal with manufacturer's tape.
   5. Seal all penetrations (including pipes) per manufacturer's instructions.
   6. No penetration of the Vapor Barrier is allowed except for reinforcing steel and permanent utilities.
   7. Repair damaged areas by cutting patches of Vapor Barrier/Retarder, overlapping damaged area 6 inches and taping all four sides with tape, providing a vapor-tight seal.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.

B. Related Sections:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
3. Section 321313 "Concrete Paving" for concrete pavement and walks.
4. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar

diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint and Control Joint Layout: Indicate proposed construction and control joints required to construct the structure.

1. Location of construction and control joints is subject to approval of the Architect.

2. Contractor to coordinate construction /control joints with flooring manufacturer requirements and flooring joint layout as required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.

e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.

c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

D. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

E. Deformed-Steel Wire: ASTM A 496/A 496M.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

G. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 94/C 94M.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
c. Euclid Chemical Company (The), an RPM company; EUCON BCN.
d. Grace Construction Products, W. R. Grace & Co.; DCI.
e. Sika Corporation; Sika CNI.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
b. Cortec Corporation; MCI- 2000.
c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
d. Sika Corporation; FerroGard 901.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ChemMasters.

b. Davis Colors.
c. Dayton Superior Corporation.
d. Hoover Color Corporation.
e. Lambert Corporation.
f. QC Construction Products.
g. Rockwood Pigments NA, Inc.
h. Scofield, L. M. Company.
i. Solomon Colors, Inc.

2. Color: As selected by Architect from manufacturer's full range.

2.6 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Greenstreak.
b. Williams Products, Inc.

2. Profile: As indicated.
3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick).

B. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. BoMetals, Inc.
b. Greenstreak.
c. Paul Murphy Plastics Company.
d. Vinylex Corp.

2. Profile: As indicated.
3. Dimensions: 4 inches by 3/16 inch thick (100 mm by 4.75 mm thick); nontapered.

C. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch (19 by 25 mm).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
b. CETCO; Volclay Waterstop-RX.
c. Concrete Sealants Inc.; Conseal CS-231.
d. Greenstreak; Swellstop.
e. Henry Company, Sealants Division; Hydro-Flex.
f. JP Specialties, Inc.; Earth Shield Type 20.

D. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch (10 by 19 mm).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
b. Greenstreak; Hydrotite.
c. Vinylex Corp.; Swellseal.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: ***See Section 030516.***

2.8 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 4 (4.75-mm) sieve.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; Emery.
b. Dayton Superior Corporation; Emery Tuff Non-Slip.
c. Lambert Corporation; EMAG-20.
d. L&M Construction Chemicals, Inc.; Grip It.
e. Metalcrete Industries; Metco Anti-Skid Aggregate.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; A-H Alox.
b. BASF Construction Chemicals - Building Systems; Frictex NS.
c. L&M Construction Chemicals, Inc.; Grip It AO.

C. Emery Dry-Shake Floor Hardener: Pigmented , factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

1. Color: As selected by Architect from manufacturer's full range.

D. Metallic Dry-Shake Floor Hardener: Pigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Color: As selected by Architect from manufacturer's full range.

E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Maximent.
b. ChemMasters; ConColor.
c. Conspec by Dayton Superior; Conshake 500.
d. Dayton Superior Corporation; Quartz Tuff.
e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 250.
f. Euclid Chemical Company (The), an RPM company; Surflex.
g. Kaufman Products, Inc.; Tycron.
h. Lambert Corporation; Colorhard.
i. L&M Construction Chemicals, Inc.; Quartzplate FF.
j. Metalcrete Industries; Floor Quartz.
k. Scofield, L. M. Company; Lithochrome Color Hardener.
l. Symons by Dayton Superior; Hard Top.

F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Mastercron.
b. ChemMasters; ConColor.
c. Conspec by Dayton Superior; Conshake 600 Colortone.
d. Dayton Superior Corporation; Quartz Tuff.
e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 200 - 205.
f. Euclid Chemical Company (The), an RPM company; Surflex.
g. Kaufman Products, Inc.; Tycron.
h. Lambert Corporation; Colorhard.
i. L&M Construction Chemicals, Inc.; Quartz Plate FF.
j. Metalcrete Industries; Floor Quartz.
k. Scofield, L. M. Company; Lithochrome Color Hardener.
l. Symons by Dayton Superior; Color Hardener.

2. Color: As selected by Architect from manufacturer's full range.

2.9 LIQUID FLOOR TREATMENTS

A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ChemMasters; Chemisil Plus.
b. ChemTec Int'l; ChemTec One.
c. Conspec by Dayton Superior; Intraseal.
d. Curecrete Distribution Inc.; Ashford Formula.
e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
f. Edoco by Dayton Superior; Titan Hard.
g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
h. Kaufman Products, Inc.; SureHard.
i. L&M Construction Chemicals, Inc.; Seal Hard.
j. Meadows, W. R., Inc.; LIQUI-HARD.
k. Metalcrete Industries; Floorsaver.
l. Nox-Crete Products Group; Duro-Nox.
m. Symons by Dayton Superior; Buff Hard.
n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Advanced Floor Products; Retro-Plate 99.
b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    b. BASF Construction Chemicals - Building Systems; Confilm.
    c. ChemMasters; SprayFilm.
    d. Conspec by Dayton Superior; Aquafilm.
    e. Dayton Superior Corporation; Sure Film (J-74).
    f. Edoco by Dayton Superior; BurkeFilm.
    g. Euclid Chemical Company (The), an RPM company; Eucobar.
    h. Kaufman Products, Inc.; Vapor-Aid.
    i. Lambert Corporation; LAMBCO Skin.
    j. L&M Construction Chemicals, Inc.; E-CON.
    k. Meadows, W. R., Inc.; EVAPRE.
    l. Metalcrete Industries; Waterhold.
    m. Nox-Crete Products Group; MONOFILM.
    n. Sika Corporation; SikaFilm.
    o. SpecChem, LLC; Spec Film.
    p. Symons by Dayton Superior; Finishing Aid.
    q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
    r. Unitex; PRO-FILM.
    s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    b. BASF Construction Chemicals - Building Systems; Kure 200.
    c. ChemMasters; Safe-Cure Clear.
    d. Conspec by Dayton Superior; W.B. Resin Cure.
    e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    f. Edoco by Dayton Superior; Res X Cure WB.
    g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    h. Kaufman Products, Inc.; Thinfilm 420.
    i. Lambert Corporation; AQUA KURE - CLEAR.
    j. L&M Construction Chemicals, Inc.; L&M Cure R.
    k. Meadows, W. R., Inc.; 1100-CLEAR.
    l. Nox-Crete Products Group; Resin Cure E.
    m. Right Pointe; Clear Water Resin.

n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc.; AH Clear Cure WB.
b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
c. ChemMasters; Safe-Cure & Seal 20.
d. Conspec by Dayton Superior; Cure and Seal WB.
e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
g. Edoco by Dayton Superior; Spartan Cote WB II.
h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
j. Lambert Corporation; Glazecote Sealer-20.
k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
l. Meadows, W. R., Inc.; Vocomp-20.
m. Metalcrete Industries; Metcure.
n. Nox-Crete Products Group; Cure & Seal 150E.
o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
p. TK Products, Division of Sierra Corporation; TK-2519 WB.
q. Vexcon Chemicals, Inc.; Starseal 309.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
b. ChemMasters; Safe-Cure Clear.
c. Conspec by Dayton Superior; High Seal.
d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
f. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
g. Kaufman Products, Inc.; SureCure Emulsion.
h. Lambert Corporation; Glazecote Sealer-20.
i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
j. Meadows, W. R., Inc.; Vocomp-20.
k. Metalcrete Industries; Metcure 0800.

l. Nox-Crete Products Group; Cure & Seal 200E.
m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
n. Vexcon Chemicals, Inc.; Starseal 0800.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
b. ChemMasters; Spray-Cure & Seal Plus.
c. Conspec by Dayton Superior; Sealcure 1315.
d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
e. Edoco by Dayton Superior; Cureseal 1315.
f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
g. Kaufman Products, Inc.; Sure Cure 25.
h. Lambert Corporation; UV Super Seal.
i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
j. Meadows, W. R., Inc.; CS-309/30.
k. Metalcrete Industries; Seal N Kure 30.
l. Right Pointe; Right Sheen 30.
m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals - Building Systems; Kure 1315.
b. ChemMasters; Polyseal WB.
c. Conspec by Dayton Superior; Sealcure 1315 WB.
d. Edoco by Dayton Superior; Cureseal 1315 WB.
e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
g. Lambert Corporation; UV Safe Seal.
h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
i. Meadows, W. R., Inc.; Vocomp-30.
j. Metalcrete Industries; Metcure 30.
k. Right Pointe; Right Sheen WB30.
l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch- (0.55-mm-) thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6.4 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.

2. Maximum Water-Cementitious Materials Ratio: As Indicated.

3. Slump Limit: As Indicated.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As indicated.

2. Maximum Water-Cementitious Materials Ratio: As Indicated.

3. Slump Limit: As Indicated.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.

2. Minimum Cementitious Materials Content: As Indicated.

3. Slump Limit: As Indicated.

4. Air Content: **6** percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size at locations indicated.

5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated..

2. Minimum Cementitious Materials Content: As Indicated.

3. Slump Limit: As Indicated.

E. Building Frame Members: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.

2. Maximum Water-Cementitious Materials Ratio: As Indicated.

3. Slump Limit: As Indicated.

F. Building Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As Indicated.

2. Maximum Water-Cementitious Materials Ratio: As Indicated.

3. Slump Limit: As Indicated.

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 (ACI 318M) and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Sheet Vapor Retarders: ***Install in accordance with Section 030516.***

1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent

formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings, to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.

    b. Contractor to provide more stringent slab tolerance as specified by the architectural floor finish manufacturer if required.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed the Floor Flatness and Floor Levelness indicated on Drawing S-002.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.

2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. (49 kg/10 sq. m) unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches ((100 mm)) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.

2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
4. Control and dispose of waste products produced by grinding and polishing operations.
5. Neutralize and clean polished floor surfaces.

C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete;**;** one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 040110 - MASONRY CLEANING

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 SUMMARY

A. Section Includes:

1. Paint removers.
2. Cleaning materials.
3. Liquid strippable masking agent.

1.2 DEFINITIONS

A. Very Low-Pressure Spray: Under [**100 psi (690 kPa)**] <**Insert value**>.

B. Low-Pressure Spray: [**100 to 400 psi (690 to 2750 kPa**)**; 4 to 6 gpm (0.25 to 0.4 L/s)**] <**Insert**.

C. Medium-Pressure Spray: [**400 to 800 psi (2750 to 5510 kPa**)**; 4 to 6 gpm (0.25 to 0.4 L/s)**].

D. High-Pressure Spray: [**800 to 1200 psi (5510 to 8250 kPa**)**; 4 to 6 gpm (0.25 to 0.4 L/s)**].

1.3 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform masonry-cleaning Work in the following sequence:

1. Remove plant growth and any other biological growth.
2. Inspect for open mortar joints. Where repairs are required, delay further cleaning Work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint or graffiti.
4. Clean masonry surfaces.
5. Where water repellents are to be used on or near masonry, delay application of these chemicals until after cleaning.

B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units and joints in accordance with masonry repair Sections.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions and application instructions.
2. Include test data substantiating that products comply with requirements.

B. Material certificates signed by manufacturer and Contractor certifying that each material complies with requirements.

C. Each type of chemical cleaning material.

D. Qualification data for firms and specialists to demonstrate their capabilities and experience. Include list of five completed projects with project names and references.

E. Cleaning Program:

1. Describe cleaning protocol, materials, methods, and equipment to be used.
2. Indicate protection of surrounding materials on people, vehicles, buildings, and site items.
3. Describe control method of runoff during operations.
4. Create written report of final cleaning methods and process used.

1.5 INFORMATIONAL SUBMITTALS

A. Cleaning program.

1.6 QUALITY ASSURANCE

A. Source of Materials: Obtain materials for masonry cleaning from a single source for each type of substrate required to ensure quality of cleaning.

B. Masonry-Cleaning Specialist Firms: A firm that provides masonry cleaning, including masonry cleaners that have been used for similar applications with successful results, and is manufacturer authorized for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

C. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, who employs factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

D. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.

1. If materials and methods other than those indicated are proposed for any phase of cleaning Work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness for this Project.

1.7 MOCKUPS

A. Prepare mockups of cleaning on existing surfaces to evaluate and establish cleaning materials and processes. Consult cleaning manufacturer for project applications.

1. Masonry Substrate: **Clay masonry**.
2. Cleaning: Clean an existing area **approximately 25 sq. ft. (2.3 sq. m)** for each type of masonry and surface condition.

a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
b. Consult with chemical cleaning product manufacturer to verify what products require pre-wetting of substrate before cleaner application.
c. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.
d. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning Work to be performed in accordance with product manufacturers' written instructions and specified requirements.

B. Clean masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to remain so for at least seven days after completion of cleaning.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has thawed and dried out, but not less than seven days after completion of cleaning.
2. Hot-Weather Requirements: Protect unit masonry Work when temperature and humidity conditions produce excessive evaporation of water from masonry. Provide artificial shade and wind breaks and use cooled materials as required.

C. Refer to chemical cleaner manufacturer's recommendations for application techniques when hot-weather conditions exist.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F (60 to 71 deg C).

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 1/2 cup (125 mL) of laundry detergent, and 20 quarts (20 L) of hot water for every 5 gal. (20 L) of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium pyrophosphate (TSPP), 5 quarts (5 L) of 5 percent sodium hypochlorite (bleach), and 15 quarts (15 L) of hot water for every 5 gal. (20 L) of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.
1. Masonry Substrate: **Clay masonry**.

F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
1. Masonry Substrate: **Clay masonry**.

2.2 ACCESSORY MATERIALS

A. Retain materials of use based on the approval of a mockup.

1. Provide materials with previous effectiveness in performing the Work involved.

a. Include materials with minimal possibility of damaging exposed surfaces.
b. Materials with consistency of each application.
c. Materials that provide uniformity of the resulting overall appearance.

B. Do not use products or tools that could do the following:

1. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces.
2. Leave residue on surfaces.

C. Equipment: Provide equipment for controlled spray application of water and chemical cleaners.

1. For chemical cleaner spray applications, provide a low-pressure tank or chemical pump suitable for the chemical cleaner indicated, equipped with spray tip for cleaning method applications.

D. Natural bristles brushes only.

E. Wood scrappers.

F. Trowels.

G. Provide additional accessories applicable to project conditions, including tapes, sheets, etc., to suit Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate conditions with specialist present, for compliance with approved mockup requirements for cleaning type, methods, products, and other conditions affecting performance.

3.2 PREPARATION

A. General: Comply with each manufacturer's written instructions for protecting people, motor vehicles, surrounding buildings, masonry areas not to be cleaned, nonmasonry surfaces, landscaping, equipment, and other surfaces that could be injured or harmed by such Work.

1. Provide temporary protective covers over pedestrian walkway areas and at points of entrance and exit for people, motor vehicles, and equipment that must remain during duration of cleaning procedures.
2. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant.
3. Temporarily protect all open joints to prevent intrusion of washing waters into the wall structure or building interior.
4. Remove all extraneous items no longer in use on face of surface unless indicated to remain. Where not indicated, obtain approval with Architect.
5. Apply masking agents in accordance with manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
6. Neutralize alkaline and acid wastes before disposal where applicable.

B. Provide disposal of 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.

C. Remove **gutters and** downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.

1. Provide temporary rain drainage during work to direct water away from building.

3.3 APPLICATION OF PRELIMINARY CLEANING MATERIALS

A. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Removing Biological Growth: Completely remove visible biological, moss, and shrub growth from masonry surfaces. Carefully remove biological growths, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible

before removal. Remove loose soil and biological debris from open joints to whatever depth they occur.

3. Mold, Mildew, and Algae Removal:

    a. Wet surface with **cold** water applied by low-pressure spray.
    b. Apply mold, mildew, and algae remover by brush **or low-pressure spray**.
    c. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
    d. Rinse with **cold** water applied by **medium**-pressure spray to remove mold, mildew, and algae remover and soil.

B. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

3.4 GENERAL APPLICATION OF CLEANING METHODS

A. Chemical Cleaning: Do not apply during winds of enough force to spread them to unprotected surfaces.

B. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from **20 ft. (6 m)** away by Architect.

C. Proceed with cleaning in an orderly manner; work from **top to bottom** of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

D. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
    e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F (60 and 71 deg C) at flow rates indicated.
    f. For steam application, use steam generator capable of delivering live steam at nozzle.

E. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

F. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed in accordance with "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.

G. Remove minor stains (cuprous, ferrous, etc.) if any.

H. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

3.5 WATER-CLEANING TYPE

A. Water Application Methods:

1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches (150 mm) from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

B. Cold-Water Soak:

1. Apply cold water by intermittent spraying to keep surface moist.
2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
3. Apply water in cycles of [**five minutes**] <**Insert time**> on and [**20 minutes**] <**Insert time**> off.
4. Continue spraying [**until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests**] [**for 72 hours**] <**Insert requirement**>.
5. Remove soil and softened surface encrustation from surface with cold water applied by low-pressure spray.

C. Cold-Water Wash: Use cold water applied by [**low**] [**medium**] [**high**]-pressure spray.

D. Hot-Water Wash: Use hot water applied by [**low**] [**medium**] [**high**]-pressure spray.

3.6 CHEMICAL-CLEANING TYPE

A. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces in accordance with chemical-cleaner manufacturer's written instructions; use brush **or spray** application. **Do not spray apply at pressures exceeding 50 psi (345 kPa).** Do not allow

chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

1. Consult with cleaning product manufacturer to verify what products require pre-wetting of substrate before cleaner application.

B. Dilute chemical cleaners with water when required to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

C. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

D. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

E. Detergent Cleaning:

1. Wet surface with **cold** water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with **cold** water applied by **medium**-pressure spray to remove detergent solution and soil.

F. Nonacidic Liquid Chemical Cleaning:.

1. Wet surface with **cold** water applied by low-pressure spray.
2. Apply cleaner to surface **in two applications** by brush **or low-pressure spray**.
3. Let cleaner remain on surface for period **recommended in writing by chemical-cleaner manufacturer**.
4. Rinse with **cold** water applied by **medium** pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and provide on-site assistance when requested by Architect. Have chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than **once** to observing progress and quality of the work.

3.8 FINAL CLEANING

A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.

B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

C. Remove masking materials, leaving no residues that could trap dirt.

D. Clean landscaping areas of debris.

3.9 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to Architect, which ensures cleaning Work without being soiled at time of substantial completion.

END OF SECTION 040110

SECTION 040120.63 - BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Masonry materials.
2. Mortar materials.
3. Manufactured repair materials.

B. Related Requirements:

1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
2. Section 040110 "Masonry Cleaning" for cleaning and paint removal existing masonry.
3. Section 040120.64 "Brick Masonry Repointing" for repointing existing brickwork.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and sealant-joint preparation for repaired masonry.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed.

Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner or storage as indicated.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

D. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

E. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of bricks to freezing and thawing.

1.3 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform brick masonry repair work in the following sequence, which includes work specified in this and other Sections:

1. Remove plant growth.
2. Inspect masonry for open mortar joints and point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Repair masonry, including replacing existing masonry with new masonry materials.
6. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
7. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in bricks in accordance with "Brick Masonry Patching" Article. Patch holes in mortar joints according to Section 040120.64 "Brick Masonry Repointing."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use.
3. Include test data substantiating that products comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of replacement bricks on the structure, showing relation of existing and new or relocated units.
2. Show provisions for expansion joints or other sealant joints.
3. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.
4. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:

1. Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, **1/2 inch (13 mm)** wide, set in aluminum or plastic channels.

    a. Have each set contain a close color range of at least **six** Samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
    b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.

2. Sand Types Used for Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars.
3. Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.

a. Have each set contain a close color range of at least **six** Samples of different mixes of patching compound that matches the variations in existing masonry when cured and dry.

4. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:

1. Each type of brick unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected. For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.
2. Each type of patching compound in the form of briquettes, at least 3 inches (75 mm) long by 1-1/2 inches (38 mm) wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.
3. Accessories: Each type of accessory and miscellaneous support.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **brick masonry repair specialist**.

1.6 QUALITY ASSURANCE

A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair firm to perform Work of this Section. Firm is to have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.

1. Field Supervision: Brick masonry repair specialist firm is to maintain experienced full-time supervisors on Project site during times that brick masonry repair work is in progress.
2. Brick Masonry Repair Workers: When bricks are being patched, at least one worker per crew should be trained and certified by manufacturer of patching compound to apply its products performing the work of brick repairs.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver bricks to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.

B. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

E. Store sand where grading and other required characteristics can be maintained and contamination avoided.

F. Handle bricks to prevent overstressing, chipping, defacement, and other damage.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit brick masonry repair work to be performed in accordance with product manufacturers' written instructions and specified requirements.

B. Temperature Limits: Repair brick masonry only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:

1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after repair.

D. Hot-Weather Requirements: Protect masonry repairs when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

E. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain **brick units** from single **source**.

B. For **exposed masonry units and cementitious mortar components**, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 1**20 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces** .

2.3 MASONRY MATERIALS

A. Masonry Materials: Face brick, required to complete brick masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork

a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

2. Brick Matching Architect's Sample: Units with colors, color variation within units, surface texture, and physical properties that match Architect's sample. Match existing units in size and shape.

a. For Architect's sample that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range rather than brick that matches an individual color within that range.

3. Special Shapes:

a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

B. Building Brick: ASTM C62, of same vertical dimension as face brick, for masonry work concealed from view.

1. Grade SW where in contact with earth.
2. **Grade SW or Grace MW** for concealed backup.

2.4 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C1329/C1329M.

E. Mortar Sand: ASTM C144.
1. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.5 MANUFACTURED REPAIR MATERIALS

A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
1. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than bricks being repaired, and develops high bond strength to all types of masonry.
2. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
3. Formulate patching compound in colors and textures to match each brick being patched. Provide **sufficient number of** colors to enable matching of the color, texture, and variation of each unit.

2.6 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.

B. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

1. Surface Preparation: Use coating requiring no better than **SSPC-SP 2, "Hand Tool Cleaning"** surface preparation in accordance with manufacturer's literature or certified statement.

C. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

2.7 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Rebuilding (Setting) Mortar by Volume: ASTM C270, Proportion Specification, **1 part portland cement, 1 part lime, and 6 parts sand**.
2. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate conditions with specialist present, for compliance with approved mockup requirements for brick units, repair methods, products, and other conditions affecting performance of the Work.

3.2 PREPARATION

A. General: Comply with each manufacturer's written instructions for protecting people, motor vehicles, surrounding buildings, masonry areas not to be cleaned, nonmasonry surfaces, landscaping, equipment, and other surfaces that could be injured or harmed by such Work.

1. Provide temporary protective covers over pedestrian walkway areas and at points of entrance and exit for people, motor vehicles, and equipment that must remain during duration of repairing procedures.
2. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant.
3. Temporarily protect all open joints to prevent intrusion of washing waters into the wall structure or building interior.
4. Remove all extraneous items no longer in use on face of surface unless indicated to remain. Where not indicated, obtain approval with Architect.

3.3 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.

1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
2. Keep wall area wet below rebuilding and repair work to discourage mortar from adhering.
3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

3.4 MASONRY REPAIR, GENERAL

A. Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from **20 ft. (6 m)** away by Architect.

3.5 ABANDONED ANCHOR REMOVAL

A. Remove abandoned anchors, brackets, wood nailers, and other extraneous items **no longer in use unless indicated to remain**.

1. Remove items carefully to avoid spalling or cracking masonry.
2. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:

    a. Cut or grind off item approximately **3/4 inch (20 mm)** beneath surface and core drill a recess of same depth in surrounding masonry as close around item as practical.
    b. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.

3. Patch hole where each item was removed unless directed to remove and replace bricks.

3.6 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated **or are to be reused**. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

1. When removing single bricks, remove material from center of brick and work toward outside edges.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. **Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.**

D. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.

1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
3. Store brick for reuse. Store off ground, on skids, and protected from weather.
4. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick in good condition, where possible, **or with new brick** matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

1. Maintain joint width for replacement units to match existing joints.
2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67/C67M initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. (30 g/194 sq. cm per min.) Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
2. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.7 BRICK MASONRY PATCHING

A. Patch the following bricks unless another type of repair or replacement is indicated:

1. Bricks indicated to be patched.
2. Bricks with holes.
3. Bricks with small areas of deep deterioration. **Patch deep deteriorations measuring more than 3/4 inch (19 mm) in least dimension and more than 1/4 inch (6 mm) deep.**

B. Remove and replace existing patches **where indicated**.

C. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least **1/4 inch (6 mm)** thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound in accordance with manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.
9. Remove and replace patches with hairline cracks or that show separation from brick at edges, and those that do not match adjoining brick in color or texture.

3.8 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

3.9 FIELD QUALITY CONTROL

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

3.10 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

B. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 040120.63

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Concrete block.
B. Facing brick.
C. Mortar and grout.
D. Reinforcement and anchorage.
E. Lintels.
F. Accessories.
G. Ground-face concrete block.

1.02 RELATED REQUIREMENTS

A. Division 1 - Administrative Requirements: Preconstruction meeting.
B. Section 04 73 13 - Calcium Silicate Manufactured Stone Masonry
C. Section 05 50 00 - Metal Fabrications: Loose steel lintels.
D. Section 07 11 13 - Bituminous Dampproofing: Dampproofing masonry surfaces.
E. Section 071300 - Sheet Waterproofing: Waterproofing masonry surfaces.
F. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
G. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
H. Section 07 84 00 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
I. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.
E. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2016a.
F. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units 2020a.
G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
H. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes 2018.
J. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale) 2019.
K. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
L. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
M. ASTM C476 - Standard Specification for Grout for Masonry 2020.

N. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry 2020.
O. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
P. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength 2019.
Q. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar 1992a (Reapproved 2014).
R. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms 2018.
S. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry 2014a.
T. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing 2017.
U. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.
V. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.
W. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting two weeks before starting work of this section; require attendance by all relevant installers.
B. Refer to Section 01 3000 - Administrative Requirements for additional information.

1.05 ACTION SUBMITTALS

A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, masonry accessories, and cleaning products including application .
B. Samples
    1. For selection
        a. Facing brick
            1) submit Manufacturers' brick panels illustrating three brick options emulating aesthetics of Basis of Design.

        b. Ivany block
            1) For preliminary color selection: Three sets of printed color sheets showing reasonable approximation of Manufacturer's full color range.
                (a) Color illustrations on Manufacturer's websites are not acceptable.
            2) For final selection: Three physical samples for each of up to three preliminary color selections by Architect.
    2. For verification
        a. Submit two samples of selected facing brick and Ivany block units illustrating color, texture, and extremes of color range.
C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements, including referenced material standards and fire ratings.
D. Shop Drawings: Provide shop drawings of vertical wall reinforcement and bond beam reinforcement. Submit, with copies to the Owner's Independent Testing and Inspection Agency, shop drawings for reinforcing detailing fabrication, bending, and placement of unit masonry reinforcing bars. Show details of construction, including dimensioned drawings, plans, elevations, sections, and details of components to be incorporated into Work including, but not limited to, the following:

1. Flashing System: Large-scale details for each element of flashing system showing layout, profiles, methods of joining, and anchorage details; including lintel units, shelf units, corner units, end dam units, drip edges, conditions showing interface and relationship to adjacent materials, and other special applications.
2. Fabricated Flashing: Detail corner units, end-dam units, drip edges, and other special applications.
3. Anchors, Ties, and Accessories: Show sizes, coursing, and locations.
4. Reinforcing: For masonry reinforcing bars; comply with ACI 315, "Details and Detailing of Concrete Reinforcement" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of masonry reinforcement. Show elevations of reinforced walls.

1.06 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each type of masonry unit, cementitious materials, and accessories required. Include data on material properties material test reports substantiating compliance with requirements. For brick, include test report for efflorescence according to ASTM C 67.
   1. Provide test reports based on testing within previous two years.

B. Material Certificates: Submit material certificates for the following, signed by manufacturer and Contractor. Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards.
   1. Each type of masonry unit.
   2. Cementitious materials. Include brand, type, and name of manufacturer. Provide certifications from manufacturer that no admixtures have been added to cementitious materials.
   3. Grout mixes. Include description of type and proportions of ingredients.
   4. Each material and grade indicated for reinforcing bars.
   5. Each type and size of joint reinforcement.
   6. Each type and size of anchors, ties, and metal accessory.

C. Mix Designs: Submit material test reports for the Owner’s Independent Testing and Inspection Agency, indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content. Include description of type and proportions of mortar ingredients.
   2. Include test reports, according to ASTM C 1019 for grout mixes required to comply with compressive strength requirement. Include description of type and proportions of grout ingredients.

D. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Pre-Faced Units: 50 of each type, size, and color combination.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: The unit masonry work to be by a single firm specializing in exterior wall masonry work, for a period of not less than 5 years, so that there will be undivided responsibility in this single firm for such work.

1. The Installer must be experienced with work comparable to the work shown and specified and who has completed projects with a successful in-service performance for a period of not less than 5 years.
2. The Installer shall engage experienced and qualified subcontractors to perform any part of the masonry work which he is not equipped or qualified to perform properly with his own forces.

B. Standards: Comply with the applicable provisions and recommendations of the following standards below, where standards conflict, the more stringent shall apply, and where a conflict between any stated standard and a project specific requirement of the specifications arise, the more stringent provision shall prevail.
1. National Concrete Masonry Association (NCMA):"TEK" Information Series.
2. American Concrete Institute (ACI):
   a. ACI 530/ASCE 5/TMS 402: "Building Code Requirements for Masonry Structures."
   b. ACI 530.1/ASCE 6/TMS 602: "Specifications for Masonry Structures."
3. Brick Industry Association (BIA) "Technical Notes on Brick Construction."
4. Underwriters Laboratories, Inc. (UL) "Fire Resistance Ratings."
5. American Society for Testing and Materials (ASTM) E 2266 “Standard Guide for Design and Construction of Low-Rise Frame Building Wall Systems to Resist Water Intrusion.”

C. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, through one source from a single manufacturer for each product required.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

E. Owner’s Independent Testing and Inspection Agency: The Owner will engage a qualified independent testing and inspection agency to perform preconstruction testing indicated below for field quality control. Payment for these services will be made by Owner. Independent testing agency to coordinate submittal of "Special Inspections" testing documentation for State of Delaware (State) review and approval.
1. The Contractor is responsible for the expense of testing or inspection resulting as a consequence of the following:
   a. Work not evidencing compliance with this specification.
   b. Testing to verify the adequacy of work done without prior notice, improper supervision, or contrary to standard construction practice.
2. Contractor's Responsibilities:
   a. Furnish labor required to facilitate testing.
   b. Provide materials, samples and access to materials as required for testing.
   c. Provide a complete set of shop and erection drawings, including revisions to previous Architect reviewed submittals.
3. Owner’s Independent Testing and Inspection Agency's Duties:
   a. The Owner’s Independent Testing and Inspection Agency shall conduct the following tests and inspections, interpret them, evaluate the results for compliance with the specifications, and report the findings to the Architect, Owner, Contractor, and Local Building Authority, as their interests may appear.
      1) Inspection and testing shall be in accordance with ACI requirements for masonry (ACI 530 and ACI 503.1) for the following inspections:
         (a) Observation, sampling and placing of masonry units used in all reinforced masonry construction.

(b) Inspection reports during reinforced masonry erection.
(c) Observations of reinforcement condition, size and placement for compliance with ACI 530.
(d) Ambient temperature during reinforced masonry erection.
(e) Inspection of reinforced masonry materials to verify compliance with ACI 530.1.
(f) Prism testing of masonry.
(g) Observation of proportioning, mixing, consistency of mortar and grout for compliance with ACI 530.1.
(h) Observation of application of mortar, grout and masonry units for compliance with ACI 530.1.
(i) Observation of installation of anchors for compliance with ACI 530.

b. Tests shall be conducted at the start of the job, using materials and mixes sampled at point of deposit.
c. Testing of Mortar: The Owner's Independent Testing Laboratory shall verify mix consistency by daily testing in accordance with ASTM C780. Test shall establish specific and overall performance characteristics of the mortar system. Test reports shall be submitted to the Owner / Architect for review under the provisions of the Division 01 section under "General Requirements".
d. Test of grout for reinforced masonry for compliance with ASTM C 476 requirements for the types specified and strength shown, conduct and report the following:
1) Compressive strength (ASTM C 1019); lab cure and break at a time increment of one at 7 days, and two at 28 days; a minimum of 1 field test shall be made for each 5000 square feet of reinforced CMU wall. Make no less than 3 tests.
e. Field Tests of Concrete Masonry Design Strength: During construction, the value of the compressive concrete masonry design strength (f'm) shall be verified by field tests in accordance with the ACI and ASTM standards. A minimum of one field test shall be made for every 5000 square feet of reinforced CMU wall. Not less than three prisms shall be made for each field test. The thickness of the prisms shall be taken as 8 inches for the reinforced CMU.

F. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
B. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
1. Deliver masonry veneer units to the jobsite on covered banded pallets with cardboard between layers. Store pallets in single stacks on level ground and cover with waterproof covering to protect the units form inclement weather. Handle masonry veneer units carefully to avoid breakage and damage to the finished surfaces.
C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Store aggregates where grading and other required characteristics can be maintained and contamination avoided. During cold weather stockpile aggregates so that it may be possible to heat them for use in mixing mortar in compliance with ACI recommendations for cold weather masonry practices.

E. Deliver pre-blended dry mortar mix, if used for the project, in moisture-resistant containers designed for use with dispensing silos. Store pre-blended dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

F. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil. Do not use metal reinforcing or ties having loose rust or other coatings, including ice, that will reduce rust or destroy bond.

1.09 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress. Prevent excess moisture from entering work in progress.
   1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.
   2. Protect door and window frames and exposed metal flashings from damage.

B. Stain Prevention: Prevent mortar and soil from staining the face of masonry to be left exposed. Immediately remove mortar and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use metal reinforcing or ties having loose rust or other coatings that will reduce or destroy bond. Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6 and ACI 530/ASCE 5 and the following requirements:
   1. If air temperature falls below 40 deg F, mixing water shall be heated.
   2. If the air temperature falls between 20 deg F and 32 deg F inclusively, sand and water shall be heated.
   3. If the air temperature falls below 20 deg F, in addition to the requirements of the preceding sub-paragraph, masonry units shall be heated, and heated enclosures shall be used with a minimum temperature of 40 deg F.
   4. Masonry shall be protected from freezing for 24 hours after laying.

D. Hot-Weather Requirements: When ambient temperature exceeds 100 deg F (38 deg C), or 90 deg F (32 deg C) with a wind velocity greater than 8 mph (13 km/h), do not spread mortar beds more than 48 inches (1200 mm) ahead of masonry. Set masonry units within one minute of spreading mortar. Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.10 DEFINITIONS

A. Exterior: Areas exposed to the elements and areas located in unconditioned spaces
B. Interior: Areas located in conditioned spaces

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide non-standard blocks configured for corners, lintels, control joint edges, jambs, sash, acoustical units, and other detailed conditions.
   3. Load-Bearing Units: ASTM C90, lightweight.
      a. Hollow block, as indicated.
B. Units with Integral Water Repellent: Provide exterior concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
   1. Performance of Units with Integral Water Repellent:
      a. Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
         1) No water visible on back of wall above flashing at the end of 24 hours.
         2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
         3) No more than 25 percent of wall area above flashing visibly damp at end of test.
      b. Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
      c. Compressive Strength: ASTM C1314; maximum 5 percent decrease.
      d. Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
   2. Use only in combination with mortar that also has integral water repellent admixture.
   3. Use water repellent admixtures for masonry units and mortar by a single manufacturer.

2.02 FACING BRICK

A. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
   1. Basis of Design Manufacturer: Glen Gery, Wyomissing, PA.
      a. Color 1 (98%): Rose Full Range.
      b. Color 2 (2%): 50-DD
   2. Other products selected to conform to the aesthetic intent of the basis-of-design products may be acceptable subject to the Architect's judgment regarding their aesthetic conformance.
B. Approved manufacturers
   1. Watsontown Brick, Watsontown, PA.
   2. The Belden Brick Company, Canton, OH.
   3. Taylor Clay Products, Salisbury, NC.
   4. Interstate Brick, West Jordan, UT.
C. Actual size: 11-5/8" long x 3-5/8" high, x 3-5/8" deep.
D. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect:

1. Corner brick units (custom angle) Stretchers with single custom bevel at watertable.
2. Soldier course units with solid corners.
3. Outside corners.

2.03 GROUND FACE MASONRY

A. Basis of design Manufacturer: York Building Products, York, PA. www.yorkbuilding.com.
   1. Ground Face Type 1: Gemstone Premium Series, color Graphite.

B. Products from other manufacturers selected to conform to the aesthetic intent of the basis-of-design products may be acceptable subject to the Architect's judgment regarding their aesthetic conformance.

2.04 MATTE FACE MASONRY

A. Basis of Design Manufacturer: York Building Products, York, PA. www.yorkbuilding.com.
   1. Matte Face Type 1: Matte Face Premium Series, color to match existing concrete sill.

2.05 MORTAR AND GROUT MATERIALS

A. Masonry Cement: not permitted.
B. Portland Cement: ASTM C150/C150M, Type I or Type II, without air entrainment.
C. Hydrated Lime: ASTM C207, Type S.
D. Mortar Aggregate: ASTM C144: sand.
E. Grout Aggregate: ASTM C404.
F. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
   1. Color(s): As selected by Architect from manufacturer's full range.
G. Water: Clean and potable.
H. Accelerating Admixture: Not permitted.
I. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
   1. Use only in combination with concrete masonry units manufactured with integral water repellent admixture.
   2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
   3. Meet or exceed performance specified for water repellent admixture used in masonry units.
      a. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
      b. Master Builders, Inc.; Rheopel
      c. Amerimix, an Oldcastle brand; AMX 410: www.amerimix.com.

2.06 MORTAR AND GROUT MIXES

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Mortar Type S: Minimum 1800 psi, for the following applications.
      a. Masonry below grade and in contact with earth.
      b. Exterior loadbearing masonry.
      c. Interior loadbearing masonry.
   2. Mortar Type N: One (1) part Portland Cement, one (1) part hydrated lime, and six (6) parts sand, for the following applications.
      a. Exterior non-loadbearing masonry.

b. Interior non-loadbearing masonry.

3. Colored Mortars
   a. Basis of Design Manufacturer: Spec Mix LLC, Minneapolis, MN.
   b. Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 of ACI 530.1/ASCE 6/TMS 602 and ACI 530/ASCE 5 for dimensions of grout spaces and pour height. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

D. Mixing: Use mechanical batch mixer and comply with referenced standards.

2.07 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
   1. Blok-Lok Limited: www.blok-lok.com.
   2. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com.
   3. WIRE-BONDwww.wirebond.com/#sle.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.

C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

D. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure. . Provide in lengths of not less than 10 feet (3 m),with prefabricated corner and tee units.

E. Multiple Wythe Joint Reinforcement: Truss type; fabricated with moisture drip; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure. Provide in lengths of not less than 10 feet (3 m),with prefabricated corner and tee units.

F. Adjustable Multiple Wythe Joint Reinforcement: Truss type with adjustable ties spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face. Provide in lengths of not less than 10 feet (3 m),with prefabricated corner and tee units.
   1. Vertical adjustment: Not less than 3-1/2 inches.

G. Flexible Anchors: 2-piece anchors that permit differential movement between masonry and building frame, sized to provide not less than 5/8 inch of mortar coverage from masonry face.

1. Steel frame: Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

H. Two-Piece Wall Ties: Formed steel wire, 0.1875 inch thick, adjustable, eye and pintle type, stainless steel, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face and to allow vertical adjustment of up to 1-1/4 in.

I. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, Stainless Steel Wire: ASTM A 580/A 580M, AISI Type 304 and / or Stainless Steel Sheet: ASTM A 167, A 240, or A 666, AISI Type 316..
   1. Anchor plates: Not less than .093 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
   2. Pintles: Trapezoidal, or rectangular shape shape, 0.1875 inch thick.
   3. Vertical adjustment: Not less than 2 inches.
   4. Manufacturers:
      a. HB-200-X anchor by Hohmann & Barnard, Inc.(/www.h-b.com)

2.08 FLASHINGS

A. See Section 076200 - Sheet Metal Flashing and Trim.

2.09 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding.

C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, duel level, trapezoidal shape and designed to prevent mortar droppings from clogging cavity weeps and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
      a. Manufacturers:
         1) Mortar Net Solutions; MortarNet with Insect Barrier: www.mortarnet.com.
      b. Locations: At flashing locations in brick veneer walls.

D. Cavity Weeps : Polyester mesh.
   1. Cavities with masonry thickness 6”<: Provide MTI, Stone Cavity Weep (SCV5012) or equivalent system that meets the following requirements:
      a. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations. a.
      b. Weep Legs: 2-1/4 inches (57 mm) wide at 9-1/2 inches (242 mm) on center.
      c. Continuous Belt Width: 1 inch (25 mm).
      d. . Overall Width: 12 inches (305 mm).
      e. Length: 25 feet (7.62 m).
      f. Squared - Channel Depth: 3/16 inch (4.76 mm).
      g. Color: Translucent.
      h. Performance Criteria:
         1) a. Fungi Resistance: No Growth; ASTM C 1338.
         2) Ultra-violet (UV) Exposure: No Cracking, checking, crazing, etc.

E. Steel Shelf Angles and Lintels: galvanized, see Section 05 12 00 - Structural Steel Framing and Section 05 50 00 - Metal Fabrications.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed

from 0.142inch (3.6mm) steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

2.10 SOURCE QUALITY CONTROL

A. Owner may engage a qualified independent testing agency to perform source quality-control testing indicated below. Payment for these services will be made by Owner.

B. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.

C. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 INSTALLATION - GENERAL

A. Comply with ACI 530.1/ASCE 6, ACI 530/ASCE 5, and other requirements indicated applicable to each type of installation included in Project.

B. Use full size units without cutting, if possible.

1. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges.
2. Allow units to dry before laying unless wetting of units is specified.
3. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets as they are placed.

D. Wetting of Brick:

1. Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67.
2. Allow units to absorb water so they are damp but not wet at time of laying.

E. Cover tops of all partially completed walls at end of day to protect completed work and prevent water from entering the cavity.

F. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.04 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.05 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
    1. Bond: Running.
    2. Coursing: One unit and one mortar joint to equal 8 inches.
    3. Mortar Joints: Concave.
D. Brick Units:
    1. Bond: Running.
    2. Coursing: Two units and two mortar joints to equal 8 inches.
    3. Mortar Joints: Concave.

3.06 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
B. Lay hollow masonry units with face shell bedding on head and bed joints.
C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
D. Remove excess mortar and mortar smears as work progresses.
E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
F. Interlock intersections and external corners.
G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Cut mortar joints flush where wall tile is scheduled, cement parging is required, or resilient base is scheduled. Use square outside corners where wall tile is scheduled or corner guards are shown. Use bullnose outside corners at typical outside CMU corner.
J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.07 WEEPS

A. Install weeps in veneer and cavity walls at 16 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
B. Place weeps directly on flashing.
C. Do not strike mortar across bottom of weep.
    1. If mortar is struck across weep, remove and replace weep.

3.08 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
C. Install cavity mortar diverter at base of cavity full width of air space and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.09 REINFORCEMENT AND ANCHORAGE - GENERAL, SINGLE WYTHE MASONRY, AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.
E. Reinforce joint corners and intersections with strap anchors 16 inches on center.
F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 16 inches horizontally and 16 inches vertically.

3.10 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

A. Install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.

3.11 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.12 REINFORCEMENT AND ANCHORAGES - MULTIPLE WYTHE UNIT MASONRY

A. Install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.
E. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
F. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 16 inches horizontally and 16 inches vertically.

3.13 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

1. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up flashing ends at least 1 inch, minimum, to form watertight pan at non-masonry construction.
2. Remove or cover protrusions or sharp edges that could puncture flashings.
3. Seal lapped ends with a minimum of two beads of continuous sealant from leading edge of horizontal surface across and up entire height of vertical/sloped surface. Seal penetrations of flashing before covering with mortar.
4. Fold flashing to create end dams at discontinuous ends. Turn up one course.
5. Seal penetrations of flashing materials at cast stone and other anchors with compatible sealant or mastic.

B. Terminate flashing up 8 inches minimum on vertical surface of backing:
   1. Install vertical leg of flashing behind water-resistive barrier over backing.
   2. Anchor vertical leg of flashing into backing with a termination bar and sealant.

C. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7.

D. Extend metal flashings flush with the exterior face of masonry. Install flashing in two beads of butyl joint sealer Type 3 below flashing to prevent moisture migration under flashing. Refer to Section 07 92 00 - Joint Sealants.

E. Support flexible flashings across gaps and openings.

F. Lap end joints of metal flashings at least 6 inches (152 mm) and seal watertight with Sealant Type 3.
   1. Refer to Sections 07 62 00 - Sheet Metal Flashing and Trim and 07 92 00 - Joint Sealants.

3.14 LINTELS

A. Refer to structural drawings for lintel requirements.

B. Install loose steel lintels over openings.

C. Maintain minimum 8 inch bearing on each side of opening.

3.15 GROUTED COMPONENTS

A. Reinforce bond beams as noted on the Contract Drawings.

B. Lap splices minimum 24 bar diameters.

C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

D. Place and consolidate grout fill without displacing reinforcing.

E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

F. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.16 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

C. Size control joints 3/8 inch wide and deep.

D. Form expansion joint as detailed on drawings.

3.17 BUILT-IN WORK

A. As work progresses, install built-in metal door frames, window frames, anchor bolts, plates, and louvers and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
    1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
D. Do not build into masonry construction organic materials that are subject to deterioration.

3.18 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.
B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.19 CUTTING AND FITTING

A. Cut and fit for chases, other items, pipes, other items, conduit, other items, sleeves, other items, grounds, other items, and other items. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.20 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.
C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.21 CLEANING

A. Remove excess mortar and mortar droppings.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with cleaning solution.
D. Use non-metallic tools in cleaning operations.

3.22 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 047200 – CAST STONE MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following Cast stone trim, sills and custom shapes, including:
   a. Copings (caps) at exterior retaining walls.
   b. Sills at exterior walls.

B. Related Sections include the following:

   1. Division 01, Section 017419 – Construction Waste Management.
   2. Division 04, Section "Unit Masonry".
   3. Division 07, Section "Sealants".

1.2 SUBMITTALS

A. Product Data: Include dimensions of individual components.

B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

C. Samples: For each color and texture of cast stone required, indicating full range of anticipated color and texture.

D. Qualification Data: For manufacturer.

E. Material Test Reports.

F. Sample Panels: Build sample panels, coordinate panel with Unit Masonry Sample Panel, to verify selections made under sample submittals and to demonstrate aesthetic effects. Locate mockup as directed by Architect with finish face to have southern exposure. Clean samples as recommended by product manufacturer. Protect during construction and do not remove until authorized by Architect.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of cast stone units similar to those indicated for this Project, with sufficient production capacity to manufacture required units.

   1. Manufacturer is a producing member of the Cast Stone Institute.
   2. Manufacturer is a producing member of the Architectural Precast Association.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store units on elevated platforms in a dry location, as recommended by manufacturer If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

PART 2 - PRODUCTS

2.1 CAST STONE UNITS

A. Basis-of-Design: Subject to compliance with requirements, and as indicated on drawings, provide units as manufactured by Reading Rock, Inc.; Architectural Cast Stone or comparable product by one of the following:
   1. Continental Cast Stone East
   2. Sun Precast Co., Inc.
   3. Products of Alternate Manufacturers will be considered upon formal submission to Architect. Refer to Division 1, "Substitutions" for process to obtain approval of other products.

B. Provide cast stone units complying with ASTM C 1364 using the vibrant dry tamp method.

   1. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges.
   2. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish.
   3. Provide units that are resistant to freezing and thawing as ermined by laboratory testing according to ASTM C 666, Procedure A, as modified by ASTM C 1364.
   4. Slope exposed horizontal surfaces 1:12, unless otherwise indicated.
   5. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
   6. Provide drips on projecting elements, unless otherwise indicated.
   7. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

C. Materials: Fabricate from following:

   1. Portland Cement: ASTM C 150, Type I, containing not more than 0.60 percent total alkali when tested according to ASTM C 114
   2. Coarse Aggregates shall be granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures and colors as needed to produce required cast stone colors. Fine Aggregates: shall be granite, natural sand or crushed stone complying with ASTM C 33, gradation as needed to produce required textures and colors as needed to produce required cast stone colors.
   3. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
   4. Admixtures: Do not use admixtures containing calcium chloride. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used. Air-Entraining Admixture: ASTM C 260. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

5. Cast-concrete members weighing over 35 kg (80 pounds) shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring.

D. Cure units by one of the following methods:

1. Cure units with steam in enclosed curing room at temperature of 105 deg F (41 deg C) or above and 95 to 100 percent relative humidity for 6 hours.
2. Cure units with dense fog and water spray in enclosed warm curing room at 95 to 100 percent relative humidity for 24 hours.
3. Cure units to comply with one of the following:

a. Not less than 5 days at mean daily temperature of 70 deg F (21 deg C) or above.
b. Not less than 6 days at mean daily temperature of 60 deg F (16 deg C) or above.
c. Not less than 7 days at mean daily temperature of 50 deg F (10 deg C) or above.
d. Not less than 8 days at mean daily temperature of 45 deg F (7 deg C) or above.

E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

F. Test Results (minimum) for Cast Stone Modular Units:

1. Compressive Strength, ASTM C140: 3200-5000 psi at 28 days
2. Absorption, ASTM C140: Less that 6% at 28 days
3. Linear Shrinkage, ASTM C426: Less than .05%
4. Density, ASTM C140: Greater than 100 lbs. per cubic inch
5. Freeze-Thaw, ASTM C 666: Less than 4%

G. Test Results (minimum) for Cast Stone Sills And Custom Profiles:

1. Compressive Strength, ASTM C1194: 6500 psi at 28 days
2. Absorption, ASTM C1195: Less that 6% at 28 days
3. Linear Shrinkage, ASTM C426: Less than .05%
4. Density, ASTM C140: Greater than 120 lbs. per cubic inch
5. Freeze-Thaw, ASTM C 666: Less than 4%

H. Size and configuration: Refer to drawings. Where units exceed 48” in length, provide minimum number of multiple pieces of equal length to suit condition.

I. Colors and Textures: As selected by Architect from manufacturer's full range.

2.2 REINFORCEMENT

A. Deformed steel bars complying with ASTM A 615/A 615M. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches (38 mm) of cast stone material.

B. Coating to be either Epoxy Coating per ASTM A 775/A 775M or Galvanized Coating per ASTM A 767/A 767M.

C. Recycled Content: 90% combined

2.3 ACCESSORIES

A. Embedded Anchors, Dowels and Other Inserts: Type 304 stainless steel

B. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner complying with requirements in Division 4 Section "Unit Masonry Assemblies" and approved for intended use by cast stone manufacturer and approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

2.4 MORTAR

A. Comply with requirements in Division 4 Section "Unit Masonry Assemblies" for mortar materials, mixes and latex additive.

1. For setting mortar, use Type N.
2. For pointing mortar, use Type N.
3. Pigmented Mortar: Use colored cement product.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 20 00.

C. Mechanically anchor cast stone units indicated; set remainder in mortar.

D. Setting:
1. Drench cast stone components with clear, running water immediately before installation.
2. Set units in a full bed of mortar unless otherwise indicated.
3. Fill vertical joints with mortar.
4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.3 TOLERANCES

A. Joints: Make all joints 3/8 inch, except as otherwise detailed.
1. Rake mortar joints 3/4 inch for pointing.
2. Remove excess mortar from face of stone before pointing joints.

3. Point joints with mortar in layers 3/8 inch thick and tool to a slight concave profile.

B. Leave the following joints open for sealant:
1. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
2. Joints in projecting units.
3. Joints between rigidly anchored units, including soffits, panels, and column covers.
4. Joints below lugged sills and stair treads.
5. Joints below ledge and relieving angles.
6. Joints labeled "expansion joint".

C. Installation Tolerances:
1. Variation from Plumb: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet or more.
2. Variation from Level: Not more than 1/8 inch in 10 feet or 1/4 inch in 20 feet, or 3/8 inch maximum.
3. Variation in Joint Width: Not more than 1/8 inch in 36 inches or 1/4 of nominal joint width, whichever is less.
4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4 REPAIR

A. Repairs: Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.
1. Repair with matching touchup material provided by the manufacturer and in accordance with manufacturer's instructions.
2. Repair methods and results subject to Architect 's approval.

3.5 CLEANING

A. Clean completed exposed cast stone after mortar is thoroughly set and cured.
1. Wet surfaces with water before applying cleaner.
2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
3. Remove cleaner promptly by rinsing thoroughly with clear water.
4. Do not use acidic cleaners.

3.6 PROTECTION

A. Protect completed work from damage.

B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION 047200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches (38 mm).
2. Welded built-up members with plates thicker than 2 inches (50 mm).
3. Column base plates thicker than 2 inches (50 mm).

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

D. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD**.** If the fabricator does not have the AISC certification they can still bid the project but they are responsible to have a third party inspector inspect the fabrication process to ensure they are meeting AISC guidelines.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector. If the erector does not have the AISC certification they can still bid the project but must be in compliance with Chapter N of AISC’s Specification indicating quality control requirements.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.

2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of moment frame and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:

1. W-Shapes: 60 percent.
2. Channels, Angles, M , S-Shapes: 60 percent.
3. Plate and Bar: 25 percent.
4. Cold-Formed Hollow Structural Sections: 25 percent.
5. Steel Pipe: 25 percent.
6. All Other Steel Materials: 25 percent.

C. W-Shapes: As Indicated.

D. Channels, Angles, M , S-Shapes: As Indicated.

E. Plate and Bar: As Indicated.

F. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: As Indicated.

G. Cold-Formed Hollow Structural Sections: As Indicated.

H. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

I. Steel Pipe: As Indicated.

1. Weight Class: Standard.
2. Finish: Black except where indicated to be galvanized.

J. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

K. Steel Forgings: ASTM A 668/A 668M.

L. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: As Indicated.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Plain.

G. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-]hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Plain.

H. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

K. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.4 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting.", Section 099600 "High-Performance Coatings.".

C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

D. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.

5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.

4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Pretensioned.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.

d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
4. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
5. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

D. Evaluation Reports: For steel deck.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.

D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Epic Metals Corporation.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Verco Manufacturing Co.
9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

   a. Color: Manufacturer's standard.

2. Deck Profile: As indicated.
3. Cellular Deck Profile: As indicated, with bottom plate.

4. Profile Depth: As indicated.

5. Design Uncoated-Steel Thickness: As indicated.

6. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.

7. Span Condition: Triple span or more.

8. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Profiles, Inc.; a Blue Scope Steel company.
2. Canam United States; Canam Group Inc.
3. CMC Joist & Deck.
4. Consolidated Systems, Inc.; Metal Dek Group.
5. Epic Metals Corporation.
6. New Millennium Building Systems, LLC.
7. Nucor Corp.; Vulcraft Group.
8. Verco Manufacturing Co.
9. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 (230) minimum, with top surface phosphatized and unpainted and underside surface shop primed with manufacturers' standard gray or white baked-on, rust-inhibitive primer.

2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230),G60 (Z180) zinc coating.

3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray or white baked-on, rust-inhibitive primer.

4. Profile Depth: As indicated.

5. Design Uncoated-Steel Thickness: As Indicated.

6. Span Condition: Triple span or more.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile indicated and recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and sloped recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: ASTM A 780.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal.

2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.

3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches (457 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.

3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches (305 mm) apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

G. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified.

3.4 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8 inch (16 mm), nominal.

2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches (305 mm) apart, but not more than 18 inches (457 mm) apart.
3. Weld Spacing: Space and locate welds as indicated.

4. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (914 mm), and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Install piercing hanger tabs at 14 inches (355 mm) apart in both directions, within 9 inches (228 mm) of walls at ends, and not more than 12 inches (305 mm) from walls at sides unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Exterior non-load-bearing wall framing.
2. Ceiling joist framing.
3. Soffit framing.

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 054000

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Division 01, Section 017419 – Construction Waste Management.

1.2 SUMMARY

A. Section Includes:
1. Steel framing and supports for countertops.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" and “Architectural Concrete” for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Division 05 Section "Structural Steel Framing."
4. Division 05 Section "Pipe and Tube Railings."

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Samples for Verification: For each type and finish of extruded nosing and tread.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For qualified professional engineer.

F. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

G. Welding certificates.

H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

E. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

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. IKG Industries, a division of Harsco Corporation; Mebac.
b. SlipNOT Metal Safety Flooring, a W. S. Molnar company; SlipNOT.
c. Approved equal.

F. Steel Tubing: ASTM A 500, cold-formed steel tubing.

G. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 (Z275) coating; 0.108-inch (2.8-mm) nominal thickness.

I. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

E. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

F. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).

G. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.

I. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

G. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).

H. Wood Screws: Flat head, ASME B18.6.1.

I. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

J. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

K. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

L. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

M. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594.

N. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with

temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 09 painting Sections.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

3. Provide bearing plates welded to beams where indicated.
4. Drill or punch girders and plates for field-bolted connections where indicated.

5. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches (600 mm) o.c.

C. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

1. Unless otherwise indicated, fabricate from Schedule 40 steel pipe.
2. Unless otherwise indicated, provide 1/2-inch (12.7-mm) baseplates with four 5/8-inch (16-mm) anchor bolts and 1/4-inch (6.4-mm) top plates.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with zinc-rich primer.

2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm) unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.10 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.12 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.13 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel pipe railings.
2. Stainless-steel pipe railings
3. Stainless-steel foot rail

B. Related Sections:
1. Section 055000 “Metal Fabrication”
2. Section 057313 “Glazed Decorative Metal Railings”
3. Section 061053 "Miscellaneous Carpentry" for wood blocking for anchoring railings.
4. Section 092216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.
2. Stainless Steel: 60 percent of minimum yield strength.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout & anchoring cement

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Steel Pipe and Tube Railings:

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) Pisor Industries, Inc.
2) Wagner, R & B, Inc.; a division of the Wagner Companies.
3) Greco Architectural Metal Products

2. Stainless Steel Footrail:
   a. Basis-of-Design Product: Subject to compliance with requirements, provide Lavi Industries; Footrail components or comparable product by one of the following:

   b. (Basis of Design) Lavi Industries Footrail Components:
      1) 1.5” Satin Stainless Steel Tube - #T9FB1191765

2) Satin Stainless Steel Flush End Post - #T9FB1191518
3) Satin Stainless Steel Flush Center Post - #T9FB1191694

c. Krowne Metal Corporation
d. Lawrence Metal Products

3. Note: Refer to drawings for overall railing dimensions and requirements.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20

D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

E. Expanded Metal: ASTM F 1267, Type II (expanded and flattened), Class 3 (corrosion-resistant steel), made from stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, Type 304.

2.4 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit

masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material Where Stainless Steel is Indicated: Alloy Group 1 **(A1)**stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage**,** but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

F. Connections: Fabricate railings with welded connections unless otherwise indicated.

G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

H. Form changes in direction as follows:

1. By bending or by inserting prefabricated elbow fittings.

I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of railing members with prefabricated end fittings.

K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

N. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Dull Satin Finish: No. 6.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic

grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

D. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

E. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

C. Attach railings to wall with wall brackets**,** except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09, Section "Painting"

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 055800 - DECORATIVE COLUMN COVERS

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. Column covers.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Decorative formed metal items, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components:

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative formed metal.

   1. Include plans, elevations, component details, and attachments to other work.
   2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples for Initial Selection: For products involving selection of color, texture, or design. Standard sample size is 5”x7”.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.

B. Qualification Data: For qualified Installer and fabricator. Manufacturer shall have a minimum of 5 years experience in manufacturing architectural metals.

C. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

D. Welding certificates.

1.6 CLOSEOUT SUBMITTALS

A. Installer Qualifications: Fabricator of products.

B. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store in a location to avoid damage from job-site traffic, direct sunlight, moisture, stacking or other job-site contaminates. Handle components to avoid denting or scratching.

1.8 WARRANTY

A. Provide manufacturer’s warranty against defects in material and workmanship for a period of 1 year.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 COORDINATION

A. Coordinate installation of anchorages for decorative formed metal items. 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.

B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes.

PART 2 - PRODUCTS

2.1 COLUMN COVERS

A. **Manufacturers:** Subject to compliance with requirements, acceptable products include column covers manufactured by:
1. Fry Reglet Corp.
2. Móz Designs, Inc.
3. Firestone Building Products

B. Substitutions: See 016000 Materials and Equipment.

C. **Basis of Design Products:** Fry Reglet Corp. Key Slot "KS" Series
1. Material:
a. Stainless Steel: Type 304, Complying with ASTM A789
b. Thickness: 14 ga
c. Finish: As selected by Architect from manufacturer's full range of options.
2. Manufactured Parts:
a. Full Round, Quantity of Sections as shown in Drawings.
b. Horizontal Joints:
1) Max Horizontal Joint Height at 12'. Refer to Drawings for Joint Dimension.
2) Provide EX Extruded Reveal Track ¾"
3) Note: Gap required at top of Column Cover for Installation
c. Height: Refer to Drawings for Dimensions.
d. Vertical Joints:
1) Soft V Butt Joints
e. Options:
1) Recessed Base (RB) 6" Brushed Stainless Steel
3. At each Column Cover, provide Fry Reglet Corp. Reveal Wall Angle Column Ring for acoustical or gypsum board ceilings as required.
a. Reveal ¾" x ¾"
b. Application: Drywall or Acoustic Ceiling as noted on RCP. Coordinate as Necessary.
c. Finish: As selected by Architect from Manufacturers full range of options.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior decorative formed metal items soundproof or lightproof as applicable to type of fabrication indicated.

E. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

F. Install decorative-formed-metal-clad doors and frames to comply with requirements specified in Section 081113 "Hollow Metal Doors and Frames."

G. Apply joint treatment at joints of spackled-seam-type metal column covers. Comply with requirements in Section 092900 "Gypsum Board."

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 055800

SECTION 05 73 13 – GLAZED DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior post-supported railing and guard systems with glass infill panels.
2. Illuminated railings.
3. Fasteners.
4. Miscellaneous materials.

B. Related Requirements:

1. Section 055213 “Pipe and Tube Railings" for decorative metal railing and guard systems with non-glass-infill panels.
2. Section 061053 "Miscellaneous Carpentry" for wood blocking for anchoring railings.

1.2 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor and exterior deck areas and for pedestrian guidance and support, visual separation, or wall protection.

1.3 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not meet structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of glazed decorative metal railings assembled from standard components.
2. Glass products.
3. Illuminated railings.
4. Fasteners.
5. Post-installed anchors

6. Handrail brackets.
7. Nonshrink, nonmetallic grout.
8. Anchoring cement.
9. Metal finishes.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

1. For illuminated railings, include wiring diagrams and roughing-in details.

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Each type of glass and glass edge required.
3. Illuminated railing.
4. Fittings, end caps, and brackets.
5. Assembled Sample of railing systems, made from full-size components, including **top rail**, post, **illuminated** handrail, and glass infill panels. Show method of finishing members at intersections. Sample need not be full height.

E. Delegated Design Calculations: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **delegated design professional engineer** & **manufacturer-certified Installer**.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: The manufacturer of railing system or a qualified installation firm that is approved, authorized, or licensed by railing system manufacturer to install manufacturer's products.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups as **cut-down assembly**.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Glazed decorative metal railing manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: **Five** year**s** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain glazed decorative metal railing systems from single source from single manufacturer. Systems must be designed, engineered, and fabricated by manufacturer of railing system.

2.2 MANUFACTURERS

A. Glazed Decorative Metal Railings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide VIVA Railings, LLC; **CIRCA** Railing System or comparable product by one of the following:

a. C.R. Lawrence (CRL)

b. Hollaender Architectural Railing Systems

c. Greco Architectural Metal Products

2. Illuminated toprail: basis of design: VIVA Railings, LLC; iRAIL **Linear Pods** illuminated handrail or comparable product by one of the following:

a. C.R. Lawrence (CRL)

b. Hollaender Architectural Railing Systems

c. Greco Architectural Metal Products

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. See Section 016000 "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.3 PERFORMANCE REQUIREMENTS

A. General: For engineering glazed decorative metal railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Stainless Steel: 45 percent of minimum yield strength.
2. Steel: 72 percent of minimum yield strength.

B. Structural Performance: Glazed decorative metal railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails

a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Glass Infill Panels:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

C. Illumination

a. General: Comply with requirements in this Section for metal railings with welded connections.
b. Illuminated Units: Provide internally wired **1-1/2-inch- (38-mm-) diameter stainless steel** rail with integral LED light fixture system to illuminate walking surfaces adjacent to railings without light leaks. Make provisions for servicing and for concealed connection to electric service. Coordinate electrical characteristics with power supply provided.
1) Light Color: Warm white; 3000 K.
2) IP Rating: IP67.
3) Light Output: **250 lumens/ft.**
4) Beam Angle: 120 degrees.
5) Orientation: **Symmetrical**.
6) LED Lens: **Frosted**.
7) CRI: Less than 90.
8) Power Supply: **120 V**ac input, 12 V dc output.

2.4 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

1. Provide stainless steel wall brackets with flange tapped for concealed anchorage with vertical and horizontal adjustment capability.

2.5 STAINLESS STEEL

A. Tubing: ASTM A554, **Grade MT 304**.

B. Castings: ASTM A743/A743M, **Grade CF 8 or Grade CF 20**

C. Sheet, Strip, Plate, and Flat Bar: ASTM A666 or ASTM A240/A240M, **Type 304**.

D. Bars and Shapes: ASTM A276, **Type 304**.

2.6 STEEL

A. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

2.7 GLASS AND GLAZING PRODUCTS, GENERAL

A. Glazing Publications: Comply with written instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA/GANA Publications: "GANA Glazing Manual."

B. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Class 1 and low-iron clear, or Class 2 (tinted) as indicated, Quality-Q3.

2.8 GLASS INFILL PANELS

A. Tempered Glass: Provide products that have been tested for surface and edge compression in accordance with ASTM C1048 and for impact strength in accordance with 16 CFR 1201 for Category II materials.

1. Glass Color: **Clear**.

2. Thickness for Glass Infill Panels: As required by structural loads, but not less than **0.51 inch (13 mm)**.
3. Glass Thickness: As indicated on Drawings.

B. Dry-Set Continuous Compression Mounting Accessories for Glass Infill Panels: As supplied by railing manufacturer for installing glass panels within railing system.

2.9 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. For Stainless Steel Components: **Type 304** stainless steel fasteners.
2. For Dissimilar Metals: **Type 304** stainless steel fasteners.
3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless **exposed fasteners are the standard fastening method for railings indicated**.

1. Provide hex, hex socket, or hex button machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/ASTM F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.10 MISCELLANEOUS MATERIALS

A. Handrail Brackets: Stainless steel with center of rail **2-1/2 inches** from face of structural glass balusters.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.11 FABRICATION

A. General: Fabricate glazed decorative metal railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

B. Shop assemble railings and guards to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

H. Form changes in direction as follows:
1. **By flush bends or by inserting prefabricated flush-elbow fittings**.

I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.

L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

M. For railing posts set in concrete, provide **stainless steel** sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.12 FABRICATION OF GLASS INFILL PANELS

A. Fabricate glass to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

B. Glass Infill Panels: Provide **tempered** glass infill panels

1. Edge Finish: **Clean-cut or flat-grind edges to produce smooth, square edges with slight chamfers at junctions of edges and faces**.

2.13 METAL FINISH REQUIREMENTS, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.14 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Stainless Steel Finishes

1. Dull Satin Finish: ASTM A480/A480M, No. 6.

2.15 STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: **As selected by Architect from manufacturer's full range**.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installation Tolerances: Structural steel and concrete slabs to be within 1/8 inch (3 mm) in 10 ft. (3.048 m) horizontally and 1/8 inch (3 mm) vertically. Correct out-of-tolerance conditions to meet railing manufacturer's requirements.

3.2 INSTALLATION, GENERAL

A. Comply with Drawings and manufacturer's written instructions for installing glazed decorative metal railings, accessories, and other components.

B. Perform cutting, drilling, and fitting required for installing metal railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of metal railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 ft. (2 mm in 1 m).
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 ft. (5 mm in 3 m).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 METAL RAILING CONNECTIONS

A. Nonwelded Connections:

1. Use mechanical or adhesive joints for permanently connecting railing components.
2. Use wood blocks and padding to prevent damage to railing members and fittings.
3. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

3.4 ANCHORING METAL POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted in sleeves, fill annular space between post and sleeve with **anchoring cement**, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, **attached to post with setscrews**.

C. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

3.5 INSTALLATION OF GLASS INFILL PANELS

A. Post-Supported Railings and Guards with Glass Infill Panels:

1. Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles.
2. Erect posts and other metal railing components, and set factory-cut glass infill panels.
3. Do not cut, drill, or alter glass infill panels in field. Protect edges from damage.

3.6 FIELD QUALITY CONTROL

A. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

B. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.7 CLEANING

A. Clean decorative metal finishes by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

C. Clean wood rails by wiping with a damp cloth and then wiping dry.

3.8 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057313

SECTION 06 10 53 - MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Window Stools
2. Painted standing and running trim
3. Interior frames and jambs (painted)
4. Shelving and support brackets
5. Interior wood blocking and nailers.
6. Blocking for cants, and nailers
7. Wood furring sleepers, and grounds.

B. Blocking shall be provided, but not limited to, at the following locations
1. Casework and shelving.
2. Tackboards and marker boards
3. Wall mounted door hardware
4. Fire Extinguisher Cabinets
5. Toilet accessories
6. Wall mounted equipment
7. As noted on drawings

C. Related Sections include the following:
1. Division 6 Section "Interior Architectural Woodwork."

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 QUALITY ASSURANCE

A. Fabricator/Installer: A firm which has successfully produced work similar to the quality specified and in the quantity shown for a period of not less than 5 years.

B. Reference Standards: Comply with the applicable provisions for grading and workmanship of the "Architectural Woodwork Quality Standards", Version 2.0 (2005), published by the Architectural Woodwork Institute (AWI) (herein referred to as Standards), except as otherwise specified.

C. Structural Performance: Design, manufacture and install handrails to resist a 200 pound concentrated force applied in any direction at any point and a uniform force of 50 pounds per linear foot applied in any direction without distortion or failure.

1.5 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency

certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS (FRTW)

A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).

1. Use treatment that does not promote corrosion of metal fasteners.
2. Use Exterior type for exterior locations and where indicated.
3. Use Interior Type A, for interior locations unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings, and the following:
1. Concealed blocking.
2. Plywood backing panels.
3. Plywood Sheathing complying with C31 and C27.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Furring.
5. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Quality Standard: Comply with AWI Section 300.

B. Grade: Custom.
1. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.
2. Assemble casings in plant except where limitations of access to place of installation require field assembly.
3. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

C. Wood Species: Any closed-grain hardwood..

2.6 Window Stools for opaque finish: Painted hardwood unless noted otherwise.

2.7 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated.
   1. Provide ½" thick, 48"x96" panel in each telephone, data, and electrical room or closet.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

   1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1)

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

   1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Separator sheet: 15# Building felt or 15 mil “underslab” vapor barrier.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

C. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

D. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

F. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved. Secure all pressure treated lumber with stainless steel or epoxy coated anchorage.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide separator sheet between all pressure treated wood blocking and metal deck, steel studs, copings, curbs, and other steel or aluminum components.

3.3 STOOLS

A. Scribe window stools to fit. Cope and return bullnose at sides and ends. Back prime prior to installation

B. Fasten to blocking with countersunk fasteners. Plug and finish flush prior to field painting.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.

B. Related Requirements:

1. Section 061053 "Miscellaneous Carpentry"
2. Section 076262 "Fluid Applied Membrane Air Barrier" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:
1. Air-barrier and water-resistant glass-mat gypsum sheathing

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from **UL's "Fire Resistance Directory."**

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

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. CertainTeed Corporation; GlasRoc.
b. G-P Gypsum Corporation; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond e(2)XP.
d. Temple-Inland Inc.; GreenGlass
e. United States Gypsum Co.; Securock.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
3. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. **Do not bridge building expansion joints**; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
   3. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

   1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

   1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

END OF SECTION 061600

SECTION 06 41 16 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets. (PL)
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.
3. Solid Surface Countertops (SS)
4. Cabinet hardware and accessories.

B. Related Requirements:

1. Section 061053 "Miscellaneous Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including high-pressure decorative laminate, solid surface, and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
4. Submit fully dimensioned shop drawings showing countertop [and window sill] layouts, joinery, terminating conditions, substrate construction, cutouts and holes. Show plumbing installation provisions. Include elevations, section details, and large scale details.

C. Samples:

1. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.

2. Countertop material, 6 by 6 inches (150 by 150 mm).
3. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of product.

1. Composite wood and agrifiber products.
2. High-pressure decorative laminate.
3. Adhesives.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

D. Maintenance Data: Submit manufacturer's published maintenance manual with closeout submittals.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers Quality Standard.

C. Quality Standard: Unless otherwise indicated, comply with WI's "Manual of Millwork" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide WI-certified compliance labels indicating that woodwork complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.

D. Testing Agency Qualifications: If required, for testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

1.9 WARRANTY

A. Manufacturer’s Limited Warranty: Provide manufacturer’s standard 10 Year Commercial Limited Warranty against defects in solid surface sheet materials.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE CABINETS – PL-1

A. Basis-of-Design Product: Wilsonart International; Div. of Premark International, Inc. Decorative Plastic Laminate. Subject to compliance with basis of design specifications and design (color, pattern, texture) shown on drawings, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. Abet Laminati Inc
2. Formica Corporation.
3. Lamin-Art, Inc.d.Pionite; a Panolam Industries International, Inc. brand.

B. Grade: Premium.

C. AWI Type of Cabinet Construction: Flush overlay.

D. WI Construction Style: Style A, Frameless.

E. WI Construction Type: Type I, multiple self-supporting units rigidly joined together.

F. WI Door and Drawer Front Style: Flush overlay.

G. Reveal Dimension: As indicated.

H. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: PVC edge banding,0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.

I. Materials for Semi exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.

b. For semi exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels.
3. Drawer Bottoms: Thermoset decorative panels.

J. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces as indicated on Finishes Legend.

L. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

M. Laminate Properties:

Laminate Composition: Decorative surface papers impregnated with melamine resins and pressed over kraft paper core sheets impregnated with phenolic resin. Sheets then bonded together under pressures greater than 1,000 lbs. per sq. in. and high temperatures approaching 300 deg F (149 deg C). Finished sheets trimmed and backs sanded to facilitate bonding to substrate.

1. Surface Burning Characteristics:

a. Test Standards: ASTM E 84, ASTM E 162, ASTM E 662, IMO FTP Code Part 2 and Part 5, and UL 723.
Interior Finish Classification, Fire-Rated Laminate: Class A according to NFPA 101. Flame spread less than 25 and Smoke Developed less than 450.

2. Vertical Surface Laminate Product: “Wilsonart” Type 355

a. Sheet Thickness: 0.028 inch nominal.
b. Laminate Conformance Standard: ISO 4586, Grades VGS and VGP
c. Color, Pattern, and Finish: As indicated in Finish Schedule.

2.2 SOLID SURFACE – SS-1-3

A. Composition Solid-Surface Material: Acrylic resins, fire-retardant mineral fillers, and proprietary coloring agents. Through-the-body color for full thickness of sheet material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Wilsonart LLC, Solid Surface. Subject to compliance with basis of design specifications, and design intent, including color and texture noted on the finish schedule include, but are not limited to:

a. Affinity Surfaces; a brand of Domain Industries, Inc.
b. Avonite Surfaces.
c. E. I. du Pont de Nemours and Company.
d. Formica Corporation.
e. LG Chemical, Ltd.
f. Meganite Inc.
g. Samsung Chemical USA, Inc.
h. Swan Corporation (The).
i. Transolid Div of Trumbull Industries.

B. Material Thickness: : 1/2 inch, nominal.

C. Conformance Standards:

1. UL 2818:

   a. GREENGUARD-Emission levels in UL 2818, Section 7.1 are applicable for furniture products.
   b. GREENGUARD Gold-Emission levels in UL 2818, Section7.2 are applicable for building materials, finishes, and furnishings.

D. Physical Characteristics:

1. Tensile Strength: 6800 psi; ASTM D 638.
2. Tensile Modulus: 1.5 x 106 psi; ASTM D 638.
3. Tensile Elongation: 0.4 percent minimum; ASTM D 638.
4. Flexural Strength: 10,000 psi; ASTM D 790.
5. Flexural Modulus: 1.5 x 106 psi; ASTM D 790.
6. Thermal Expansion Coefficient: 1.37 x 105 in./in.oF; ASTM D 696.
7. Hardness (Barcol Impressor): 55-62; ASTM D 2583.
8. Impact Resistance: 144 in. drop with no fracture; NEMA LD-3, Method 3.8.
9. Izod Impact: 0.28 (ft-lb.)/in.; ASTM D 256, Method A.
10. Light Resistance - Xenon: No effect; NEMA LD-3, Method 3.3.
11. Stain Resistance: Pass; ANSI Z 124.3, modified.
12. Wear and Cleanability: Pass; ANSI Z 124.3.
13. Fungi Resistance: Pass; ASTM G 21.
14. Bacterial Resistance: Pass; ASTM G 22.
15. Boiling Water Resistance: No effect; NEMA LD-3, Method 3.5.
16. High Temperature Resistance: No effect; NEMA LD-3, Method 3.6.
17. Weatherability: Delta E less than 5; ASTM G 155.
18. Moisture Absorption: Less than 0.25 percent; ASTM D 570, long term.
19. Specific Gravity: 1.7 gram/cm3; ASTM D 792.
20. Weight: 4.4 lb./ft2.
21. Surface Burning Characteristics: Class I and Class A; ASTM E 84.

E. Color, Pattern, and Finish Design: Provide materials and products that result in colors and textures of exposed laminate surfaces as indicated on Finishes Legend.

F. Edge Detail: V-Grooved Edge.

G. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Fabricate tops with shop-applied backsplashes.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.

2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

3. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Environ Biocomposites Manufacturing LLC; Biofiber Wheat.
2) Sorm Incorporated; Primeboard Premium Wheat.

4. Softwood Plywood: DOC PS 1, medium-density overlay.

5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)."

B. Butt Hinges: 2-3/4-inch (70-mm), 5-knuckle steel hinges made from 0.095-inch (2.4-mm) thick metal, and as follows:
1. Semi-concealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches (102 mm) long, 1-1/4 inches (32 mm) deep, and 5/16 inch (8 mm) in diameter.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

G. Drawer Slides: BHMA A156.9, B05091.

1. Standard Duty: Grade 1, side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel ball bearing.
2. Heavy Duty: Grade 1HD-100, side mounted; full extension type; zinc-plated ball bearing.
3. Box Drawer Slides: Grade 1; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
4. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
5. Pencil Drawer Slides: Grade 2 for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.
6. Keyboard Slides: Standard Duty, Grade 1; for computer keyboard shelves.

H. Door and Drawer Locks: BHMA A156.11, E07121.

I. Grommets for Cable Passage through Countertops: 1-3/4 inches (45-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage. Color to be selected by architect from manufacturer's full range of colors.

1. Product: Subject to compliance with requirements, provide "**SG** series" by Doug Mockett & Company, Inc.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

L. Millwork Channel with Return Keys:

1. Basis of Design: Subject to compliance with requirements, provide Fry Reglet - Millwork Channel with Return Keys. Subject to compliance with basis of design specifications, and design intent, or approved equivalent.
2. Characteristics:
   a. Description: Provides a straight, uniform reveal vertically between panels.
   b. Material: Extruded Aluminum.
   c. Dimensions: Coordinate with wall panel construction. Refer to sections.
   d. Color: Architect to select from manufacturer's full range of colors.

M. LED Millwork U Channel:
1. Basis of Design: Subject to compliance with requirements, provide Fry Reglet – LED Millwork U Channel. Subject to compliance with basis of design specifications, and design intent, or approved equivalent.
2. Characteristics:
   a. Description: Creates a lighted horizontal or vertical recessed reveal in millwork applications.
   b. Material: Clear anodized extruded aluminum
   c. Lengths: Refer to plans, elevations and sections.

d. Width: ½”
e. Color: Architect to select from manufacturer’s full range of colors.
f. LED Tape:
   1) Variable White – 10mm
g. Light wattage/ft:
   1) Variable White – 2.5 wt/ft
h. Kelvin Temperature Specify:
   1) Variable White – 2700-5500
i. Driver:
   1) Variable White – DRV-UNV242V2CH, Constant Voltage 24V DC 110-277 VAC Input, 96W Output – Class 2 – 2 Channel DMX dimming module

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate cabinets to dimensions, profiles, and details indicated.

C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.

2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk, and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.

3.3 Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood framing, blocking, or hanging strips.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi exposed surfaces.

END OF SECTION

SECTION 070150.19 - PREPARATION FOR REROOFING

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. Full tear-off **of entire roof**
2. Removal of base flashings.
3. Temporary roofing.

B. Related Requirements:

1. Section 011000 "Summary" for use of the premises and phasing requirements.
2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

B. Roof Re-Cover Preparation: Existing roofing system is to remain and be prepared for new roof installed over it.

C. Full Roof Tear-Off: Removal of existing roofing system from **deck**.

D. Partial Roof Tear-Off: Removal of selected components and accessories from existing roofing system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, sections, and details.

C. Temporary Roofing Submittal: Product data and description of temporary roofing system. If temporary roof remains in place, include surface preparation requirements needed to receive permanent roof, and submit a letter from roofing manufacturer, stating acceptance of the temporary roof and that its inclusion does not adversely affect the roofing system's resistance to fire and wind **or its FM Global rating**.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Include certificate that Installer is approved by warrantor of existing roofing system.
2. Include certificate that Installer is licensed to perform asbestos abatement.

B. Fastener pull-out test report.

C. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

D. Landfill Records: Indicate receipt and acceptance of **demolished roofing materials and** hazardous wastes, such as asbestos-containing materials, by a landfill facility licensed to accept them.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Approved installer by manufacturer with experience successfully performing work of similar size & scope.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Reroofing Conference: Conduct conference at **Project site**.

1. Meet with Owner; Architect; Owner's insurer if applicable; testing and inspecting agency representative; roofing system manufacturer's representative; roofing Installer, including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing, including installers of roof deck, roof accessories, and roof-mounted equipment.

2. Review methods and procedures related to roofing system tear-off and replacement, including, but not limited to, the following:

a. Reroofing preparation, including roofing system manufacturer's written instructions.
b. Temporary protection requirements for existing roofing system components that are to remain.
c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
e. Existing roof deck conditions requiring notification of Architect.
f. Structural loading limitations of roof deck during reroofing.
g. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing..

h. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
i. Governing regulations and requirements for insurance and certificates if applicable.
j. Existing conditions that may require notification of Architect before proceeding.

1.7 FIELD CONDITIONS

A. Existing Roofing System: **APP-modified bituminous protected membrane** roofing. Verify exact roofing system in field

B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

D. Conditions existing at time of inspection for bidding are maintained by Owner as far as practical.

1. Construction Drawings for existing roofing system are provided for Contractor's convenience and information, but are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.

E. Limit construction loads on roof to loads as noted by MEP Engineer for rooftop equipment wheel loads and for uniformly distributed loads.

F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

G. Hazardous Materials: It is not expected that hazardous materials, such as asbestos-containing materials, will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work. Existing roof will be left no less watertight than before removal.

2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

H. Hazardous Materials: 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 according to procedures specified elsewhere in the Contract Documents.

3. Coordinate reroofing preparation with hazardous material remediation to prevent water from entering existing roofing system or building.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty. Notify warrantor before proceeding.

1. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

A. Expanded Polystyrene (EPS) Insulation: ASTM C 578.

B. Plywood: DOC PS1, Grade CD Exposure 1.

C. OSB: DOC PS2, Exposure 1.

2.2 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shut off rooftop utilities and service piping before beginning the Work.

B. Test existing roof drains to verify that they are not blocked or restricted. Immediately notify Architect of any blockages or restrictions.

C. Protect existing roofing system that is not to be reroofed.

1. Limit traffic and material storage to areas of existing roofing that have been protected.
2. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.

D. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

E. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

F. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

1. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

A. General: Notify Owner each day of extent of roof tear-off proposed for that day.

B. Remove ballast, protection mat, and extruded-polystyrene insulation from protected roofing membrane.

C. Full Roof Tear-Off: **Remove** existing roofing and other roofing system components down to the **deck**.

1. Remove **substrate board**, **roof insulation and cover board**.
2. Remove wood blocking, curbs, and nailers.
3. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen, unadhered felts, and wet felts.

4. Remove excess asphalt from steel deck. A maximum of 15 lb/100 sq. ft. (0.72 kg/sq. m) of asphalt is permitted to remain on steel decks.

5. Remove fasteners from deck **or cut fasteners off slightly above deck surface**.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect. Do not proceed with installation until directed by Architect.

C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect. Do not proceed with installation until directed by Architect.

D. Provide additional deck securement as indicated on Drawings.

3.4 INFILL MATERIALS INSTALLATION

A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.

B. Install new roofing patch over roof infill area. If new roofing is installed the same day tear-off is made, roofing patch is not required.

3.5 TEMPORARY ROOFING

A. Install approved temporary roofing over area to be reroofed.

B. Install temporary roofing over area to be reroofed. [**Mechanically fasten base sheet and install a glass-fiber felt**, lapping each sheet 19 inches (483 mm) over preceding sheet. Embed glass-fiber felt in a solid mopping of hot roofing asphalt applied within equiviscous temperature range. Glaze-coat completed surface with hot roofing asphalt.

C. Remove temporary roofing before installing new roofing.

D. Prepare temporary roof to receive new roofing **according to approved temporary roofing proposal**. Restore temporary roofing to watertight condition. Obtain approval for temporary roof substrate from roofing manufacturer and Architect before installing new roof.

3.6 BASE FLASHING REMOVAL

A. Remove existing base flashings. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

B. Do not damage metal counterflashings that are to remain. Replace metal counterflashings damaged during removal with counterflashings o**f same metal, weight or thickness, and finish.**

C. Remove existing parapet sheathing and replace with new parapet sheathing to comply with Section 061600 "Sheathing." If parapet framing, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

D. When directed by Architect, replace parapet framing, wood blocking, curbs, and nailers to

3.7 FASTENER PULL-OUT TESTING

A. **Perform** fastener pull-out tests according to SPRI FX-1, and submit test report to **Architect** and **roofing manufacturer** before installing new roofing system.

1. Obtain **Architect's** & **roofing manufacturer's** approval to proceed with specified fastening pattern. **Roofing manufacturer** may furnish revised fastening pattern commensurate with pull-out test results.

3.8 DISPOSAL

A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

1. Storage or sale of demolished items or materials on-site is not permitted.

B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150.19

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

PART 1 GENERAL

2.01 SECTION INCLUDES

A. Sheet Waterproofing:
   1. Self-adhered modified bituminous sheet membrane.
   2. Self-adhered HDPE sheet membrane.

B. Drainage panels and protection board.

2.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.
   1. Waterstops as specified in Section 03 30 00.

B. Section 04 20 00 - Unit Masonry: CMU substrate.

C. Section 07 92 00 - Joint Sealants: Sealing moving joints in waterproofed surfaces that are not required to be treated in this section.

2.03 ABBREVIATIONS

A. HDPE - High-Density Polyethylene.

B. NRCA - National Roofing Contractors Association.

2.04 REFERENCE STANDARDS

A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).

B. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).

C. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2012.

D. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2010).

E. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2015).

F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.

G. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 1993 (Reapproved 2014).

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.

I. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2013).

J. NRCA (WM) - The NRCA Waterproofing Manual; 2005.

2.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for membrane.

C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.

D. Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

2.06 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

2.07 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

2.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Contractor shall correct defective Work within a five year period after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.

C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

3.01 MEMBRANE MATERIALS

A. Self-Adhered Modified Bituminous Sheet Membrane:

1. Thickness: 60 mil, 0.060 inch, minimum.
2. Sheet Width: 36 inch, minimum
3. Tensile Strength:
   a. Film: 5000 pounds per square inch, minimum, measured according to ASTM D882 and a grip-separation rate of 2 inches per minute.
   b. Membrane: 325 pounds per square inch, minimum, measured according to ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
4. Elongation at Break: 300 percent, minimum, measured according to ASTM D412.
5. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with ASTM E96/E96M.
6. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
7. Peel Strength: 7 pounds per inch, minimum, when tested according to ASTM D903.
8. Lap Adhesion Strength: 5 pounds per inch, minimum, when tested according to ASTM D1876.
9. Puncture Resistance: 50 pounds, minimum, measured in accordance with ASTM E154/E154M.
10. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
11. Hydrostatic Resistance: Resists the weight of 200 feet when tested according to ASTM D5385/D5385M.
12. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
13. Manufacturers:
    a. Sika; SikaShield S60

b. Henry, a Carlisle Company; Blueskin WP 200
c. W.R. Meadows, Inc; Mel-Rol
d. Substitutions: See Section 01 60 00 – Material and Equipment Product Requirements.

B. Self-Adhered HDPE Sheet Membrane: Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.
1. Sheet Thickness: 46 mil (0.046 inch), minimum.
2. Low Temperature Flexibility: Unaffected when tested according to ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
3. Hydrostatic Resistance: Resists the weight of 231 feet when tested according to ASTM D5385/D5385M.
4. Elongation at Break: 500 percent, minimum, measured according to ASTM D412.
5. Tensile Strength, Film: 3,500 pounds per square inch, minimum, measured according to ASTM D412.
6. Lap Peel Adhesion: 5 pounds per inch, minimum, when tested according to ASTM D1876.
7. Water Vapor Permeance: 0.01 perm, maximum, measured in accordance with ASTM E96/E96M.
8. Bond to Concrete: 5 pounds per inch, minimum, per ASTM D903.
9. Lateral Water Migration Resistance: Resists the weight of 231 feet when tested according to ASTM D5385/D5385M.
10. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
11. Manufacturers:
a. GCP Applied Technologies; Preprufe 300R
b. W. R. Meadows; PRECON
c. Henry, a Carlisle Company; Blueskin PreSeal 435
d. Substitutions: See Section 01 60 00 - Material and Equipment Product Requirements.

C. Seaming Materials: As recommended by membrane manufacturer.
D. Membrane Sealant: As recommended by membrane manufacturer.

3.02 ACCESSORIES
A. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
B. Protection Board: Provide type capable of preventing damage to waterproofing due to backfilling and construction traffic.
C. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
1.Composition: Dimpled polystyrene core; polypropylene filter fabric.
2.Products:
a. Epro Services, Inc; ECODRAIN-MS
b. Mar-flex Waterproofing & Building Products; ArmorDrain 150
c. Mar-flex Waterproofing & Building Products; ArmorDrain 400
d. W.R. Meadows; MEL-DRAIN 5012/5035
D. Flexible Flashings: Type recommended by membrane manufacturer.

PART 3 EXECUTION

4.01 EXAMINATION
A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

4.02 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.
B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
F. Prepare building expansion joints at locations as indicated on drawings.
G. Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.

4.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
B. Roll out membrane, and minimize wrinkles and bubbles.
C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
H. Seal membrane and flashings to adjoining surfaces.

4.04 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
B. Place protection board directly against drainage panel; butt joints. Scribe and cut boards around projections, penetrations, and interruptions.
C. Adhere protection board to substrate with compatible adhesive.

4.05 PROTECTION

A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION
PART 1 GENERAL

1.01 SECTION INCLUDES
- A. Board insulation at cavity wall construction; perimeter foundation wall; and underside of floor slabs.
- B. Batt insulation in exterior construction.
- C. Acoustical insulation in interior partitions.
- D. Batt insulation for filling fire-rated assemblies.

1.02 RELATED REQUIREMENTS
- A. Section 07 62 62 – Fluid Applied Membrane Air Barrier
- B. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.
- C. Section 07 53 00 - Elastomeric Membrane Roofing: Insulation specified as part of roofing system.

1.03 DEFINITIONS
- A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, an 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, with Editorial Revision (2024).
- 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; 2024.
- 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; 2024.
- G. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2024.
- H. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

J. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015.
K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

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 a 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 /4A: 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.
H. Type 7: Spray Polyurethane Foam
   1. Application: Thermal insulation.
   2. Location: Exterior cavity walls behind masonry veneer.
   3. See Section 07 26 40 - Spray Polyurethane Foam Insulating Air Barrier .
I. Type 8: Polyisocyanurate Board Insulation
   1. Application: Thermal insulation.
   2. Location: Exterior continuous insulation as shown.

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.
      b. Dow Chemical Company ; Highload 40 : www.dow.com.
      c. Owens Corning Corporation ; FOAMULAR Type 400 Extruded Polystyrene (XPS) Insulation : www.ocbuildingspec.com.
      d. Substitutions: See Section 01 60 00 - Materials and Equipment Product Requirements.
B. Type 8: Polyisocyanurate (ISO) Board Insulation: Non-Halogenated (NH), High-Performance, Glass-Fiber Reinforced Polyisocyanurate Foam, in compliance with ASTM C1289.
   1. Classifications:
      a. Type I: Faced with aluminum foil on both major surfaces of the core foam.
         1) Class 2 - Glass fiber reinforced or non-reinforced core foam.
         2) Compressive Strength: 20 psi , minimum.

3) Thermal Resistance, R-value : At 1-1/2 inch thick; 10.0 , minimum, at 75 degrees F .

2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
4. Water Vapor Permeance: 0.01 perm , maximum, at 1 inch thickness, and when tested in accordance with ASTM E96/E96M, desiccant method.
5. Board Size: 48 inch by 96 inch.
6. Board Thickness: 1.5 inch, unless otherwise noted.
7. Board Edges: Square.
8. Products:
   a. DuPont de Nemours, Inc; Thermax Brand Basic NH Insulation: www.building.dupont.com.
   b. Johns Manville; CI Max : www.jm.com.
   c. Sika; ECOMAXci FR: www.rmax.com .
   d. Substitutions: See Section 01 60 00 - Materials and Equipment Product Requirements.

2.03 MINERAL FIBER BOARD INSULATION MATERIALS

A. Type 4A: 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
      b. Thermafiber, Inc; RainBarrier HD : www.thermafiber.com
   9. Substitutions: See Section 01 60 00 - Materials and Equipment 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.
      b. ROCKWOOL ; CURTAINROCK 40: www.rockwool.com.
      c. ROCKWOOL ; ROXUL SAFE: www.rockwool.com.
      d. Thermafiber, Inc ; FireSpan 40: www.thermafiber.com.
      e. Thermafiber, Inc ; Safing: www.thermafiber.com.
   4. Substitutions: See Section 01 60 00 - Materials and Equipment 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. Thermal Resistance: R-value of 4.0 per inch .

3. Products:
   a. Johns Manville ; Mineral Wool TempControl Batts : www.jm.com.
   b. ROCKWOOL; COMFORTBATT: www.rockwool.com.
   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; SAFB : www.jm.com.
      b. ROCKWOOL; AFB : www.rockwool.com/#sle.
      c. Thermafiber, Inc; SAFB : www.thermafiber.com/#sle.
      d. Substitutions: See Section 01 60 00 – Materials and Equipment 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. a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Grip-Lok Hurricane Washer: www.trufastwalls.com.

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 62 62 for insulation compatible with fluid applied membrane air barrier.

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 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Factory formed metal roof panels.
2. Associated underlayment, air barrier, metal trim, accessories, fasteners, insulation, and sealants.
3. Snow guards.

B. Related sections

1. 07 21 00 Thermal Insulation: Insulation installed with roof assemblies using metal roof panels. Also see Drawings.

1.02 DEFINITIONS

A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight roofing system.

B. References

1. American Society for Testing and Materials (ASTM)
   a. ASTM A 653: Steel Sheet, Zinc Coated by the Hot Dip Process
   b. ASTM A 792: Steel Sheet, Aluminum-Zinc Alloy Coated by the Hot Dip Process
   c. ASTM B 209: Aluminum and Aluminum Alloy Sheet and Plate
   d. ASTM B370 Standard Specification for Copper Sheet and Strip for Building Construction
2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
   a. SMACNA Architectural Sheet Metal Manual, latest edition.
3. American Iron and Steel Institute (AISI)
   a. AISI Cold Formed Steel Design Manual, latest edition.
4. Aluminum Association
   a. Aluminum Design Manual, latest edition.
5. Metal Construction Association
   a. Preformed Metal Wall Guidelines, latest edition.
6. Code References
   a. ASCE, Minimum Loads for Buildings and Other Structures

1.03 QUALITY ASSURANCE

A. Manufacturer and Installer shall each demonstrate experience of a minimum of five (5) years in the installation of metal roof panels.

B. Panels shall be factory-produced only. No portable, installer-owned, or installer-rented rolling or forming machines will be permitted.

1.04 SYSTEM DESCRIPTION

A. Material to comply with ASTM A792/A792M Standard Specification for Sheet Steel, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip process.

1.05 ROOF SYSTEM PERFORMANCE TESTING

A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Roof System shall be designed to meet wind load requirements of applicable codes.

C. Panels to meet:

1. Water Penetration: When tested per ASTM E-283/1680 and ASTM E-331/1646 there shall be no uncontrolled water penetration or air infiltration through the panel joints.
2. Roof System shall be designed to meet a UL Class 90 wind uplift in accordance with UL standard 580 and panel system shall be ASTM 1592 tested and approved.
3. UL 2218 - Impact Resistance rated.

1.06 WARRANTIES

A. Provide Manufacturer's weathertightness warranty, minimum term 20 years.
B. Provide Manufacturer's non-prorated finish warranty, minimum term 35 years.

1.07 SUBMITTALS

A. Furnish detailed drawings showing profile and gauge of exterior sheets, location and type of fasteners, location, gauges, shape and method of attachment of all trim locations and types of sealants, and any other details as may be required for a weather-tight installation.
B. Shop drawings
   1. Show fabrication and installation layouts of metal roof panels, metal wall panels or metal soffit panels, details of edge conditions, side-seam joints, panel profiles, corners, anchorages, trim, flashings, closures and accessories, and special details.
   2. Distinguish between factory and field-assembled work.
C. Coordination Drawings: Roof plans, drawn to scale, on which the following are shown and coordinated with each other, based on input from installer of the items involved:
   1. Roof panels and attachments.
   2. Metal trusses, bracings and supports.
   3. Roof-mounted items, including snow guards and items mounted on roof curbs.
D. Samples
   1. For Initial Selection
      a. Provide physical color cards or samples showing Manufacturer's full color range.
         1) Electronic documents and color prints produced therefrom are not acceptable.
   2. For Verification
      a. Provide three (3) physical samples of specified finish applied to specified material in color selected, minimum 4 inches by 4 inches.

1.08 DELIVERY, STORAGE AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
B. Deliver components, sheets, metal roof panels and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
C. Unload, store and erect metal roof panels in a manner to prevent bending, warping, twisting and surface damage.
D. Stack metal roof panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting or other surface damage.
E. Protect strippable protective coating on any metal coated product from exposure to sunlight and high humidity, except to the extent necessary for material installation.

1.09 PROJECT CONDITIONS

A. Weather Limitations: proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed.

B. Field Measurements: Verify dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

1.10 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports and roof penetrations with actual equipment provided.

B. Coordinate metal roof panels with rain drainage work, flashing, trim and construction of decks, parapet walls and other adjoining work to provide a leakproof, secure and noncorrosive installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Petersen Aluminum Corporation, Annapolis Junction, MD.

1. Manufacturers that may offer products meeting the basis of design specifications and design intent, including spacing, rib height and color selection include, but are not limited to:
   a. MBCI: www.mbci.com
   b. McElroy Metal: mcelroymetal.com

B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 METAL ROOF PANELS

A. Basis of Design: PAC-150 180° Seam metal panels by Petersen Aluminum Corporation.

B. General

1. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips inside laps.
   a. Include clips, cleats, pressure plates and accessories required for a weathertight installation.
2. Design panels for attachment with concealed fastener clips, spaced as required by the manufacturer to provide for both positive and negative design loads, while allowing for the expansion and contraction of the entire roof system resulting from variations in temperature.
3. Forming: Provide factory-formed panel systems only using continuous end rolling method.
   a. Factory forming or shop forming must be able to produce panel lengths up to 64 feet.
   b. No end laps on panels.
   c. No portable rollforming machines will be permitted.
   d. No installer-owned or installer-rented machines will be permitted.
4. Produce panels with factory supplied hot melt mastic in the seams.
5. Apply strippable protective coating to the top sides of pre-finished panels to protect the finishes during fabrication, shipping and handling.

C. Fabrication

1. Fabricate components in factory, ready for field assembly.
   a. Fabricate components and assemble units to comply with fire performance requirements specified.
2. Comply with dimensions, profile limitations, gauges and fabrication details shown in Drawings. If not shown, provide manufacturer's standard product fabrication.

D. Properties

1. Material: 24 gauge steel.

2. Configuration
   a. Pan variation: Smooth.
   b. Width: 20 inches unless otherwise noted.
   c. Seams: 1 1/2" high, mechanically seamed together at 180 degrees.
3. Finish: Galvalume.
   a. Top side: Total dry film thickness of 0.95 to 1.25 mil to meet AAMA 621.
      1) Prime coat: film thickness of 0.25 to 0.30 mil.
      2) Finish coat: 70 percent polyvinylidene fluoride, film thickness of 0.70 to 0.90 mil.
      3) Finish color: Champagne, a premium color.
   b. Bottom side
      1) Primer: dry film thickness of 0.25 mil.
      2) Finish shall conform to all tests for adhesions, flexibility and longevity as specified by polyvinylidene fluoride finish supplier.

E. Accessories
1. Trim: Match roof panel face sheet material and finish.
   a. Provide trim formed either by Roofing Manufacturer or its approved dealer.
      1) Press-break trim in lengths of 10 to 12 feet.
      2) Miter and factory-weld inside and outside corners.
   b. Install trim in overlapped condition.
      1) Use lap strips only as indicated on drawings.
2. Closures: Use composition or metal-profiled closures at the top of each elevation to close panel ends. Metal closures to be made in the same material and finish as face sheet.
3. Fasteners: Fasteners shall be of type, material, size, corrosion resistance, holding power and other properties required to fasten miscellaneous framing members to substrates.
4. Sub framing: Metal Z-furring, infilled with polyisocyanruate insulation. See Drawings.

2.03 UNDERLAYMENT

A. Provide underlayment under metal panels.
1. Basis of design: Carlisle WIP 300 HT High Temperature Protection Self Adhering Roofing Underlayment.
2. Other acceptable manufacturers and products include the following.
   a. W.R Grace, Ice & Water Shield.
   b. Interwrap Titanium PSU-30.
   c. Carlisle CCW WIP 300HT.
   d. Interwrap Titanium PSU.
   e. Tamko TW Tile and Metal Underlayment.
3. Properties
   a. Thickness: Minimum 40 mil.
   b. Surface texture: Smooth, non-granular.
   c. Suitable for high-temperature applications.

B. Air and vapor barrier: Provide air and vapor barrier between acoustical deck and board insulation.
1. Manufacturer and product: Carlisle Syntec, VapAir Seal MD

2.04 SEALANTS

A. For vertical and horizontal joints, provide one of the following sealants in accordance with the Roofing Manufacturer instructions.
1. Two-part polysulfide, class B non-sag type.
2. One-part polysulfide, not containing pitch or phenolic extenders.
3. Exterior grade silicone.

4. One-part polyurethane formulated for exterior application, non-sag type, gun grade.

2.05 SNOW GUARDS

A. Basis-of-Design Product: SnoCleat RCT Standing Seam Roof manufactured by Action Manufacturing, LLC, Lemoyne, PA. https://www.metalroofsnowguards.com/snocleatrct.

B. Requirements

1. Description
   a. Snow guard with 4" wide face and inside roof clamp dimensions 1" wide by 1 3/8" high.
   b. Able to fit standing T seam and bulb seams up to 1" inch wide.
2. Material: Extruded 6063 – T5 aluminum with stainless steel threaded, cupped nose set screws. Round nose set screws not permitted.
3. Finish: Powder coat to match metal roof color.
4. Quantities, locations, and spacings
   a. Provide as recommended by Manufacturer.
   b. Submit Manufacturer's recommendations for Architect's review during construction.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine alignment of structural steel and related supports, primary and secondary roof framing, solid roof sheathing, prior to installation.

B. For the record, prepare written report, endorsed by installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 UNDERLAYMENT INSTALLATION

A. Install underlayment as required by Roof System Manufacturer to attain weathertightness warranty.

B. Comply with following procedures unless otherwise directed in the Underlayment Manufacturer's installation instructions.

1. Lay underlayment in horizontal layers.
2. Lap the bottom edge of each section of underlayment over the top edge of the section below it, minimum lap width six inches.
3. Secure underlayment laps and ends.

3.03 FASTENERS

A. Secure fasteners to supports using Manufacturer's recommended fastener types, quantities, and spacing for application.

3.04 INSTALLATION

A. Install panels plumb and true in a proper alignment and in relation to the structural framing.

B. Install metal panels, fasteners, trim, and sealants both in accordance with approved shop drawings and as required for a weather-tight installation.

C. Remove strippable protective coating. Provide dry wipedown of panels as they are erected.

3.05 DAMAGED MATERIAL

A. Upon determination of responsibility, repair or replace damaged metal panels and trim to the satisfaction of the Architect and Owner.

END OF SECTION

SECTION 07 42 13.23 - ALUMINUM COMPOSITE RAINSCREEN

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 ACM wall panels, also identified in drawings as MCM wall panels.

1.3 DEFINITIONS

A. DBVR: Drained and back-ventilated rainscreen system; rainscreen system designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.

B. ACM; Aluminum Composite Material - Cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.

C. MCM; Aluminum Composite Material - Cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference

1. Meet with Owner, Architect, Owner's insurer if applicable, ACM panel Fabricator and Installer, ACM sheet manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects ACM panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to ACM panel installation including manufacturers written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect ACM panels.

6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for ACM panel assembly during and after installation.
8. Review procedures for repair of panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of ACM panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly including girts, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of ACM panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. ACM Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other ACM panel accessories. Submit custom color samples in paint manufacturer's standard size.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

1. ACM Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1407.14 and IBC 1703.5.
2. ACM System Fabricator's Certified System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting compliance code section. Base performance requirements on ACM system type provided.
   a. DBVR System: Tested to AAMA 509.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For ACM panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by ACM Fabricator.

B. Mockups: Mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for ACM fabrication and installation. Approximately 7’x8’ to incorporate horizontal and vertical joint and partial window head, sill and jamb
   1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, ACM panels, and other manufactured items so as not to be damaged or deformed. Package ACM panels for protection during transportation and handling.

B. Unload, store, and erect ACM panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack ACM panels on platforms or pallets, covered with suitable weathertight and ventilated covering. Store ACM panels to ensure dryness, with positive slope for drainage of water. Do not store ACM panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on ACM panels during installation.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of ACM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.11 COORDINATION

A. Coordinate ACM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Warranty on Panel Material: Manufacturer's standard form in which manufacturer agrees to replace ACM that fails within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace ACM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: **20** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide ACM panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330:

1. Wind Loads: as indicated on structural documentation.
2. Panel Deflection Limit: For wind loads, no greater than **1/60** of the span
3. Framing Member Deflection Limits: For wind loads, no greater than **1/240** or < of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested in accordance with ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration to room side of assembly when tested for 15 minutes in accordance with ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Locate expansion and contraction points to allow for free and noiseless thermal movements from surface temperature changes.

1. Temperature Change (Range): minus 20 deg F to 180 deg F (minus 29 to 82.2 deg C), material surfaces.

2.2 METAL COMPOSITE WALL PANELS

A. Wall Panel Systems: Provide factory-formed and assembled, ACM wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic / fire retardant core; formed into profile for installation method indicated. Include various components, panel stiffeners, and accessories required for weathertight system.

B. Manufacturers:
   1. Basis-of-Design Manufacturer: 3A Composites USA Inc.
   2. Other Manufacturers
      a. Other manufacturers' products must be submitted for consideration prior to bidding, and must meet the appearance and the performance of the basis of design and the other requirements of this section.
      b. Subject to pre-approval of physical colors and samples, including accessories, products from the following manufacturers may be acceptable.
         1) Petersen Aluminum Corporation.
         2) Arconic Architectural Products (USA).
         3) Mitsubishi Chemical Composites.

C. Products:
   1. Basis-of-Design Product: 3A Composites USA Inc; **ALUCOBOND® PLUS – Dry Seal Exterior System**.

D. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch (0.50-mm) thick, coil-coated aluminum sheet facings.

   1. Panel Thickness: 0.157 inch (4 mm).
   2. Core: Fire retardant.
   3. Weight: 1.56 lb/ft^2
   4. Exterior Finish: PVDF fluoropolymer.
      a. Color: As selected by Architect from manufacturer's full range

   5. Peel Strength: 22.5 in-lb/in. (100 N x mm/mm) when tested for bond integrity in accordance with ASTM D1781.
   6. Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with ASTM E84.

E. Attachment Assembly Components: Formed from material compatible with panel facing.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of ACM panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets,

fillers, closure strips, and similar items. Match material and finish of ACM panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as ACM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, end walls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent ACM panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of ACM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in ACM panels and remain weathertight; and as recommended in writing by ACM panel manufacturer.

2.4 FABRICATION

A. General: Fabricate and finish ACM panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations or recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. PVDF Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, ACM panel supports, and other conditions affecting performance of the Work.
1. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by ACM wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating ACM panels to verify actual locations of penetrations relative to seam locations of ACM panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and ACM panel manufacturer's written recommendations.

3.3 ACM PANEL INSTALLATION

A. General: Install ACM panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless

otherwise indicated. Anchor ACM panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving ACM panels.
2. Flash and seal ACM panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by ACM panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as ACM panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of ACM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by ACM panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support ACM wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
2. DBVR System: Install using Fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by Fabricator. Attach ACM wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
    a. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by manufacturer. Use Fabricator's standard horizontal tracks and vertical tracks that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach ACM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.
    b. Panel Installation:
        1) Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
        2) Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
    c. Joint Sealing: Seal all joints in accordance with AAMA 509. Do not apply sealants to joints unless otherwise indicated.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete ACM panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by ACM panel Fabricator; or, if not indicated, provide types recommended in writing by ACM system Fabricator.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Site Verifications of Conditions:

1. Verify conditions of substrate previously installed under other Sections are acceptable for the ACM system installation. Provide documentation indicating detrimental conditions to the ACM system performance.
2. Once conditions are verified, ACM system installation tolerances are as follows:

a. Shim and align ACM wall panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. ACM wall panels will be considered defective if they do not pass test and inspections.

B. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as ACM panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of ACM panel installation, clean finished surfaces as recommended by ACM panel manufacturer. Maintain in a clean condition during construction.

B. After ACM panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace ACM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13.23

SECTION 07 52 00 - HYBRID THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY -

A. Hybrid Thermoplastic membrane roofing over prepared substrate and insulation system.

1. Roof Demolition and Preparation
2. Insulation and Coverboard
3. Wood Blocking, Intumescent Primer, Self Adhered Base Sheet
4. Torch Applied Base Sheet in Field
5. KEE Thermoplastic Cap Sheet adhered in 2-part Spatter Spray Adhesive
   Option 1 – 30 year warranty
   Option 2 – 40 year warranty
5. Sheet Metal, Flashing and Trim

B. This portion of the specification sets forth the general requirements and describes materials and workmanship for installing the two-ply thermoplastic/modified bituminous membrane hybrid roof system over prepared substrates.

1.3 RELATED SECTIONS

A. Division 7 Section “Roof Insulation” for insulation above the roof deck.
B. Division 7 Section “Modified Bituminous Membrane Re-Roofing Procedures”.
C. Division 7 Section “Sheet Metal Flashing and Trim”.

1.4 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.

B. American Society for Testing and Materials (ASTM):

   1. ASTM D41, Specification for Asphalt Primer Used in Roofing, Dampproofing and Waterproofing.

   2. ASTM D312, Specification for Asphalt Used in Roofing.

   3. ASTM D451, Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.

   4. ASTM D1079, Terminology Relating to Roofing, Waterproofing and Bituminous Materials.

5. ASTM D1863, Specification for Mineral Aggregate Used as a Protective Coating for Roofing.
6. ASTM D2178, Specification for Asphalt Glass Felt Used as a Protective Coating for Roofing.
7. ASTM D2822, Specification for Asphalt Roof Cement.
8. ASTM D2824, Specification for Aluminum-Pigmented Asphalt Roof Coating.
9. ASTM D4601, Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing.
10. ASTM D5147, Test Method for Sampling and Testing Modified Bituminous Sheet Materials.
11. ASTM D6162, Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
12. ASTM D6163, Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements.
13. ASTM E108, Test Methods for Fire Test of Roof Coverings.

C. Factory Mutual Research (FM):
   1. Roof Assembly Classifications.

D. National Roofing Contractors Association (NRCA):
   1. Roofing and Waterproofing Manual.

E. Underwriters Laboratories, Inc. (UL):
   1. Fire Hazard Classifications.

F. Warnock Hersey (WH):
   1. Fire Hazard Classifications.

1.5 SYSTEM DESCRIPTION

A. It is the intent of this specification to install a long-term, quality roof system that meets or exceeds all current NRCA guidelines as stated in the most recent edition of the NRCA Roofing and Waterproofing Manual. Please discuss any concerns with the Engineer and Roofing System Manufacturer.

1.6 DISCLOSURE OF MATERIALS

A. The materials outlined herein are the materials that are to be used in this project. When a particular make or trade name is specified, it shall be indicative of the minimal standard of material required and to be used.

   i. The Architect reserves the right to be the final authority on the acceptance or rejection of any or all bids, or materials that has not met all specified requirement criteria.

1.7 SUBMITTALS

A. Submit under provisions of Contract Documents, Division 1 and this section.

B. Product Data: Provide manufacturer's technical product data for each type of roofing product specified. Include data substantiating that materials comply with specified requirements.

C. Samples: Submit two (2) samples of each product specified.

D. Manufacturer's Installation Instructions: Submit installation instructions and recommendations indicating special precautions required for installing the membrane.

E. Manufacturer's Fire Compliance Certificate: Certify that roof system furnished is approved by Factory Mutual, Underwriters Laboratories, Warnock Hersey or approved third party testing facility in accordance with ASTM E108, Class A for external fire and meets local or nationally recognized building codes.

F. Manufacturer's Wind Uplift Certificate: The manufacturer of the modified bitumen membrane must provide certification that the proposed roof system will be secured properly to the structure to meet or exceed the specific project wind uplift requirements per Section 1.16 Design and Performance Criteria.

G. Manufacturer's Manufacturing Certificate: Certify that modified membrane materials to be used on this project conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

H. Manufacturer's Manufacturing Certificate: Submit a certified copy of the roofing manufacturer's ISO 9001:2008 compliance certificate.

I. Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147. Testing must be performed at 77°F. Tests at 0°F will not be considered.

J. Submit a copy of an unexecuted manufacturer's warranty for review.

K. Provide approval letters from insulation manufacturer for use of their insulation within this particular roofing system type.

L. Provide a sample of each insulation type.

M. Shop Drawings:

1. Submit four (4) copies of manufacturer's shop drawings indicating complete installation details of tapered and flat insulation system, including identification of each insulation block, sequence of installation, layout, drain locations, sumps, roof slopes, thicknesses, tapered crickets and saddles.

2. Shop drawing shall include: Outline of roof, location of drains, sumps, complete board layout of tapered insulation components, thickness and the minimum and average "R" value for the completed insulation system.

N. Design Loads: Submit copy of manufacturer's minimum design load calculations according to ASCE 7-16, Method 2 for Components and Cladding, prepared by an engineer employed by the system manufacturer. In no case shall the design loads be taken to be less than those detailed in article 1.16 of this specification.

1.8 QUALITY ASSURANCE & QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 12 years documented experience and having ISO 9001:2008 certification.

B. Manufacturer: The manufacturer must also have current ISO 9001:2015 certification for the manufacturing of the products to be utilized on this project.

C. Installer: Company specializing in modified bituminous roofing installation with a minimum 5 years experience and certified by roofing system manufacturer as qualified to install manufacturer's roofing materials.

D. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work and at any time roofing work is in progress. Maintain proper supervision of workmen. Maintain a copy of the specifications in the possession of the Supervisor/Foremen and on the roof at all times.

1. Maintain a copy of the Contract Documents in the possession of the Supervisor/Foreman and on the roof at all times.

E. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.

1. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.

F. Immediately correct roof leakage during construction. If the Contractor does not respond within twenty-four (24) hours, the Owner has the right to hire a qualified contractor and backcharge the original contractor.

G. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.9 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Roofing Conference: Convene a pre-roofing conference approximately two (2) weeks before scheduled commencement of modified bituminous roofing system installation and associated work**.**

B. Require attendance of installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing which must precede or follow roofing work (including mechanical work if any), Architect, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner's insurers, testing agencies and governing authorities.

C. Objectives of conference to include:
1. Review foreseeable methods and procedures related to roofing work.
2. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations and other preparatory work performed by others.
3. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
4. Review roofing system requirements (drawings, specifications and other contract documents).
5. Review required submittals both completed and yet to be completed.
6. Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
7. Review required inspection, testing, certifying and material usage accounting procedures.
8. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not mandatory requirement).
9. Record discussion of conference including decisions and agreements (or disagreements) reached and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.
10. Review notification procedures for weather or non-working days.

D. The Owner's Representative will designate one of the conference participants to record the proceedings and promptly distribute them to the participants for record.

E. The intent of the conference is to resolve issues affecting the installation and performance of roofing work. Do not proceed with roofing work until such issues are resolved the satisfaction of the Owner and Engineer of Record. This shall not be construed as interference with the progress of Work on the part of the Owner or Engineer of Record.

1.10 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.

B. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to ensure no possibility of significant moisture exposure. Store rolls of felt and other sheet materials on

pallets or other raised surface. Stand all roll materials on end. Cover the roll goods with a canvas tarpaulin or other breathable material (not polyethylene).

C. In accordance with the manufacturer's recommendations, immediately remove the plastic wrapping on the roof recovery boards and cover with a watertight, ventilated enclosure (i.e. tarpaulins). Prevent the formation of condensation on the boards.

D. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.

E. It is the responsibility of the contractor to secure all material and equipment on the job site. If any material or equipment is stored on the roof, the contractor must make sure that the integrity of the deck is not compromised at any time. Damage to the deck caused by the contractor will be the sole responsibility of the contractor and will be repaired or replaced at his expense.

F. Keep materials enclosed in a watertight, ventilated enclosure (i.e. tarpaulins).

1.11 MANUFACTURER'S INSPECTIONS

A. When the project is in progress, the roofing system manufacturer will provide the following:
   1. Keep the Architect informed as to the progress and quality of the work as observed.
   2. Provide job site inspections a minimum of three (3) days a week.

1.12 PROJECT CONDITIONS

A. Proceed with roofing work only when existing and forecasted weather conditions will permit unit of work to be installed in accordance with manufacturer's recommendations and warranty requirements.

B. Do not apply roofing insulation or membrane to damp deck surface.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.13 SEQUENCING AND SCHEDULING

A. Sequence installation of modified bituminous sheet roofing with related units of work specified in other sections to ensure that roof assemblies including roof accessories, flashing, trim and joint sealers are protected against damage from effects of weather, corrosion and adjacent construction activity.

B. Fully complete the installation of insulation system and base roofing ply assembly, and/or the installation of the modified bituminous membrane roof ply each day. Phase construction between the base roofing ply and modified membrane roof ply (top ply) is acceptable.

1.14 WARRANTY

A. Upon completion of installation, and acceptance by the Architect, the manufacturer will supply to the Owner a single-source, thirty (30) year (NDL) warranty. This warranty shall cover the roof system, and al surfacing's. Warranty will include the roof systems, modified bitumen base flashings and the transition between all systems.

B. Installer will submit a minimum of a three (3) year warranty to the manufacturer with a copy directly to Owner.

C. At the request of the Owner, the roofing system manufacturer shall provide the Owner, or his representative, with an annual inspection of the roofing system. This period shall be for the duration of the delivered warranty period.

1.15 SITE CONDITIONS

A. Field measurements and material quantities:

1. Contractor shall have SOLE responsibility for accuracy of all measurements, estimates of material quantities and sizes, and site conditions that will affect work.

B. Existing Conditions:

1. Building space directly under roof area covered by this specification will be utilized by on-going operations. Do not interrupt Owner operations unless prior written approval is received from Owner.

C. Waste Disposal:

1. Do not re-use, re-cycle or dispose of materials except in accordance with all applicable regulations. The use of products is responsible for proper use and disposal of product containers.

D. Safety Requirements:

1. All application, material handling, and associated equipment shall conform to and be operated in conformance with OSHA safety requirements.
2. Comply with federal, state, local and Owner fire and safety requirements.
3. Advise Owner whenever work is expected to be hazardous to Owner, employees, and/or operators.
4. Maintain a crewman as a floor area guard whenever roof decking is being repaired or replaced.
5. Maintain fire extinguisher within easy access whenever power tools, roofing kettles, fuels, solvents, torches and open flames are being used.

1.16 DESIGN AND PERFORMANCE CRITERIA

A. Uniform Wind Uplift Load Capacity

1. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.

   a. Design Code: ASCE 7-16, Method 2 for Components and Cladding.

   b. Category III Building with an Importance Factor of 1.0.

   c. Wind Speed: 129 mph

   d. Exposure Category: C

   e. Roof Pitch: 1/4 inches per foot

   f. Topographic Factor: 1.00

2.

Zone	Design Uplift Pressures	Length/Width
Zone 1	46.6 psf	
Zone 2	59.0 psf	16’L X 10”W
Zone 3	77.7 psf	5’8”W X 16’10”L.

Fasteners: 11 fasteners per 4 ft by 8 ft board in **Zone 1**, 17 fasteners per 4 ft by 8 ft board in **Zone 2**, 22 fasteners per 4 ft by 8 ft board in **Zone 3**.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. When a particular trade name or performance standard is specified it shall be indicative of the minimum standard required. Product names for the materials used in this section shall be based on performance characteristics of the modified bitumen roof system manufactured by The Garland Company, Cleveland, OH, and shall form the basis of design for these contract documents.

B. Provide primary products, including each type of roofing membrane, base flashings, flashing membrane ply and miscellaneous flashing materials from a single source roof manufacturer. Provide secondary products (insulation, recovery board, etc.) only as recommended by the roof manufacturer of primary products for use with the roof system specified.

C. Any item or materials submitted as a substitution to the basis of design manufacturer specified, must be submitted by the bidding Contractor and must comply in all respects as to the quality and performance of the brand name specified. The Architect shall be the sole judge as to whether or not an item submitted as a substitute is truly equal. Should the Contractor choose to submit a substitute product, he shall assume all monetary or other risk involved, should the Architect find the substitution unacceptable.

D. The following manufacturers are acceptable, providing they meet these specifications and the minimum standards stated.

a. The Garland Company, Inc. (Basis of Design)
b. Tremco, Inc.
c. SR Products

2.2 DESCRIPTION

A. Modified bituminous roofing work including but not limited to:

1. Prior to installing the insulation system on the roof deck, repair or replace any defects in accordance with the project specifications.

2. On all exposed and concealed wood nailers/blocking/insulation stops, Apply one (1) coat of intumescent primer at ½ gallon per square covered with one (1) ply SBS self-adhering fire retardant modified membrane sheet fully adhered to all exposed wood blocking.

3. Installation of polyisocyanurate insulation and recovery board over the properly prepared roof deck in accordance with Division 7 Roof Insulation Section.

4. Self-Adhered Base Flashing Ply: One (1) ply of 110 mil thick SBS fiberglass reinforced, self-adhering modified base sheet fully adhered to any exposed wood surfaces that need to be waterproofed.

5. Base Roofing Ply: One (1) ply of 110 mil thick SBS Torch Grade Base Sheet fully adhered to approved torchable insulation with roofer's torches.

6. Base Flashing Ply: (1) ply of 110 mil thick SBS Torch Grade Base Sheet fully adhered to approved torchable insulation with roofer's torches.

7. Thermoplastic Inter-ply Foam Adhesive: two-component, low rise, solvent free, polyurethane foam adhesive.

8. Thermoplastic Membrane Roofing Ply: 60 mil thermoplastic cap sheet roofing membrane modified with Ketone EthyleneEster (KEE) reinforced with a polymer coated polyester scrim; polyester fleece bonded to the backside.

9. Thermoplastic Flashing Adhesive: acrylic, pressure sensitive, solvent-free adhesive designed for non-fleeceback KEE membranes.

10. Thermoplastic Membrane Flashing Ply: 60 mil, non-fleeceback thermoplastic cap sheet roofing membrane with Ketone EthyleneEster (KEE) reinforced with polymer coated polyester scrim.

2.3 BITUMINOUS MATERIALS

A. Asphalt Primer: V.O.C. compliant, ASTM D-41.

B. Asphalt Roofing Mastic: V.O.C. compliant, ASTM D-2822, Type II.

C. Flashing Adhesive and Temporary Tie-Off mastic

D. Elastomeric Asphaltic Sealant

2.4 THERMOPLASTIC MATERIALS AND ACCESSORIES

A. Thermoplastic Inter-ply Foam Adhesive: two-component, low rise, solvent free, polyurethane foam adhesive.

B. Thermoplastic Flashing Adhesive: pressure sensitive, solvent-free adhesive designed for non-fleeceback KEE membranes.

C. Thermoplastic Accessories: KEE factory welded, non-fleeceback, reinforced membrane compliant with ASTM D 6754 standards.
   a. Universal Conical Boot
   b. Split Pipe Boots (1" to 6")
   c. Square Split Boot (2" x 2", 3" x 3", 4" x 4", 5" x 5", 6" x 6")
   d. Inside Corner
   e. Outside Corner
   f. T-Joint Cover

D. Thermoplastic Mastic: white, polyether, Zero VOC trowel grade mastic for cold applied applications.

E. Thermoplastic Mastic Sealant.

2.5 SHEET MATERIALS

A. Base Roofing Ply:
   1. 110 mil SBS fiberglass reinforced self-adhering modified base sheet with the following minimum performance requirements according to ASTM D-5147.

Properties (Finished Membrane):		
Tensile Strength (ASTM D-5147)		
2 in/min. @73.4 ± 3.6°F	MD 75 lbf/in	XD 50 lbf/in
Tear Strength (ASTM D-5147)		
2 in/min. @ 73.4 ± 3.6°F	MD 105 lbf	XD 100 lbf
Elongation at Maximum Tensile (ASTM D-5147)		
2 in/min. @ 73.4 ± 3.6°F	MD 5.0%	XD 5.0%
Low Temperature Flex (ASTM D-5147)		
2 in/min. @ 73.4 ± 3.6°F	0°F	
Thickness :	100 mils	

B. Base Roofing Ply
1. 110 mil SBS Torch Grade Base Sheet with woven fiberglass scrim reinforcement with the following minimum performance requirements according to ASTM D-5147.

Properties: (Finished Membrane):		
Tensile Strength (ASTM D-5147)		
2 in/min. @73.4 ± 3.6°F	MD 210 lbf/in	CMD 210 lbf/in
Tear Strength (ASTM D-5147)		
2 in/min. @ 73.4 ± 3.6°F	MD 250 lbf	CMD 250 lbf
Elongation at Maximum Tensile (ASTM D-5147)		
2 in/min. @ 73.4 ± 3.6°F	MD 4.0%	CMD 4.0%
Thickness :		110 mils
Post-Consumer Recycled Content :		6%

C. Base Flashing Ply:
1. 110 mil SBS Torch Grade Base Sheet with woven fiberglass scrim reinforcement with the following minimum performance requirements according to ASTM D-5147.

Properties: (Finished Membrane):		
Tensile Strength (ASTM D-5147)		
2 in/min. @73.4 ± 3.6°F	MD 210 lbf/in	CMD 210 lbf/in
Tear Strength (ASTM D-5147)		
2 in/min. @ 73.4 ± 3.6°F	MD 250 lbf	CMD 250 lbf
Elongation at Maximum Tensile (ASTM D-5147)		
2 in/min. @ 73.4 ± 3.6°F	MD 4.0%	CMD 4.0%
Thickness :		110 mils
Post-Consumer Recycled Content :		6%

D. Thermoplastic Membrane Field Ply: (30 Year Warranty Option)
1. 60 mil thermoplastic cap sheet roofing membrane modified with Ketone EthyleneEster (KEE) reinforced with a polymer coated polyester scrim; polyester fleece bonded to the backside ASTM D 6754,

Breaking Strength (ASTM D 751)	375 lbf 1668 N
Tear Strength (ASTM D 751)	120 lbf 534N
Elongation at Break (ASTM D5147)	40%
Low Temperature Flexibility (ASTM D 2136):	Passes -40°F (-40°C)

Puncture Resistance (ASTM D 751)	161 lbs.
Factory Seam Strength (ASTM D 751, Grab Method)	620 lbf. Min.
Thickness	60 mils

E. Thermoplastic Membrane Field Ply: (40 Year Warranty Option)
1. 60 mil thermoplastic cap sheet roofing membrane modified with Ketone EthyleneEster (KEE) reinforced with a polymer coated polyester scrim; polyester fleece bonded to the backside ASTM D 6754,

Breaking Strength (ASTM D 751)	375 lbf 1668 N
Tear Strength (ASTM D 751)	150 lbf 667N
Elongation at Break (ASTM D5147)	40%
Low Temperature Flexibility (ASTM D 2136):	Passes -40°F (-40°C)
Puncture Resistance (ASTM D 751)	190 lbs.
Factory Seam Strength (ASTM D 751, Grab Method)	645 lbf. Min.
Thickness	60 mils

Accelerated Weathering Test after 5000-H Fluorescent/Condensation Exposure (ASTM G 154)

F. Thermoplastic Membrane Flashing Ply: 60 mil, non-fleeceback thermoplastic cap sheet roofing membrane with Ketone EthyleneEster (KEE) reinforced with polymer coated polyester scrim.
ASTM D 6754.

Breaking Strength (ASTM D 751)	375 lbf	1668 N
Tear Strength (ASTM D 751)	MD 145 lbf	XD 200 lbf
Elongation at Break (ASTM D 751)	MD 30%	XD 35%
Elongation at Break, strip		> 90% of original
Low Temperature Flexibility (ASTM D 2136):		Passes -40°F (-40°C)
Thickness		60 mils

G. End Lap Seam Stripping Ply
1. 60 mil, six (6) inch wide unreinforced thermoplastic

membrane modified with Ketone EthlyeneEster (KEE) for use as a stripping ply to cover a seam in the KEE-STONE FB 60 system and to field wrap difficult to flash penetrations.

2.5 SURFACINGS

A. Thermoplastic Modified Membrane Roofing Cap Ply: White thermoplastic membrane modified with Ketone EthyleneEster (KEE).
   a. Reflectivity …….0.87 min (initial)
   b. Emittance…….0.88 min (initial)
   c. SRI……...110 min (initial)

2.6 RELATED MATERIALS

A. Roof Insulation and Recovery Boards: In accordance with Division 7 Roof Insulation Section.

B. Roof Insulation Fasteners: In accordance with Division 7 Roof Insulation Section.

C. Nails and Fasteners: Non-ferrous metal or hot dipped galvanized fasteners complying with ASTM A153 and connectors complying with ASTM A653, Class G185; Type 304 or Type 316 stainless steel fasteners and connectors shall be used with new generation of pressure-treated wood; Nails and fasteners shall be flush-driven through flat metal discs of not less than one (1) inch diameter. Omit metal discs when one-piece composite nails or fasteners with heads not less than one (1) inch diameter are used.

D. Metal Discs: Flat discs or caps of zinc-coated sheet metal not lighter than twenty eight (28) gauge and not less than one (1) inch in diameter. Form discs to prevent dishing. Bell or cup shaped caps are not acceptable.

E. Metal Flashing Sheet: Metal flashing sheet is specified in Section 07 60 00 - Sheet Metal Flashing and Trim.

F. Lead Flashing Sheet: Meets Federal Specification QQ-L-201, Grade B, four pounds per square foot.

G. Metal Termination Bars:

   1. Shall be heavy flat bar aluminum unless otherwise recommended by membrane manufacturers.

   2. Material shall be .125” x 1” (minimum) aluminum conforming to ASTM B-221, mill finish.

H. Protection and Walkway Pads: Recycled rubber (97% recycled rubber), anti-skid surface pads, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, ½ inch thick, minimum.

   1. Minimum Pad Size: 3’-0” x 3’-0”

I. Primer: Pro-Stop FR or approved equal; a water-based, non-corrosive intumescent primer used on the wood components

J. Primer: Prime all exposed metal, lead sleeves and lead drain pans, wood and concrete block surfaces with asphalt primer compatible roof system material and as manufactured, supplied and recommended by roof system manufacturer.

K. Urethane Sealant: One part, non-sag sealant as recommended by the membrane manufacturer for moving joints.

L. Non-Shrink Grout: Use an all weather fast setting chemical action concrete material to fill pitch Pans.

M. Self Adhering Primer: polymer emulsion-based primer designed to improve the adhesion of self-adhered membranes (t**o be used prior to torch application where exposed wood blocking is found).**

N. Intumescent Primer: water-based, non-corrosive intumescent primer used on the wood components of Garland roof assemblies. When applied to flammable substrates then exposed to high temperatures and flame the primer swells up and creates a char-barrier helping to prevent further spread of the fire and smoke.

O. New Drains**:** Existing drains are to be replaced. The new drains shall be J.R. Smith, or equal, and match existing size and configuration. New drains shall be a complete assembly having new drain bowls, deck clamps, threaded receivers, and cast iron strainers. Drains shall be installed prior to or during the roof installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate surfaces to receive modified bituminous membrane roof system and associated work and conditions under which roofing will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to the manufacturer.

B. Prior to installing the finish modified membrane roofing ply, the contractor must notify the roof system manufacturer representative, and Owner's representative, to examine the roof area for high and low spots. It may be necessary to mist the roof with water to identify the problem areas. The contractor will correct all problem areas identified. This examination should take place no less than 24 hours in advance of installing the finished membrane.

C. Verify that deck surfaces and project conditions are ready to receive work of this section.

D. Verify that deck is supported and secured to structural members.

E. Verify that deck is clean and smooth, free of depressions, projections or ripples, and is properly sloped to drains or level as shown in the project documents. Clean roof deck of dirt, debris, water and snow.

F. Verify that adjacent roof members do not vary more than 1/4 inch in height.

G. Verify that deck surfaces are dry, free of snow or ice, not deteriorated, do not have bacterial growth, and are structurally sound.

H. Confirm that moisture content within the wood blocking and nailers does not exceed twelve (12) percent by moisture meter tests.

I. Verify that openings, curbs, pipes, conduit, sleeves, ducts, and other items which penetrate the roof are set solidly, and that wood cant strips, wood nailing strips and reglets are set in place. Verify that all roof curb heights are satisfactory and that the wood blocking height along the perimeter of the building and/or roof levels is satisfactory to provide positive roof pitch away from the building edge.

J. Contractor is responsible to verify existing substrate and structure is sloped as stated in/on the project documents prior to installation of insulation system. All defects in roof pitch to be accommodated with tapered insulation to insure a positive pitch to all roof drains.

3.2 PREPARATION - REMOVAL

A. Remove existing roof system(s), counter-flashings, roof flashings, and all accessories back to the roof deck and masonry walls.

B. Remove all existing scupper assemblies and install new scupper assemblies. New scuppers shall be in accordance with the above specification.

1. Prior to beginning work, contractor shall verify/test that existing roof drains are in working, or non-working, order. If the drains are in non-working order, the Owner shall address the non-working drain to working conditions. If the drains are in working order, then the contractor will be required to maintain, and deliver, the drains back to the Owner in working order.

C. Clean substrate of debris and other substances detrimental to roofing installation according to the roof system manufacturer's written instructions. Remove sharp objects.

D. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Use roof drain plugs as required to prevent materials from entering and clogging roof drains and conductors. Remove roof drain plugs at the end of each work day or when rain is forecasted. Replace or restore other work damaged by installation of the modified bituminous roofing system.

E. All existing roofing shall be torn off and removed completely down to the roof structure decking. Dispose off-site in dumpsters.

F. Tear off only enough roofing, which can be successfully reroofed, in a single day.

G. Fully complete the installation of insulation system and base roofing ply assembly, and/or the installation of the modified bituminous membrane roof ply each day. Phase construction

between the base roofing ply and modified membrane roof ply (top ply) is acceptable.

3.3 PREPARATION – METAL DECK

A. Clean substrate of debris and other substances detrimental to roofing installation according to the roof system manufacturer's written instructions. Remove sharp objects.

B. If bad corroded, deteriorated, damaged or unsound decking is present, it shall be removed and replaced using the same materials as the original, unless otherwise specified.

C. As required, install preformed sound absorbing insulation strips in acoustic deck flutes in accordance with manufacturer's instructions.

3.4 WOOD PROTECTION

A. Apply one (1) coat of the specified intumescent primer to the properly prepared wood substrates at an application rate of ½ gallon per 100 sf. Allow to dry and cure before applying the self-adhering fire retardant membrane.

B. Install one (1) layer of the specified self-adhering fire retardant membrane to the properly prepared and primed wood substrates to protect the wood from the torch application. Install the ply in a shingle type manner.

3.5 DRAIN INSTALLATION

A. All existing drains shall be water tested. All existing drains shall be removed and replaced, unless noted otherwise. New drains shall be accordance with project documents and specified above. Sizes and configuration shall match existing. Drains will have new deck clamps, drain bowls, adjustable drains as needed, threaded receivers, and cast iron metal strainers. Drains shall be installed prior to or during the roof installation. **Drains shall be set to the proper height above the roof deck to allow for a tapered insulation sump having ½" per foot slope.**

3.6 GENERAL INSTALLATION REQUIREMENTS

A. Cooperate with manufacturer, inspection and test agencies engaged or required to perform services in connection with installing the roof system.

B. Insurance/Code Compliance: Where required by code, install and test the roofing system to comply with governing regulation and specified insurance requirements.

C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of the modified bituminous roofing system.

D. Coordinate installation of roofing system components so that the insulation is not exposed to precipitation or left exposed overnight. Provide cut-offs at end of each day's work to cover exposed ply sheets and insulation with two (2) plies of #15 organic roofing felt with joints

and edges sealed with roofing cement and other jointly agreed upon tie-in detail. Remove cut-offs immediately before resuming work.

E. Substrate Joint Penetrations: Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

F. Apply roofing materials as specified by manufacturer's instructions.
1. Keep roofing materials dry before and during application.
2. Begin and apply only as much roofing in one day as can be completed that same day.

G. Cut-Offs/Envelope Waterstops: At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and insulation. Install waterstop/temporary flashing a minimum of 6 inches under face edge of insulation and wrapped up face and back a minimum of 6 inches from the face in asphalt mastic at ¾ pounds per foot, top dress waterstop with asphalt mastic.

H. All exposed wood blocking and/or sheathing where noted is to be primed with the specified PRO-STOP FR PRIMER or approved equal at a rate of .5 gallons per square and allowed to dry. All wood is to be covered with SA membrane extending beyond the wood edges a minimum of 2" in all direction.

I. A minimum two-hour fire watch is required for each day that torch-applied membranes are Installed unless noted otherwise by Owner. Keep an approved rated fire extinguisher every 3,000 square feet maximum on the roof. The fire extinguisher shall be placed in a central location in that area where all workers know where it is and how to operate in properly.

3.7 INSULATION INSTALLATION

A. Refer to Roof Insulation specification Division 7 Section 07 22 00 for complete installation requirements.

B. Deck type: Metal Deck.

C. Insulation: Tapered and Flat, rigid polyisocyanurate insulation with a minimum total thickness as specified, and a gypsum core recovery board.

D Insulation Attachment: Polyisocyanurate insulation shall be mechanically attached to the metal roof decks and subsequent layers of the polyisocyanurate insulation shall be installed in the specified insulation adhesive in accordance with manufacturer's recommendations. The recovery board shall be installed over the polyisocyanurate insulation system in the specified insulation adhesive in accordance with manufacturer's recommendations.

E. Joints of Recovery Board: Before installing the torch-applied modified bitumen roof system over the recovery board, ALL joints of the recovery board must be sealed with a 3-course application of mesh and cold-applied, solvent free adhesive or specified roof board joint tape.

3.8 BASE ROOFING PLY INSTALLATION:

A. Install the specified Base Roofing Ply to the properly prepared substrate. Shingle in proper

direction to shed water on each area of roofing.

B. To an approved recovery board, lay out the roll in the course to be followed and unroll six (6) feet.

C. Using a roofing torch, heat the surface of the coiled portion until the burn-off backer melts away. At this point, the material is hot enough to lay into the substrate. Progressively unroll the sheet while heating and press down with your foot to insure a proper bond.

D. After the major portion of the roll is bonded, re-roll the first six (6) feet and bond it in a similar fashion.

E. Repeat this operation with subsequent rolls with side laps of four (4) inches and end laps of eight (8) inches.

F. Give each lap a finishing touch by passing the torch along the joint and spreading the melted bitumen evenly with a rounded trowel to insure a smooth, tight seal.

G. Extend underlayment two (2) inches beyond top edges of cants at wall and projection bases.

H. Install base flashing ply to all perimeter and projection details.

3.9 THERMOPLASTIC MEMBRANE INSTALLATION

A. Install specified Thermoplastic Cap Roofing Ply as described below.

B. Prior to installing the thermoplastic cap roofing ply, the contractor must notify the roof system manufacturer representative, and Owner's representative, to examine the roof area for high and low spots. It may be necessary to mist the roof with water to identify the problem areas. The contractor will correct all problem areas identified. This examination should take place no less than 24 hours in advance of installing the finished membrane.

C. Before installation of the thermoplastic membrane contractor must sweep or blow away any dust, dirt or debris off the modified bitumen base sheet.

D. Relax the thermoplastic membrane cap sheet prior to application. This will allow the membrane to sit down into the adhesive.

E. Apply specified spatter spray foam adhesive to the specified modified base sheet in accordance with manufacturers recommendations. Coverage rate is approximately twenty-four (24) squares per set. The skin time for the adhesive is typically 5 – 8 minutes (70°F/50% RH).

F. Position the thermoplastic membrane where it is ready to be installed and then roll the membrane into the specified foam adhesive. **Ensure that foam adhesive is not applied to any side laps or areas where the membrane is to be welded.**

G. Broom in the thermoplastic flashing membrane immediately after install to ensure even continuous contact between the fleece backing and the foam adhesive immediately followed by a weighted roller to ensure contact with the adhesive and push out any air pockets.

H. When installing, start at the low point of the roof with an appropriate roll width to offset side laps form the underlying modified base sheet a minimum of eighteen (18) inches. Work with manageable lengths for proper handling. Position the thermoplastic membrane with the salvage edge at low side of the roof. Install in shingle fashion, with no laps against the flow of water. **Once the membrane has had a chance to bond, utilize a seam probe to check all of the laps and joints for full adhesion. Any areas not properly bonded require welding, or, if necessary, the application of a utility patch to seal any un-bonded areas that exist.**

I. All field seams must be clean and dry prior to initiating any field welding. Remove foreign materials from the seams (dirt, oils, etc.) with acetone or authorized alternative. Use CLEAN WHITE COTTON cloths and allow approximately five minutes for solvents to dissipate before initiating the automatic welder. Do not use denim or synthetic rags for cleaning. Contaminated areas within a membrane seam will inhibit proper welding and will require a membrane patch or strip.

J. All welding shall be performed only by qualified personnel to ensure the quality and continuity of the weld. The lap or seam area of the membrane may be intermittently tack welded to hold the membrane in place. Heat weld all seams with a Leister Variant or approved heat welding machine. All seams exceeding 10 feet in length shall be welded with an approved automatic welder. The back interior edge of the membrane shall be welded first, with a thin, continuous weld to concentrate heat along the exterior edge of the lap during the final welding pass. Hand weld T joints, inside corner pieces and outside corner pieces along with hard to reach areas. Membrane without selvedge edge are to be butted together and sealed with a heat welded utility roll. Refer to Leister equipment manual for proper heat welding instructions.

K. Hand weld T joints, inside corner pieces and outside corner pieces along with hard to reach areas. Membrane without selvedge edge are to be butted together and sealed with a heat welded utility roll. Refer to Leister equipment manual for proper heat welding instructions. Refer to local code requirements for electric supply, grounding and surge protection. The use of a dedicated, portable generator is highly recommended to ensure a consistent electrical supply, without fluctuations that can interfere with weld consistency. Properly welded seams shall utilize a 1.5 inch wide nozzle, to create a homogeneous weld, a minimum of 1.5 inches in width.

L. Aesthetics will be a punch list item. The roof must match the owner’s standards for appearance.

M. Install thermoplastic flashing ply to all perimeter and projection details in the specified flashing adhesive. Install the adhesive per specification and heat weld seams in the same manner.

3.10 THERMOPLASTIC FLASHING MEMBRANE INSTALLATION:

A. Remove all dust, dirt or debris from the base flashing ply.

B. Position thermoplastic membrane flashing ply where it is ready to be installed. Use preferred method to align sheet with install path.

C. Apply specified flashing adhesive to the exposed side of the already installed base flashing ply and to the backside of the KEE Non Fleeceback Flashing membrane at a total combined rate of 1.0-1.5 gallons per 100 sq. ft. Leave bottom 3" of membrane free of adhesive to allow for proper heat welding to the field ply. **NOTE:** *Once adhesive is applied to both surfaces, allow a minimum 30 minutes (depending on environmental conditions) for the adhesive to become tacky. Using the finger-push method, check that the adhesive develops strings, signifying that it has reached ideal tackiness.*

D. Install KEE Non-Fleeceback Flashing ply extending min. 9" onto the field of the roof and at the desired width depending on the size of the crew handling the membrane. Typical lengths are 10'-18' for easy handling. **NOTE**: *Once the adhesive is tacky enough, set the KEE-Stone NF 60 Flashing in place on the wall. Immediately roll the surface using a 2 in. wide weighted roller to ensure proper mating of the two surfaces.*

E. Broom in the thermoplastic flashing membrane immediately after install to ensure even continuous contact between the fleece backing and the foam adhesive.

F. On all vertical seams, overlap the membrane a minimum of 3" and heat weld.

G. Complete all inside and outside corner flashing details by fully heat welding the thermoplastic utility roll centered on the seam and/or using the specific specified accessory rolls. **Once the membrane has had a chance to bond, utilize a seam probe to check all of the laps and joints for full adhesion.**

H. Once the specified flashing adhesive has set up and all vertical seams have been sealed, heat weld unadhered edge of the cap flashing ply to the KEE field membrane.

I. All vertical flashings shall be terminated a minimum of eight (8) inches above the top layer of insulation in the field with an approved termination bar followed by counter-flashing system

3.11 FLASHING MEMBRANE INSTALLATION

A. Apply one (1) coat of the specified intumescent primer to the properly prepared wood substrates at an application rate of ½ gallon per 100 sf. Allow to dry and cure before applying the self-adhering fire retardant membrane.

B. Install one (1) layer of the specified self-adhering fire-retardant membrane to the properly prepared and primed wood blocking and substrates to protect the wood from the torch application. Install the ply in a shingle type manner.

C. Seal all curb, wall and parapet flashings with an application of mastic and mesh on a daily basis. Do not permit conditions to exist that will allow moisture to enter behind, around or under the roof or flashing membrane.

D. Prepare all walls, drain lead flashing, penetrations and where shown on the drawings to be flashed with asphalt primer at the rate of one hundred (100) square feet per gallon. Allow primer to dry tack free.

E. Coordinate counter flashings, cap flashings and similar work with modified bitumen roofing work as specified in other sections.

F. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work as specified in other sections.

G. Flash all penetrations as specified below and per the project documents. If specific detail is not shown in drawings or specified below, flash detail in accordance with the manufacturer's specifications to comply with the specified guaranty.

H. On HVAC equipment, equipment supports, exhaust fans, etc. install 0.040" aluminum slip flashing to act as counterflashing. Install per roofing system manufacturer's recommendation and instructions.

I. Install all metal counterflashings in accordance with project specifications and roofing systems manufacturer's recommendations and instructions.

J. Aesthetics will be a punch list item. The roof must match the owner's standards for appearance. The desired result of the laps should be a small uniform pencil line bead of compound visible at all the laps.

K. Roof Drain:
1. Plug drain to prevent debris from entering plumbing.
2. Run complete roof system plies over drain. Cut out plies inside drain bowl.
3. Set 4lb. lead flashing (thirty (30) inch square minimum) in ¼ inch bed of mastic. Run lead into drain a minimum of two (2) inches. Prime lead at a rate of one hundred (100) square feet per gallon and allow to dry.
4. Install base flashing ply (forty (40) inch square minimum) per specification.
5. Install thermoplastic membrane (forty-eight (48) inch square minimum) in the specified flashing adhesive. Stop both flashings plies short of the clamping ring and seal edge of modified flashing plies with a heat welded finish.
6. Install clamping ring over lead flashing.
7. Remove drain plug and install strainer.

L. Exhaust Fan/Passive Vent/Air Intake:
1. Minimum curb height is eight (8) inches off the finished roof surface. As required, raise existing curbs to the required height. Prime vertical curb surface at a rate of one hundred (100) square feet per gallon and allow to dry.
2. Set cant in bitumen. Run base roofing ply over cant a minimum of two (2) inches.
3. Install base flashing ply in the specified adhesive covering curb with six (6) inches on to field base ply of the roof.
4. Install thermoplastic cap field ply run over the base flashing ply in foam adhesive.
5. Install the thermoplastic flashing ply in adhesive nine (9) inches on to the field of the roof
6. Install passive vent/air intake over the wood nailers and flashing to act as counter-flashing. Fasten per manufactures recommendations.

M. Plumbing/Soil Stack:
1. Minimum stack height is twelve (12) inches.
2. Run roof base ply over the entire surface of the roof. Seal the base of the stack with elastomeric sealant.
3. Prime flange of new lead sleeve. Install properly sized lead sleeve set in ¼ inch bed of roof cement.
4. Install base flashing ply in the specified adhesive.
5. Install thermoplastic membrane in the specified flashing adhesive.
6. Caulk the intersection of the membrane with elastomeric sealant.
7. Turn sleeve a minimum of one (1) inch down inside of stack.

N. Pitch Pocket:
1. Run all base plies up to the penetration.
2. Place the pitch pocket over the penetration and prime all flanges.
3. Strip in flange of pitch pocket with one (1) ply of base flashing ply in the specified adhesive. Extend six (6) inches onto the base ply of the field of roof.
4. Install thermoplastic membrane in the specified flashing adhesive and extend nine (9) inches onto field of the roof.
5. Fill pitch pocket half full with non-shrink grout. Let this cure and top off with specified two-part pourable sealer.
6. Caulk joint between roof system and pitch pocket with the specified elastomeric asphaltic sealant.

O. Heat Stack:
1. Minimum stack height is twelve (12) inches.
2. Run roof system over the base plies of the entire surface of the roof. Seal the base of the stack with elastomeric asphaltic sealant or roof cement.
3. Prime flange of new sleeve. Install properly sized sleeves set in ¼ inch bed of roof cement.
4. Install base flashing ply in the specified flashing adhesive.
5. Install thermoplastic membrane in the specified flashing adhesive.
6. Caulk the intersection of the membrane with roof cement.
7. Install new collar over cape. Weld collar or install stainless steel draw brand.

P. Pre-manufactured Curb for Equipment Support:
1. **Secure curb to roof deck.** Minimum flashing height of curb shall be eight (8) inches above finished roof. Prime vertical at a rate of one hundred (100) square feet per gallon and allow to dry.
2. Run all base field plies to the top edge of cant strip and seal with asphalt mastic to a watertight condition.
3. Install base flashing ply in the specified adhesive covering pre-manufactured curb with six (6) inches on to field base ply of the roof.
4. Install thermoplastic membrane field ply over the base flashing ply in the specified foam adhesive.
5. Install the thermoplastic flashing ply in the specified flashing adhesive over the base flashing ply**,** nine (9) inches on to field of the roof.
6. Terminate the flashing system at the top of the curb and fasten with cap nails at eight (8) inches on center. Install a 0.040” aluminum slip flashing under the equipment support

cover and fasten to the curb at eight (8) inches on center with neoprene gasketed screws. The slip flashing shall cover the top of the flashing system three (3) inches minimum.

Q. Skylight/Roof Hatch:
1. Minimum curb height is eight (8) inches. Prime vertical at a rate of one hundred (100) square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field base plies over cant a minimum of three (3) inches.
3. Install base flashing ply covering curb in the specified adhesive with six (6) inches on to field base ply of the roof.
4. Install thermoplastic membrane field ply over the base flashing ply in the specified foam adhesive.
5. Install the thermoplastic flashing ply in the specified flashing adhesive over the base flashing ply**,** nine (9) inches on to field of the roof.
6. Install pre-manufactured lens and fasten flashing sides at eight (8) inches o.c. with fasteners and neoprene washers.
7. Install 0.040" aluminum counterflashing and fasten at eight (8) inches o.c. with fasteners and neoprene washers.

R. Curb Detail/Air Handling Station:
1. Minimum curb height is eight (8) inches. Prime vertical at a rate of one hundred (100) square feet per gallon and allow to dry.
2. Set cant in bitumen. Run all field base plies to the top edge of cant strip and seal with asphalt mastic to a watertight condition.
3. Install base flashing ply in the specified adhesive covering curb with six (6) inches on to field of the roof.
4. Install thermoplastic membrane field ply over the base flashing ply in the specified foam adhesive.
5. Install the thermoplastic flashing ply in the specified flashing adhesive over the base flashing ply**,** nine (9) inches on to field of the roof.
6. Install a 0.040" aluminum slip flashing under the existing counterflashing and over the roof flashing system, and fasten to the curb at eight (8) inches on center with neoprene gasketed screws. The slip flashing shall cover the top of the flashing system three (3) inches minimum.

S. Surface Mounted Counter-Flashing:
1. The new surface mounted counter shall be installed to provide a minimum of eight (8) inches of flashing height from the top of roof to the termination bar securing the roof flashing system.
2. Maximum flashing height is twenty-four (24) inches. Prime vertical wall at a rate of one hundred (100) square feet per gallon and allow to dry.
3. Set cant in bitumen. Run all field base plies to the top edge of cant strip and seal with asphalt mastic to a watertight condition.
4. Install base flashing ply in the specified adhesive covering wall with six (6) inches on to field of the roof.
5. Install thermoplastic membrane field ply over the base flashing ply in the specified foam adhesive.
6. Install the thermoplastic flashing ply in the specified flashing adhesive over the base flashing ply**,** nine (9) inches on to field of the roof.

7. Install the specified termination bar even with the top of the flashing, and secure the termination bar through flashing and into wall every six (6) inches on center. Seal top of termination bar and flashing system with specified elastomeric asphaltic sealant or a three-course application of specified mastic and mesh.
8. Install the new surface mounted counterflashing on the wall and secure with neoprene gasketed screws at 8" on center. End joints shall be interlocking and overlapping not less than 3". Corners shall be mitered and welded to a watertight condition. The bottom of the cap flashing insert shall project ¼" from the face of the wall with a down turned drip edge (provide a down turned hem in areas subject to human contact). The new counterflashing shall extend down over the roof flashing system a minimum of four (4) inches below the termination bar.

T. Pre-Manufactured Metal Edge Flashless Fascia System:
1. Inspect the nailer to assure proper attachment and configuration prior to installing the roof system. Install new wood nailers as required and/or specified to achieve the proper height of one (1) blocking higher than the thickness of the insulation system and recovery board. **Wood nailers shall be set for one (1) blocking higher than the highest thickness of insulation and roof recovery board, and shall be maintained constant around the perimeter of the roof.**
2. Install tapered edge/cant strip in adhesive to create a smooth transition from roof system to wood blocking.
3. Run base roofing ply over the edge. **Assure coverage of all wood nailers**. Fasten plies with ring shank nails at eight (8) inches o.c.
4. Run thernoplastic roofing ply to the outside edge of the roof.
5. **Install new metal fascia/extender system(s) with continuous cleats. Fasten to wood fascia as specified.**
6. Install two (2) ¼" wide beads of GreenLock Sealant XL on the bottom surface of the anchor bar flange. Install the new extruded anchor bar onto the modified membrane roof ply and over the edge of the roof, and face fasten the anchor bar to the wood blocking/structure through pre-punched slots every 12" o.c. staggered. The anchor bars shall be butted up next to each other leaving a minimum gap. Install the splice plate at each anchor bar joint.
7. Install compression seals every 40" o.c. in the slots located at the top of the extruded anchor bar.
8. Install fascia cover over the extruded anchor bar and press downward firmly until "snap" occurs and the cover is engaged along the entire length.
9. Install a splice plate at each end of the extruded anchor bar.

3.12 FIELD QUALITY CONTROL

A. Perform field inspection and testing as required by this specification.

B. Correct defects or irregularities discovered during field inspection.

C. Require attendance of roofing materials manufacturers' representatives at site during installation of the roofing system

3.13 CLEANING

A. Remove bitumen adhesive drippings from all walls, windows, floors, ladders and finished surfaces.

B. In areas where finished surfaces are soiled by bitumen or any other sources of soiling caused by work of this section, consult manufacturer of surfaces for cleaning instructions and conform to their instructions.

C. Repair or replace defaced or disfigured finishes caused by work of this section.

3.14 FINAL INSPECTION

A. At completion of roofing installation and associated work, meet with Contractor, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

C. The roofing system manufacturer and/or Owner reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor at a negotiated price.

D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.

E. Repair or replace deteriorated or defective work found at time above inspection as required to produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. Notify the Owner and roofing system manufacturer upon completion of corrections.

G. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.

END OF SECTION 07 52 00

SECTION 07 53 23 - EPDM MEMBRANE ROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Elastomeric roofing membrane, adhered conventional application.
B. Polyisocyanurate insulation, flat and tapered.
C. Flashings.
D. Roofing stack boots, roofing expansion joints, 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 53 - Miscellaneous Carpentry: Wood nailers and curbs.
C. Section 07 21 00 – Thermal Insulation: Mineral wool insulation for Roof Types R6, R6.A, and R8.
D. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings, reglets.
E. Section 07 71 00 - Roof Specialties: Copings, fascia, prefabricated roofing expansion joint flashing; to be included in roofing system warranty.
F. Section 07 72 00 - Roof Accessories: Roof-mounted units; prefabricated curbs.
G. Section 22 10 06 - Plumbing Piping Specialties: Roof drains.
H. 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 33 00 – Submittals.
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.
C. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer.
   1. Upon request of the Architect or Owner, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the 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 36 - Warranties 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. Basis of Design Manufacturer: Carlisle Syntec Systems, Inc: www.carlisle-syntec.com.
   2. Other Manufacturers: Products by the following manufacturers are acceptable subject to compliance with the requirements of this section.
      a. Versico Roofing Systems: https://www.holcimelevate.com/.
      b. Elevate; Amrize Building Envelope LLC: https://elevatecommercialbp.com/us-en.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ROOFING

A. Elastomeric Membrane Roofing: One ply membrane, fully adhered, over insulation and cover-board.

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. Minimum 2 layers of 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. Color: Black.

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.
   1. Thickness: 60 mil.
   2. Tensile Strength: 1,200 psi.
   3. Elasticity: 50 percent with full recovery without set.
   4. Color: Black.

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. Dens Deck Prime, Georgia-Pacific Gypsum.
    b. Securock Ultra Light Coated; USG
    c. Gold Bond DEXcell Glass-Mat Roof Board; National Gypsum

2.05 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. Board characteristics
      a. Minimum LTTR value (ASTM C 1289): R-5.6.
      b. Compressive Strength: 20 psi.
      c. Board Size: 48 by 96 inch.
      d. Board Thickness (base layer): 1.7 inch minimum.
      e. Board Edges: Square.
   2. Installation parameters
      a. Flat board insulation: Total 5 1/2", applied in two layers.
      b. Tapered board insulation: Slope as indicated; minimum thickness 5 inch; fabricate of fewest layers possible.
         1) Minimum slope: 1/4 inch per foot.
      c. Sumps at drains: 4'-0" square; 1/2" per foot slope.

2.06 ACCESSORIES

A. Prefabricated Roofing Expansion Joint Flashing: Sheet butyl over closed-cell foam backing seamed to stainless steel flanges.
B. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
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.
H. 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.
I. Air and vapor barrier: Provide air and vapor barrier between metal deck and board insulation.

1. Acceptable Products:
   a. Carlisle Syntec, VapAir Seal MD.
   b. Versico Roofing Systems, VapAir Seal MD
   c. Elevate; Amrize Building Envelope LLC, V-Gard

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 - UNDER MEMBRANE

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 parallel to flutes with insulation board edges bearing on deck 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 with end joints staggered between rows. Adhesive attach cover board, 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 over cant strips and 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 associated 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 07 53 23

SECTION 076200 – SHEET METAL FLASHING AND TRIM

1.1 MANUFACTURED ROOF COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet concealed anchorage, concealed fasteners, concealed splice plates with same finish as coping caps, mitered corner units, and end cap units, including corners and special shapes.

B. Basis-of-Design Product:

1. Carlisle Syntec Systems - SecurEdge 200 Gold Coping (Tapered Version) Or a comparable product by one of the following:

    a. ATAS International, Inc.
    b. Cheney Flashing Company.
    c. Merchant & Evans, Inc.
    d. Metal-Era, Inc
    e. MM Systems Corporation.
    f. Perimeter Systems, a division of Southern Aluminum Finishing Co.
    g. W. P. Hickman, Company
    h. Petersen Aluminum Corp.

2. Coping Caps: Snap-on fabricated from the following exposed metal: Aluminum: 0.050 inch minimum.

3. Corners: Continuously welded or mechanically cinched and sealed watertight.

4. Color: to be selected by architect from manufacturer's full range of finishes

5. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches (300 mm) wide, 0.028 inch (0.7 mm) thick, with integral cleats.

6. Face Leg Cleats: Concealed, continuous galvanized steel sheet.

1.2 MANUFACTURED ROOF EDGE FLASHINGS

A. Gravel Stops and Edge Fascia: Manufactured, one-piece, formed-metal gravel stop in section lengths not exceeding 12 feet with a horizontal flange and vertical leg fascia terminating in a drip edge, continuous hold-down cleat, and concealed splice plates of same material, finish, and shape as gravel stop. Provide mitered and welded or soldered corner units.

1. Basis-of-Design Product: Provide same manufacturer as coping.

2. Fabricate from the following exposed metal: Formed Aluminum: 0.050 inch.

3. Height: Refer to Drawings

4. Color: to be selected by architect from manufacturer's full range of finishes Corners: Continuously welded or mechanically cinched and sealed watertight.

5. Snap-on Coping Anchor Plates: Concealed, galvanized steel sheet, 12 inches (300 mm) wide, 0.028 inch (0.7 mm) thick, with integral cleats.

6. Face Leg Cleats: Concealed, galvanized steel sheet.

1.3 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

1. Examine walls, roof edges, and parapets for suitable conditions for manufactured roof specialties.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 INSTALLATION

A. General: Install manufactured roof specialties according to manufacturer's written instructions. Anchor manufactured roof specialties securely in place and capable of resisting forces specified in performance requirements. Use fasteners, separators, sealants, and other miscellaneous items as required to complete manufactured roof specialty systems.

1. Install manufactured roof specialties with provisions for thermal and structural movement.

2. Torch cutting of manufactured roof specialties is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of aluminum manufactured roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing exposed-to-view components of manufactured roof specialties directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Install manufactured roof specialties level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks.

D. Install manufactured roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

E. Expansion Provisions: Provide for thermal expansion of exposed manufactured roof specialties. Space movement joints at a maximum of 12 feet (3.6 m) with no unplanned joints within 18 inches of corners or intersections.

F. Fasteners: Use fasteners of type and size recommended by manufacturer but of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

G. Seal joints with elastomeric sealant as required by manufacturer of roofing specialties.

2.3 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to resist uplift and outward forces according to performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's recommended spacing.

2.4 ROOF EDGE FLASHING INSTALLATION

A. Install cleats, cant dams, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings to resist uplift and outward forces according to performance requirements.

2.5 ROOF EDGE DRAINAGE SYSTEM INSTALLATION

A. General: Install parapet scuppers to produce a complete roof drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.

2.6 EXPOSED FLASHING INSTALLATION

A. Counterflashings: Coordinate installation of exposed flashing, and brick caps with installation of adjacent finish materials. Insert minimum 4 inches behind metal panels and bed with sealant.

2.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as manufactured roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace manufactured roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 07 62 66 - FLUID APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES
- A. Fluid Applied Vapor Permeable Air Barrier.
- B. Flashings.
- C. Flashing Primer.
- D. Sealant.
- E. Thru-wall Flashing.

1.02 RELATED REQUIREMENTS
- A. 04 20 00 – Unit Masonry: Installation work results.
- B. 07 21 00 – Thermal Insulation: Board insulation used in exterior wall cavities.
- C. 07 25 00 – Weather Barriers: Sheet-applied membrane barriers.
- D. 07 62 00 – Sheet Metal Flashing and Trim: Through-wall flashings.
- E. 09 21 16 – Gypsum Board Assemblies: Installation work results.

1.03 REFERENCE STANDARDS
- A. American Architectural Manufacturers Association (AAMA):
  1. AMMA 2400-02, Standard Practice for Installation of Windows with a Mounting Flange in Stud Frame Construction
- B. American Society for Testing and Materials (ASTM):
  1. ASTM D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension
  2. ASTM D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
  3. ASTM D2243, Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings
  4. ASTM D5590, Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
  5. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
  6. ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials
  7. ASTM E1677, Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls
  8. ASTM E2112, Standard Practice for Installation of Exterior Windows, Doors and Skylights
  9. ASTM E2178, Standard Test Method for Air Permeance of Building Materials
  10. ASTM E2357, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- C. National Fire and Protection Agency (NFPA):
  1. NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.04 SUBMITTALS
- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Action Submittals

1. Product Data
    a. Air Barrier Manufacturer's guide specification.
    b. Air Barrier Manufacturer's technical data sheets.
    c. Air Barrier Manufacturer's details.

C. Certificates
1. Product certification that the assembly components are supplied and warranted by a single-source Air Barrier Manufacturer.
2. LEED HPD declaration.
3. Declaration Status: LBC Red List Free.

D. Tests and Evaluation Reports
1. NFPA 285 wall assembly compliance
    a. Air Barrier Manufacturer's statement that the anticipated wall assembly complies with NFPA 285.

E. Sample warranty as specified.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility:
1. Obtain air barrier, flashings, sealants and primers from a single Air Barrier Manufacturer regularly engaged in the manufacturing and supply of the specified products.
2. Verify product compliance with federal, state, and local regulations.

B. Manufacturer Qualifications:
1. Air Barrier Manufacturer must not issue warranties for terms longer than they have been manufacturing and supplying specified products for similar scope of Work.

C. Installer Qualifications:
1. Perform Work in accordance with Air Barrier Manufacturer published literature and as specified in this section.
2. Maintain one (1) copy of Air Barrier Manufacturer's installation instructions on site.
3. Allow the Air Barrier Manufacturer representative site access during installation.
4. Contact the Air Barrier Manufacturer a minimum of two weeks prior to scheduling a meeting.

1.06 MOCKUPS

A. Mock-ups
1. Incorporate products into wall assembly mockups required in the Drawings or elsewhere in the Specifications to verify selections made under submittals and to set quality standards for materials and execution.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials
1. Deliver materials to the jobsite in undamaged and clearly marked containers and/or wrapping indicating the name of the Air Barrier Manufacturer and product.

B. Storage of Materials
1. Store materials as recommended by the Air Barrier Manufacturer and conform to applicable safety regulatory agencies. Refer to all applicable data including, but not limited to, Safety Data Sheets, Product Data sheets, product labels, and specific instructions for personal protection.
2. Keep solvents away from open flame or excessive heat.
3. Store rolled materials on end.

C. Handling
1. Product requirements may vary. Refer to product specific Safety Data Sheet.

1.08 FIELD CONDITIONS
A. Environmental Requirements
1. Do not perform Work during rain.
2. Do not perform Work on frost covered or wet substrates.
3. Product requirements may vary. Refer to product specific Technical Data Sheet.
B. Protection
1. It is the responsibility of the installing Subcontractor to protect all surfaces not included in scope of Work from damage.
2. Protect top and backside of substrate walls against bulk water during and after application of air barrier.
C. Complete preparation Work prior to installing the air barrier assembly.
D. WARRANTY
1. Manufacturer Material Warranty
a. Provide Air Barrier Manufacturer's standard ten (10) year material warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Basis of Design Manufacturer
1. Henry Company, 999 N. Pacific Coast Highway, Suite 800 El Segundo, CA 90245, (800) 486-1278, www.Henry.com.
B. Acceptable Manufacturers
1. Any whose products comply with the requirements of this Section.
2. Submission requirements for consideration of proposed alternate products
a. Documentation specified in Paragraph 1.04 SUBMITTALS above.
b. Documentation from an independent testing laboratory certifying the performance of the system, including auxiliary components, meets the requirements of this specification.
c. References indicating the Air Barrier Manufacturer has successfully completed projects of similar scope and nature on an annual basis for a minimum of ten (10) years.

2.02 MATERIALS
A. Obtain air barrier and auxiliary materials as a single-source from the Air Barrier Manufacturer to ensure compatibility and compliance with the following requirements:
1. Vertical and lateral flame propagation: Meets IBC NFPA 285 Exception #2 Per ASTM E1354 and ASTM E84.
2. Minimum Application Temperature: +20° F (-6° C).
3. Service Temperature: -40 °F to +180 °F (-40 °C to +82 °C).
4. Water Vapor Permeance (ASTM E96)
a. Method B: 14 perms.
5. Water Absorption (ASTM D570): 5.6%.
6. Surface Burning Characteristics (ASTM E84)
a. Flame Spread Index: 10, Class A.

b. Smoke developed: 15, Class A.
7. VOC Content, max (EPA Method 24): 100g/L Method 24.
8. Declaration Status: LBC Red List Free.

B. Fluid Applied Vapor Permeable Air Barrier (Basis of Design):
1. Single-component, water-based, water-resistive air barrier designed to provide a vapor permeable air and water barrier when applied on above-grade wall assemblies, having the following typical properties:
a. Basis of Design: Henry® Air-Bloc® 17MR Fluid Applied Vapor Permeable Air Barrier.
b. Color: Graphite.
c. Vertical and lateral flame propagation: Meets IBC NFPA 285 Exception #2 per ASTM E1354 and ASTM E84.
d. Solids Content
1) Weight: 63%.
2) Volume: 53%.
e. Minimum Application Temperature: +20 °F (-6 °C).
f. Service Temperature: -40 °F to +180 °F (-40 °C to +82 °C).
g. Water Vapor Permeance (ASTM E96)
1) Method B: 14 perms.
h. Air Permeance
1) Material (ASTM E2178): 0.0001 cfm/ft2 (0.0005 L/s.m.2).
2) Air Leakage – Assembly (ASTM E2357): Pass.
i. Elongation (ASTM D412): 250%.
j. Tensile Strength (ASTM D412): 140 psi.
k. Nail Sealability (AAMA 711/ASTM D1970 modified): Pass.
l. Water Absorption (ASTM D570): 5.6%.
m. Surface Burning Characteristics (ASTM E84)
1) Flame Spread Index: 10, Class A.
2) Smoke developed: 15, Class A.
n. Fire Testing (NFPA 285): Complies in various assemblies.
o. VOC Content, max (EPA Method 24): 100g/L Method 24.

C. Auxiliary Materials
1. Flashings; choose from the following:
a. Liquid-applied flashing
1) Moisture-cure one component elastomeric liquid applied flashing using an STPE (Silyl-Terminated Polyether) polymer.
(a) Basis of Design: Henry® Air-Bloc LF® Liquid Applied Flashing.
(1) Color: Blue.
b. Self-Adhered flashing:
1) Vapor impermeable, self-adhered water resistive air and vapor barrier consisting of an SBS rubberized asphalt compound, integrally laminated to a blue engineered thermoplastic film.
(a) Basis of Design: Henry Blueskin® SA Self-Adhered Water Resistive Air Barrier.
(b) Color: Blue.

D. Adhesives/Primers for Self-Adhered Flashing
   1. Standard VOC
      a. Synthetic rubber based quick setting adhesive; having the following typical physical properties.
      b. Basis of Design: Henry® Blueskin® Adhesive.
         1) Color: Blue.
         2) VOC Content, max (EPA Method 24): 450g/L Method 24.
   2. Low VOC
      a. Synthetic rubber based quick setting adhesive with low VOC content; having the following typical physical properties.
         1) Basis of Design: Henry® Blueskin® LVC Adhesive.
            (a) Color: Blue.
            (b) VOC Content, max (EPA Method 24): <240g/L Method 24.
      b. Polymer emulsion-based primer for self-adhered membranes, and having the following typical properties:
         1) Basis of Design: Henry® Aquatac™ Primer.
            (a) Color: Aqua.
            (b) VOC Content, max (EPA Method 24): 50g/L Method 24.

E. Sealants
   1. Moisture cure, medium modulus polymer modified sealing compound, having the following typical properties:
      a. Basis of Design: Henry® 925 BES Sealant
      b. Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
      c. Complies with ASTM C920, Type S, Grade NS, Class 35.

F. Thru-Wall Flashing
   1. Vapor impermeable, self-adhered water resistive air and vapor barrier consisting of an SBS rubberized asphalt compound, integrally laminated to a yellow engineered thermoplastic film, having the following typical properties:
      a. Basis of Design: Henry® Blueskin® TWF Self-Adhered Thru-Wall Flashing
      b. Color: Yellow.

PART 3 EXECUTION

3.01 EXAMINATION

A. It is the installing Subcontractor's responsibility to verify the substrate is in accordance with Air Barrier Manufacturer requirements and as specified in this Section prior to installation of air barrier. Commencement of the Work or any parts thereof, indicates installer acceptance of the substrate.
   1. Acceptable substrates include exterior-grade gypsum sheathing, plywood, OSB, precast or cast-in-place concrete, CMU, primed steel, aluminum mill finish, anodized aluminum, and galvanized metal.
   2. Verify surfaces are sound, clean and free of frost, oil, grease, dirt, excess mortar or other contaminants.
   3. Substrate must be continuous and secure.
   4. Sheathing fasteners must be installed into solid backing and set flush with sheathing.

5. Masonry joints must be struck flush. Allow fresh CMU mortar joints to cure for a minimum of thirty-six (36) hours.
6. Tie holes/voids in poured concrete to be flush and smooth shall be filled. Allow new concrete to cure a minimum of sixteen (16) hours after forms are removed.
7. Top and backside of substrate walls must be protected against bulk water during and after application of air barrier.
8. Curing compounds must be resin based without oil, wax or pigments. Substrates must be free of form release agents.

B. Notify contractor in writing of any conditions that are not acceptable.

C. Do not apply air barrier assembly components until substrate and environmental conditions are in accordance with Air Barrier Manufacturer's published literature.

3.02 PREPARATION

A. Verify surfaces are in accordance with the product specific technical data sheet and as stated in this specification.

B. Protection

1. Protect top and backside of substrate walls against bulk water during and after application of air barrier.

3.03 INSTALLATION

A. Environmental Requirements

1. Do not perform Work during rain or inclement weather.
2. Do not perform Work on frost covered or wet substrates; can be applied to damp surfaces.
3. Do not perform Work when air and substrate temperatures are below 20 °F (-6 °C).

B. Refer to Air Barrier Manufacturer detail drawings for installation procedures including, but not limited to, the following.

1. Changes in substrate.
2. Control joints.
3. Crack treatment.
4. Inside corners.
5. Outside corners.
6. Penetrations.
7. Rough openings.
8. Sheathing joints.

C. Moving Joints

1. Contact Air Barrier Manufacturer.

D. Contact Air Barrier Manufacturer to coordinate transition of air barrier to adjacent areas including, but not limited to, the following.

1. Roofing.
2. Waterproofing.
3. Fastener penetrations.

E. Thru-Wall Flashing

1. Coordinate with Section 07 62 00.

F. Primary Air Barrier

1. Install air barrier assembly in accordance with Air Barrier Manufacturer product specific TDS, details, guide specification, and technical bulletins to create a monolithic air and watertight application without sags, runs or voids.

2. Lap air barrier onto flashing a minimum of 1 inch.
3. Application Rate
   a. Application rates and cured dry film thickness are approximate, and may vary depending on texture and porosity of surface.
   b. Smooth surfaces
      1) Wet film thickness (WFT): 70 mils.
      2) Dry film thickness (DFT): 37 mils.
   c. Rough surfaces
      1) Wet film thickness (WFT): 90 mils.
      2) Dry film thickness (DFT): 37 mils.

3.04 FIELD QUALITY CONTROL

A. Final Observation and Verification
   1. Upon completion of the air barrier assembly installation, schedule a field observation to be attended concurrently by Architect and by Air Barrier Manufacturer as required by warranty.

3.05 CLEANING

A. As the Work proceeds, and upon completion, promptly clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing Work.
B. Clean soiled surfaces, spatters, and damage to adjacent areas caused by Work of this Section.
C. Check area to ensure cleanliness and remove debris, equipment, and excess material from the site.

END OF SECTION

SECTION 077100 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including copings.
B. Roof expansion joint covers.

1.02 RELATED REQUIREMENTS

A. Section 04 72 00 – Cast Stone Masonry: Cast stone copings.
B. Section 07 42 13 - Metal Wall Panels: Copings associated with metal wall panel systems
C. Section 07 53 00 - Elastomeric Membrane Roofing: Roof warranty requirements
D. Section 07 72 00 - Roof Accessories: Manufactured curbs and roof hatches.

1.03 PRICE AND PAYMENT PROCEDURES

A. See Section 01 23 00 - Alternates, for alternates affecting the work of this section.

1.04 REFERENCE STANDARDS

A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems 2017.
B. NRCA (RM) - The NRCA Roofing Manual 2019.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
D. Samples: Submit two appropriately sized samples of coping and expansion joint cover.
E. Manufacturer's Installation Instructions: Indicate special procedures, fasteners, supporting members, and perimeter conditions requiring special attention.

1.06 WARRANTY

A. Provide a roofing manufacturer's full system warranty to include roof edge systems.
B. See Section 075300 for warranty requirements.
C. Provide a 20-year warranty for painted finishes, covering color fade, chalk and film integrity.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roof Edge Flashings and Copings:

1. Metal-Era Inc: www.metalera.com.
2. OMG Roofing Products: www.omgroofing.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Expansion Joint Covers:

1. GAF: www.gaf.com/sle.
2. Johns Manville: www.jm.com.
3. MM Systems Corp: www.mmsystemscorp.com.
4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Pipe and Penetration Flashings:

1. Portals Plus: www.portalsplus.com.
2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.

1. Configuration: Fascia, and edge securement for roof membrane.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
3. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
4. Finish: 70 percent polyvinylidene fluoride.
5. Color: To be selected by Architect from manufacturer's full range.
6. Manufacturers:

a. OMG Roofing Products; Terminedge EX: www.omgroofing.com/#sle.
b. Metal-Era, Inc., Anchor-Tite Fascia: www.metalera.com.
c. Substitutions: See Section 01 60 00 - Product Requirements.

B. Copings, Prefabricated Metal

1. Basis of Design

a. Manufacturer: Metal-Era, Inc., www.metalera.com.

1) Cantilevered metal coping: Perma-Tite Gold Cantilever Coping.
2) Other metal copings: Perma-Tite Double-Tapered Coping.

b. Other manufacturers' products are acceptable subject to meeting the requirements of this section.
c. Substitutions: See Section 01 60 00 - Product Requirements.

2. Requirements

a. General

1) All copings

(a) Pull-off resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
(b) Factory-fabricated to sizes required.
(c) Fasteners: Concealed.
(d) Corners: One-piece shop-fabricated construction with mitered angles.

(1) Corners consisting of separate legs joined by sealant-treated lap joints do not meet the intent of this specification.

(e) Installed with manufacturer's accessories, including but not limited to covers, anchor clips, and concealed splice plates.

2) Cantilevered metal coping: Able to cantilever to a maximum of 6" when secured to a minimum 7" structural base.

b. Cover

1) Material: Formed aluminum sheet, minimum 0.040 inch thick.
2) Finish: 70 percent polyvinylidene fluoride.
3) Color: To be selected by Architect from manufacturer's full range.

C. Expansion Joint Covers: Composite construction of 6 inch wide flexible compatible flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges. designed for nominal joint widths indicated in structural drawings. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

D. Pipe and Penetration Flashing: Base of rounded aluminum, compatible with specified roof systems, and capable of accommodating pipes sized between 3/8 inch and 12 inch.

2.03 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

2.04 FINISHES

A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

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 and NRCA (RM) applicable requirements.

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

SECTION 077200 - ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A. Manufactured curbs.
- B. Equipment rails.
- C. Pipe, duct, and conduit mounting pedestals.
- D. Roof hatches.

1.02 RELATED REQUIREMENTS
- A. Section 07 53 00 - Elastomeric Membrane Roofing
- B. Section 07 71 00 - Roof Specialties: Other manufactured roof items.

1.03 DELIVERY, STORAGE, AND HANDLING
- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

1.04 WARRANTY
- A. Correct defective Work within a two year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURED CURBS
- A. General
  1. Factory-fabricated hollow sheet metal construction with fully mitered and sealed corner joints welded or mechanically fastened, integral counterflashing, internal reinforcing, and tops, sides and edges formed to shed water.
  2. Height
     a. Above Roof Deck: 16 inches, minimum.
     b. Above Finished Roof Surface: 8 inches, minimum
- B. Manufactured Curbs
  1. Sheet Metal: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G90 coating designation; 18 gage, 0.048 inch thick.
  2. General configuration
     a. Bases
        1) Configured to match slopes and configuration of roof decks.
        2) With mounting flanges for installation directly on roof deck, not on insulation.
     b. Tops: Level.
     c. See Drawings for specific layouts and configurations of individual assemblies.
  3. Curbs Adjacent to Roof Openings: Provide curb with horizontal top surface for mounting equipment on each side of opening.
     a. Provide preservative treated wood nailers along top of curb.
     b. Insulate inside curbs with 1-1/2 inch thick fiberglass insulation.
- C. Equipment Rails
  1. Two-sided curbs in straight lengths with horizontal top surface for mounting equipment.
  2. Provide preservative treated wood nailers along top of rails.
  3. Height
     a. Above Roof Deck: 16 inches, minimum.
     b. Above Finished Roof Surface: 8 inches, minimum.

D. Pipe, duct, and conduit mounting pedestals
   1. Vertical posts, minimum 8 inches square unless otherwise indicated.
   2. Provide sliding channel welded along top edge with adjustable height steel bracket, manufactured to fit item supported.
   3. Height
      a. Above Roof Deck: 16 inches, minimum.
      b. Above Finished Roof Surface: 8 inches, minimum.

2.02 ROOF HATCHES AND VENTS

A. Basis of design:
   1. Manufacturer: Bilco Company;: www.bilco.com.
   2. Product: Model L-50TB.
      a. Thermally Broken, with added insulation to frame and cover.
      b. Inside Opening Size: Inside Opening Size: 30” x 96” for access by ships ladder, or 36” x 36” for access by vertical ladder.
      c. Style: Provide flat metal covers unless otherwise indicated.
      d. Mounting: Provide frames and curbs suitable for mounting conditions indicated on the drawings.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Safety Railing System (Roof Hatches): Manufacturer's standard accessory safety rail system mounted directly to curb.
   1. Manufacturers:
      a. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Requirements
      a. 29 CFR 1910.23 compliant, with a safety factor of two.
      b. Posts and Rails: Aluminum tube.
      c. Gate: Same material as railing; automatic closing with latch.
      d. Finish: Manufacturer's standard, factory applied finish.
      e. Fasteners: Stainless steel, Type 316.

C. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.
   4. Latch: Upon closing, engage latch automatically and reset manual release.
   5. Manual Release: Pull handle on interior.
   6. Locking: Padlock hasp on interior.

D. Smoke and Heat Vents (Stage):
   1. Basis of Design:
      a. Manufacturer: Bilco Company; www.bilco.com/#sle.
      b. Product: Acoustical Model ACDSV 4896
      c. Substitutions: See Section 01 60 00 – Product Requirements.
   2. Style: Provide flat metal cover unless otherwise indicated.
   3. Mounting Substrate: Provide frames and curbs suitable for mounting on flat roof deck sheathing with insulation.
   4. Sound Rated Hatches: Minimum STC of 46.

5. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   a. Material: Galvanized steel, 14-gauge, 0.0747-inch thick.
   b. Finish: Factory prime paint.
   c. Insulation: Manufacturer's standard; 4-inch fiberboard.
   d. Curb Height: Minimum 12-inches from finished surface of roof.
6. Metal Covers:
   a. Capable of supporting 40-psf live load.
   b. Material: Galvanized steel; outer cover: 14-gauge, 0.0747-inch thick; liner: 22-gauge, 0.03-inch thick.
   c. Finish: Factory prime paint.
   d. Insulation: Manufacturer's standard 4-inch mineral wool.
   e. Gasket: Extruded PVC, continuous around cover perimeter.
7. Where "smoke" or "smoke/heat" operation is indicated, provide the following additional features and also include manual operation for access:
   a. Smoke Release Mechanism: Automatic opening on melting of replaceable UL (DIR) listed fusible link at 165 deg F.
   b. UL (DIR) or FM (AG) listed as automatically operated smoke and heat vent.
   c. Provide 120V, electrically operated curb-mounted resettable release mechanism. Include three-button push control station ('open', 'close', 'stop') for each smoke vent accessible from the stage floor, at location shown.
      1) Bilco Thermolatch II or equivalent product of other listed manufacturers.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

END OF SECTION

SECTION 078400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 07 05 53 - Fire and Smoke Assembly Identification.

B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).

D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.

E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.

F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus 2020.

G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015.

I. ITS (DIR) - Directory of Listed Products current edition.

J. FM (AG) - FM Approval Guide current edition.

K. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.

L. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.

M. UL (DIR) - Online Certifications Directory Current Edition.

N. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD) or FM (AG) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Trained by manufacturer.
   2. Verification of minimum three years documented experience installing work of this type.

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products: www.3m.com/firestop.
   2. Hilti, Inc;: www.us.hilti.com/#sle.
   3. Nelson FireStop Products: www.nelsonfirestop.com.
   4. Specified Technologies Inc: www.stifirestop.com/#sle.
   5. International Fireproof Technology, Inc. ; www.painttoprotect.com/.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

D. Fire Ratings: Refer to drawings for required systems and ratings.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. General:
   1. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
   2. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

B. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.

1. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.

C. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
   1. Movement: Provide systems that have been tested to show movement capability as indicated.

D. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
   1. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

E. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
   1. Temperature Rise: Where penetration is not contained in a wall cavity, provide systems that have been tested to show T Rating equal to F Rating, where required by code.
   2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

2.04 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
B. Remove incompatible materials that could adversely affect bond.
C. Install backing materials to prevent liquid material from leakage.

3.03 COORDINATION

A. Coordinate construction of openings, penetrations and construction joints to ensure that the fire stop systems are installed according to specified requirements.
B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems. Coordinate construction and sizing of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
C. Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.

D. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

3.04 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
C. Install labeling required by code.

3.05 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.06 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.07 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

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.

C. Related items:

1. Fire dampers and manufactured devices: Refer to Division 23 Section HVAC Air Distribution.

1.2 REFERENCES

A. Underwriters Laboratories

1. UL Fire Resistance Directory

a. Through-penetration firestop devices (XHCR)
b. Fire resistance rating (BXUV)
c. Through-penetration firestop systems (XHEZ)
d. Fill, void, or cavity material (XHHW)

B. American Society for Testing and Materials Standards:

C. ASTM E 814-88: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.3 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.

B. Barriers: Time-rated fire walls, smoke barrier walls, time-rated ceiling/floor assemblies and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign material passing through or into barrier or structural floor

such that full thickness of rated materials is not obtained.

E. System: Specific products and applications, classified and numbered by Underwriters Laboratories, Inc. to close specific barrier penetrations.

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+

PENETRATING ITEM	CONCRETE	GYPSUM	WOOD FLOOR/CEILING
Non-Metallic	CAJ2001 FS-195+, 1-inch& 2-inch WIDE, PPD'S CAJ2002 FS-195+ CAJ2003 CS-195+, FS-195+ CAJ2005 FS-195 CAJ2006 FS-195+ CAJ2013 FS-195+ CAJ2019 2000, 2000+, 2003 CAJ2027 FS-195+, CP 25N/S, CP 25S/L, CP 25WB+ CAJ2028 FS-195, MPS-2+ CAJ2029 FS-195+, PPD'S CAJ2030 CS-195+, FS-195+ CAJ2040 FS-195+, CP 25WB+ CAJ2044 FS-195+, CP 25N/S, CP 25S/L CP 25 WB+ CAJ2090 FS-195+ CAJ2177 FS-195+, PPD'S FA2001 FS-195+, PPD'S FS2002 CS-195+, FS-195+, MPS-2+, PPD'S FA2011 FS-195+ WJ2012 FS-195+ 1-inch WIDE	WL2002 FS-195+, PPD'S WL2003 FS-195+ WL2004 FS-195+ WL2005 FS-195+ 4' WIDE WL2006 FS-195+ WL2013 FS-195+ WL2031 CS-195+, FS-195+ WL2032 CS-195+, FS-195+ WL2033 FS-195+ WL2073 FS-195+ 1-inch WIDE	FC2002 FS-195+, PPD'S FC2007 FS-195+, PPD'S FC2008 FS-195+ FC2009 FS-195+, PPD'S FC2024 FS-195 FC2026 FS-195+ FC2028 FS-195, 1' & 2-inch WIDE, PPD'S
Insulated Metallic Pipe	CAJ5001 CP 25N/S, CP 25S/L, CP 25WB+ CAJ5002 FS-195+ CAJ5003 FS-195+ CAJ5005 MPS-2+ CAJ5009 2000+, 2003 CAJ5017 FS-195+, CP 25 CAJ5022 FS-195+ CAJ5024 FS-195+ CAJ5030 CS-195+, FS-195+ CAJ5041 2000, 2000+, 2003 CAJ5060 CP 25WB+ CAJ5074 2000+ CBJ5002 CP 25 CBJ5003 FS-195+ FA5001 FS-195+, CP 25WB+	WL5001 FS-195+ WL5002 FS-195+ WL5009 FS-195+ WL5010 FS-195+ WL5011 CP 25WB+ WL5032 2000+ WL5038 CP 25WB+ WL5039 CP 25WB+ WL5040 CP 25WB+ WL5045 CP 25WB+ WL5053 2000+	FC5002 FS-195+ FC5008 FS-195+
Miscellaneous Mechanical HVAC Ducts	CAJ7001 CP 25N/S CP 25S/L CAJ7003 CP 25WB+ CAJ7009 DUCT WRAP, BULK PUTTY		FC7001 CP 25S/L, CP 25N/S
Mixed Penetrating Items Combos	CAJ8001 CS-195+ FS-195 CAJ8003 2000, 2000+, 20003 CAJ8004 2000, 2000+, 20003 CAJ8006 2001 CAJ8013 FS-195+, CP 25 CBJ8004 CS-195, FS-195+ CBJ8005 CS-195+, MPS-2+ CBJ8008 2001 FA8001 FS-195+, CP 25WB+	WL8002 CS-195+, FS-195+	

*Underwriter's Laboratories, Inc., Fire Resistance Directory.

END OF SECTION

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SECTION 079200 - 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 62 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; 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
    b. Sika Corporation; Sikasil WS-290: 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. Non-fire-rated hollow metal doors and frames.
B. Hollow metal frames for wood doors.
C. Fire-rated hollow metal doors and frames.
D. Thermally insulated hollow metal doors with frames.
E. Oversize, sound-rated, hollow metal doors and frames.
F. Sound-rated hollow metal doors and frames.
G. Bullet-resistant hollow metal frames.
H. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.
B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
C. Section 08 88 13 - Fire-Rated Glazing : Glazing for fire-rated doors and sidelites.
D. Section 09 91 13 - Exterior Painting: Field painting.
E. Section 09 91 23 - Interior Painting: Field painting.

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; 2024.
C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
F. 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; 2024.
G. 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.
H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
K. ASTM E413 - Classification for Rating Sound Insulation; 2022.
L. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
N. ITS (DIR) - Directory of Listed Products; Current Edition.
O. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
P. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.
Q. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
S. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
V. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
W. UL (DIR) - Online Certifications Directory; Current Edition.
X. UL 752 - Standard for Bullet-Resisting Equipment; Current Edition, Including All Revisions.
Y. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
Z. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; 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. Shop Drawings: Include the following:
    1. Elevations of each door design.
    2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
    3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
    4. Locations of reinforcement and preparations for hardware.
    5. Details of anchorages, joints, field splices, and connections.
    6. Details of accessories.
    7. Details of moldings, removable stops, and glazing.
    8. Details of conduit and preparations for power, signal, and control systems.
D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
E. 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. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and

Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

C. 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.

1.08 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
1. Ceco Door, an Assa Abloy Group company: www.cecodoor.com
2. Curries Company, an Assa Abloy Group company: www.curries.com.
3. De La Fontaine: www.delafontaine.com/#sle.
4. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
5. Steelcraft, an Allegion brand: www.allegion.com/sle.
6. Technical Glass Products: www.tgpamerica.com.
7. Substitutions: See Section 01 60 00 - Product Requirements.

B. Sound-Rated Hollow Metal Doors and Frames:
1. AMBICO Limited: www.ambico.com/#sle.
2. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
3. Overly Door Company: www.overly.com/#sle.
4. 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. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 12 gauge continuous channel with pierced holes, drilled and tapped.
D. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets

E. 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.

F. Door Finish: Factory primed and field finished.

G. 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: 16 gauge, 0.053 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.

H. Interior Doors, Non-Fire Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 3 - Extra Heavy-duty.
      b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 2 - Seamless.
      d. Door Face Metal Thickness: 16 gage, 0.053 inch, minimum.
      e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M, at wet locations.
   2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
   3. Door Thickness: 1-3/4 inches, nominal.
   4. Top and Bottom Closures: Flush with top of faces and edges.

I. Fire-Rated Doors:
   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: 16 gage, 0.053 inch, minimum.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
   3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      a. Attach fire rating label to each fire rated unit.
   4. Smoke and Draft Control Doors: Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
      a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.

b. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
c. Label: Include the "S" label on fire-rating label of door.

5. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
6. Door Thickness: 1-3/4 inches, nominal.
7. Top and Bottom Closures: Flush with top of faces and edges.

J. Sound-Rated Interior Doors:

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: 14 gage, 0.067 inch, minimum.
   e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Sound Transmission Class (STC) Rating of Door and Frame Assembly: STC of 52, calculated in accordance with ASTM E413, and tested in accordance with ASTM E90.
   a. Each unit to bear a physical label applied to door certifying the product construction and identifying the specific STC rating
3. Door Core Material: Manufacturer's standard construction as required to meet acoustic requirements indicated.
4. Door Thickness: As listed on the Door Schedule and required to meet acoustic requirements indicated.
5. Door Face Sheets: Flush.
6. Sound Seals: Manufacturer's standard fully adjustable head and jamb seals and bottom seals and threshold as required for STC rating .
7. Opening Force of Sound-Rated Doors, Non-Fire-Rated: 5 pounds 5 pounds, maximum, in compliance with ADA Standards.

K. Bullet-Resistant Doors; Interior and Exterior:

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: 14 gauge, 0.067 inch, minimum.
2. Bullet Resistance: UL 752, Threat Level Rating - Level 2.
3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
4. Door Thickness: As required to meet requirements indicated.
5. Hinge Rail and Reinforcement: Non-beveled edge, reinforced with continuous steel channel, 12 gauge, 0.093 inch minimum metal thickness, welded at 5 inch on center maximum, and compatible with 4-1/2 inch full mortise template and continuous geared hinges.

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. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

G. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

H. Sound-Rated Door Frames: One piece, flush profile, mitered and welded unit, furnished split inside and outside.
   1. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.

I. Bullet-Resistant Door Frames: Comply with UL 752, with same level of bullet resistance as door; face welded construction, ground smooth, fully prepared and reinforced for hardware installation.
   1. Frame Metal Thickness: 12 gauge, 0.093 inch, minimum.

J. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.

K. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
   1. Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame.
   2. Fasten members at crossings and to jambs by butt welding.

L. Transom Bars: Fixed, of profile same as jamb and head.

M. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.

N. Frames in Masonry Walls: Size to suit masonry coursing with head member 2 inch high to fill opening without cutting masonry units.

O. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
   1. Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.

P. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.

Q. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

R. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

S. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.

T. Electrical Thru-Wiring: Provide hollow metal frames receiving electrified hardware with loose wiring harness (not attached to open throat components or installed in closed mullion tubes) and standardized Molex™ plug connectors on one end to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electric through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware".

U. Electrical Knock Out Boxes: Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; including but not limited to, electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as specified in hardware sets in Division 08 Sections "Door Hardware" and "Access Control Hardware".
   1. Provide electrical knock out boxes with a dual 1/2-inch and 3/4-inch knockouts.
   2. Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
   3. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section "Door Hardware".
   4. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.

V. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

W. 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.

X. 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".

Y. 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, 08 88 13.
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.

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. Comply with glazing installation requirements of Section and 08 88 13.

G. Coordinate installation of electrical connections to electrical hardware items.

H. 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.

I. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

J. 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 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid core doors with wood veneer faces.
2. Factory finishing wood doors.
3. Factory fitting wood doors to frames and factory machining for hardware.
4. Light frames and glazing installed in wood doors.

B. Related Sections:
1. Division 06 Section "Interior Architectural Woodwork" for requirements for veneers from the same flitches for both wood doors and wood paneling.
2. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.
3. Division 08 Section "Glazing" for glass view panels in wood doors.
4. Division 08 Sections "Door Hardware" for door hardware for flush wood doors and wood frames.
5. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A208.1 - Particleboard.
2. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
3. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
4. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
6. United States Green Building Council (USGBC).
7. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.
8. Window and Door Manufacturers Association - WDMA I.S. 10 Industry Standard for Testing Cellulosic Composite Materials for Use in Fenestration Products.

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A or AWS classifications. Include factory finishing specifications.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire protection ratings for fire rated doors.

D. Samples for Initial Selection: For factory finished doors.

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.

2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.

    a. Provide samples for each species of veneer and solid lumber required.
    b. Finish veneer faced door samples with same materials proposed for factory finished doors.

3. Frames for light openings, 6 inches long, for each material, type, and finish required.

E. Warranty: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors."

C. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package pre-finished doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
c. Telegraphing of core construction and delaminating of face in decorative laminate-faced doors.

2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION – GENERAL

A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.

B. Environmentally Responsible Doors: Provide where specified doors manufactured with the following environmentally responsible components:

1. Particleboard Core:

a. Certified Wood: Interior wood flush doors (including fire rated doors) to be manufactured in accordance with FSC principles and criteria for wood building component and have FSC Chain of Custody certification.
b. Recycled Content: Interior wood flush doors to contain a minimum of 20% recycled content.
c. Low Emitting Materials: Interior wood flush doors must contain no added urea-formaldehyde resins.

2. Engineered Composite Lumber Core:

a. Certified Wood: Interior wood flush doors (including fire rated doors) to be manufactured in accordance with FSC principles and criteria for wood building component and have FSC Chain of Custody certification.
b. Low Emitting Materials: Interior wood flush doors must contain no added urea-formaldehyde resins.
c. Stiles and Rails: No added urea formaldehyde.

2.2 CORE CONSTRUCTION

A. Engineered Composite Core Wood Doors:

1. Structural Composite Lumber: Engineered hardwood composite wood products tested in accordance with WDMA I.S.1A, Testing Cellulosic Composite Materials for Use in Fenestration Products containing no added Urea Formaldehyde. Comply with minimum performance levels below:

a. Screw Withdrawal, Face: 700 lbf (3100 N).
b. Screw Withdrawal, Edge: 550 lbf (2440 N).

2. Acceptable Manufacturers:

a. Algoma Hardwoods, Inc
b. Ampco
c. Graham Wood Doors
d. Marshfield: DCL
e. Mohawk Doors; a Masonite Company.
f. Vancouver Door Company
g. VT Industries, Inc

B. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.
2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.
3. Blocking: When through-bolted hardware is not used, provide wood blocking in particleboard core doors as follows:

a. 5-inch (125-mm) top-rail blocking, in doors indicated to have closers.
b. 5-inch (125-mm) mid-rail blocking, in doors indicated to have exit devices.

1) Optional Cores for Blocking: Provide doors with either glued-wood-stave or structural-composite-lumber core instead of particleboard core for doors indicated to receive closers and exit devices.

4. Acceptable Manufacturers:

   a. Algoma Hardwoods, Inc
   b. Ampco
   c. Graham Wood Doors
   d. Marshfield Door Systems, Inc
   e. Mohawk Doors; a Masonite Company
   f. Vancouver Door Company
   g. VT Industries, Inc

2.3 VENEERED DOORS FOR TRANSPARENT FINISH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. **Algoma Hardwoods, Inc**
2. **Ampco**
3. **Graham Wood Doors**
4. **Marshfield Door Systems, Inc.**
5. **Mohawk Doors; a Masonite Company**
6. **Vancouver Door Company**
7. **VT Industries, Inc.**

B. Interior Solid Core Doors:

1. Grade and Faces: Face grades as note below; veneer minimum 1/50-inch (0.5mm) thickness at moisture content of 12% or less.

   a. Plain Sliced Select White Maple, A grade faces.

2. Match between Veneer Leaves:

   a. Book match.

3. Assembly of Veneer Leaves on Door Faces:

   a. Running Match.

4. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
5. Room Match: Match door faces within each separate room or area of building. Corridor door faces do not need to match where they are separated by 10 feet or more.
6. Transom Match: Continuous match.
7. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.

8. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.
10. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

2.4 LIGHT FRAMES AND GLAZING

A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer’s standard lipped profile. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire Rated Doors over 20-minute rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.

C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

1. Factory Glazing: Factory install glazing in doors as indicated. Doors with factory installed glass to include all of the required glazing material.

2.5 FABRICATION

A. Factory fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire rated doors.

B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

D. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."

3. Louvers: Factory install louvers in prepared openings.

E. Electrical Raceways: Provide flush wood doors receiving 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 "Door Hardware". Wire nut connections are not acceptable.

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.

1. Grade: Premium.
2. Finish: Meet or exceed WDMA I.S. 1A TR6 Catalyzed Polyurethane finish performance requirements.
3. Staining: As selected by Architect from manufacturer's full range.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 14 16

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.
2. Floor access doors and frames.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof hatches.

2. Section 083113.53 "Security Access Doors and Frames" for access doors and frames for security applications.
3. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 ALLOWANCES

A. Access doors and frames are part of an access door and frame allowance.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details**, fire ratings,** materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, **provide products by one of the following**

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:
1. Metropolitan Door Industries Corp.
2. MIFAB, Inc.
3. Milcor Inc.

C. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

D. Flush Access Doors with Exposed Flanges
1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: **Wall and ceiling**
3. Door Size: **24” x 24”**.

4. Stainless-Steel Sheet for Door: **Nominal 0.062 inch (1.59 mm), @16 gage**.

a. Finish: **As selected by Architect from manufacturers full range of options**.

5. Frame Material: **Same material, thickness, and finish as door**.
6. Hinges: **Manufacturer's standard**.
7. Hardware: Lock.

E. Hardware:

1. Latch: **Slam latch** operated **by flush key**
2. Lock: **by manufacturer**

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

E. Rolled-Stainless-Steel Floor Plate: ASTM A 793, manufacturer's standard finish.

F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, **Type 316**. Remove tool and die marks and stretch lines or blend into finish.

G. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

H. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

I. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than strength and durability properties of Alloy 5005-H15; with minimum sheet thickness according to ANSI H35.2 (ANSI H35.2M).

J. Frame Anchors: Same type as door face.

K. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for **gypsum board** securely attached to perimeter of frames..
2. Provide mounting holes in frames for attachment of units to metal or wood framing.
3. Provide mounting holes in frame for attachment of masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Finish: Architect to select from full range of manufacturer options.

2.6 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.7 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

2.8 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

SECTION 083513 - FOLDING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Accordion folding doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for folding doors.

B. Shop Drawings:

1. Include plans, elevations, sections, and installation details.
2. Include clearances required for operation, **operating and control mechanisms, access requirements, storage pockets and pocket doors,** and accessory items.

3. Fire-Release System: Describe system, including testing and resetting instructions for fire-rated folding doors.

4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For each type of exposed finish.

1. Include Samples of hardware and accessories involving color and finish selection.

E. Samples for Verification: For each type of exposed finish.

1. Include Samples of hardware and accessories to verify color and finish selection.

F. Product Schedule: For folding doors refer to door schedule**.**

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each fire-rated folding door, for tests performed by a qualified testing agency.

C. Evaluation Reports: For fire-rated folding doors, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For folding doors to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of fire-rated folding doors.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install folding doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for building occupants after completion of construction during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PANEL FOLDING DOORS

A. Description: Top-supported, horizontal-sliding, manually operated panel folding doors, with panels joined by continuous hinge connectors for the full height of panels.

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 Moderco**; Signature 842** or comparable product by one of the following:

a. American Folding Door Company, Inc.
b. FolDoor.
c. Panelfold Inc.
d. Woodfold Mfg., Inc;

2.2 OPERATION

A. Manually operated, top supported paired panels.

B. INITIAL SEAL:
1. Bulb seal.

C. FINAL CLOSURE:
1. Telescopic closure panel equipped with a telescopic jamb mounted to a rack and pinion mechanism and extended with a lever handle.

2.2 PANEL CONSTRUCTION

A. Nominal 4" [102mm] thick panels, up to 48 1/2" [1230mm] width. Framing members to be steel-braced mechanically fastened 6065-T5 aluminum alloy extrusions. Thinnest extrusion section to be no less than 3/32" [2.5mm]. Trolley pipes welded to 1 1/2" X 1 1/2" X 3/32" [38mm X 38mm X 2.5mm] steel tube mechanically fastened to top frame extrusion. Panel cavity to be filled with acoustical insulation. Panel faces to be removable and replaceable on site to accommodate changes in room function, interior finishes, etc.

B. ACOUSTICAL RATING :
1. 52 STC.

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C. PANEL FACE CONSTRUCTION
1. STC 52: galvannealed steel skins laminated to 1/2" [13mm] gypsum board. Steel thickness based on STC rating.

D. HINGES:
1. (With protective trims) Discreet steel hinges blend into the shape of the frame extrusion.

E. VERTICAL TRIMS:
1. Protective trims cover and protect all edges of the panel faces and face finish.

F. PANEL WEIGHT:
1. Between 6 to 10.5 lbs/sq.ft [29.5 to 51.5 kg/sq.m] (based on STC rating).

2.4 PANEL FINISHES

A. Face finish shall be (select as required):
1. Factory applied Class A reinforced vinyl wallcovering with woven backing, weighing 21 oz/lin.yard [545 g/lin.m]. Color selected from manufacturer’s standard color selector.

B. Panel frame finish shall be (select one):
2. Powder coating. Color selected from RAL Classic color system. (Optional)

2.5 SOUND SEALS

A. VERTICAL SEALS:
1. Dual aluminum and pvc tongue and groove interlocking seals in each panel edge.

B. HORIZONTAL SEALS:

4. Type AA: Automatically operated top and bottom seals. Top and bottom seals extend and retract simultaneously without use of a tool. Top and bottom seals retract automatically when panel is pulled away from wall or adjacent panel. (Optional)

a. AA-1.5: 1" [25mm] track clearance. 1 1/2" [38mm] floor clearance with 3/4" [19mm] operating range.

2.6 Suspension system

A. TRACK & TROLLEYS:

1. #45-T aluminum track: 6063-T6 aluminum alloy extrusion with integral soffit trim supported by pairs of 3/8" [10mm] dia. threaded rods connected to structural support, with or without optional hanger brackets.

a. #45 trolley: Each trolley shall have four precision ground ball bearing wheels with nylon tires.
b. Usage: For panels up to 15'-3" [4648mm] height.
c. Articulated trolley body will keep all wheels on track rolling surfaces at all times.
d. Each panel to be supported by one trolley.

B. TRACK FINISH:

1. Aluminum track finish shall be (select one):
a. Powder coating. Color selected from RAL Classic color system. (Optional)

2. Steel track finish shall be:
a. Powder coating. Color selected from RAL Classic color system. (Optional)

2.7 OPTIONAL FINISHES

D. Pocket door:

1. Acoustical pocket door of same construction and same finish as partition panels.
2. Non-acoustical pocket door of same basic construction and same finish as partition panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. For folding doors supported by or anchored to permanent construction, advise installers of specific requirements for placement of anchorage devices. Furnish installers of other work with templates and drawings indicating locations of anchorage devices and similar items.

3.3 INSTALLATION

A. General: Install folding doors complying with manufacturer's written installation instructions. Install track in one piece.

B. Standard Floor Clearances: 1/4 to 3/4 inch (6.4 to 19 mm) maximum (above floor finish).

3.4 ADJUSTING

A. Adjust units to ensure smooth, quiet operation without warping or binding. Adjust hardware to function smoothly. Confirm that latches engage accurately and securely without forcing or binding.

B. Pocket Doors: Adjust to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-rated folding doors.

END OF SECTION 083513

SECTION 08 41 13 - ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Exterior and Interior storefront framing.
2. Interior manual-swing aluminum entrance doors.
3. Steel elements clip angles, brackets, and reinforcing for storefront and securing same to abutting construction

B. Related Sections:

1. Division 7, Section "Sealants"
2. Division 8, Section 081416 - “Flush Wood Doors” for wood doors in modified aluminum frames.
3. Division 8, Section 088000 - "Glazing" for glass and glazing materials
4. Division 8, Section 084413 - “Glazed Aluminum Curtain Walls”.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.

2. Dimensional tolerances of building frame and other adjacent construction.

3. Failure includes the following:

    a. Deflection exceeding specified limits.
    b. Thermal stresses transferring to building structure.
    c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
    d. Noise or vibration created by wind and by thermal and structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.
    f. Sealant failure.
    g. Failure of operating units.

B. Structural Loads:

1. Wind Loads:

    a. Basic Wind Speed: 90 mph.
    b. Importance Factor: 1.15.
    c. Exposure Category: B.

2. Design Wind Pressure: System shall be designed to withstand the following loads normal to the plane of the wall:

    a. Pressure (Positive and negative) of not less than 35 PSF at non-corner zones.
    b. Pressure (Positive and negative) of not less than 35 PSF at corner zones.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested

according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.27 lbf/sq. ft. (300 Pa).

1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

G. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

3. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

H. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 66 when tested according to AAMA 1503.

I. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.36 Btu/sq. ft. x h x deg F when tested according to AAMA 1503.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Engineering Analysis: Provide data indicating compliance with all performance requirements and design criteria indicated.

1. Provide load analysis, design calculations and/or manufacturers design tables, fully demonstrating compliance with lateral design loads as well as gravity loading as applicable. Indicate reinforcing, anchorage and bracing and other supports and engineering analysis.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Submit a set of two (2) samples of required aluminum finish, showing extremes of color and appearance, on minimum 4" long extrusions of the alloys to be used for the Work.

1. The right is reserved to require samples of typical fabricated sections, showing joints, exposed fastenings (if any), quality of workmanship, hardware and accessory items, before fabrication of the Work proceeds.

F. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Qualification Data: For qualified Installer.

H. Welding certificates.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

J. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

K. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Framed Storefront Systems: Basis-of-Design Product and Subject to compliance with requirements, provide Kawneer North America; Series 450 and 451UT, center set outside glazed, Storefront Framing, or comparable product by one of the following:

1. EFCO Corporation 433T
2. Tubelite Inc.
3. United States Aluminum.
4. Vistawall Architectural Products
5. YKK

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch nominal width. Kawneer 500 series or equal

    a. Bottom rail: not less than 10 inches above floor or ground plane and complying with accessibility requirements.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets. Provide nonremovable glazing stops on outside of door.
4. Entrance Door Hardware: As specified in Division 8 Section "Door Hardware."

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction:

a. Exterior Storefront: Thermally improved.
b. Interior and Vestibule Storefront: non-thermally broken.

2. Glazing System: Retained mechanically with gaskets on four sides.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components. Provide reinforcing as required to achieve design loading indicated.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Attachments, Supports and Bracing: All work and components required for proper installation - but not indicated - shall be the responsibility of the window wall systems installer. Installer shall provide all components, materials and equipment necessary for the complete and operational installation of products and materials described here. Any work, including supports, brackets, anchorage, miscellaneous steel, not indicated on the drawings to be provided by others, shall be the responsibility of the installer.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

F. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 8 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

a. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Color: Matching structural sealant.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch nominal width. Kawneer 500 series or equal

a. Bottom rail: not less than 10 inches above floor or ground plane and complying with accessibility requirements.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets. Provide nonremovable glazing stops on outside of door.
4. Entrance Door Hardware: As specified in Division 8 Section "Door Hardware."

2.6 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 7 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.

3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range and to match aluminum window finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 8 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 7 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:

    a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
    b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

1. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
2. Perform testing in accordance with AAMA 503 on (3) minimum units.

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 08 41 13

SECTION 08 42 29 – AUTOMATIC SLIDING DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following types of automatic entrances:
   1. Exterior and interior, single and bi-parting sliding automatic entrances.

B. Related Sections:
   1. Division 7 Sections for caulking to the extent not specified in this section.
   2. Division 08 Sections for "Aluminum-Framed Entrances and Storefronts" for entrances furnished and installed separately in Division 8 Section.
   3. Division 8 Section "Door Hardware" for hardware to the extent not specified in this section.
   4. Division 08 Section "Glazing" for materials and installation requirements of glazing for automatic entrances.
   5. Division 26 and 28 Sections for electrical connections including conduit and wiring for automatic entrance operators and access-control devices.

1.3 REFERENCES

A. References: Refer to the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. CUL – Approved for use in Canada.
   4. NFPA 70 - National Electrical Code.
   5. NFPA 101 - Life Safety Code.

B. American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA).
   1. ANSI/BHMA A156.10 (current year) American National Standard for Power Operated Pedestrian Doors.
   2. ANSI Z97.1 Standards for Safety Glazing Material Used in Buildings.

C. Underwriters Laboratories (UL).
   1. UL 325 Standard for Safety for Door, Drapery, Gate, Louver and window Operators and Systems.

D. American Association of Automatic Door Manufacturers (AAADM).

E. American Society for Testing and Materials (ASTM).

1. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
2. ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

F. American Architectural Manufacturers Association (AAMA).
1. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.

G. National Association of Architectural Metal Manufacturers (NAAMM).
1. Metal Finishes Manual for Architectural Metal Products.

H. International Code Council (IBC).
1. IBC: International Building Code Building Code.

1.4 DEFINITIONS

A. Activation device: Device that, when actuated, sends an electrical signal to the door operator to initiate the door operation.

B. Monitored Safety Devices: A tested system that works in conjunction with the automatic door control that detects the presence of a person or an object within a zone where contact could occur and provides a signal to stop the movement of the door.

C. AAADM: American Association of Automatic Door Manufacturers.

D. For automatic door terminology, refer to ANSI/BHMA A156.10 for definitions of terms.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide automatic doors that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturers corresponding systems.

B. Compliance:
1. ICC/IBC International Building Code
2. ANSI/BHMA A 156.10 American National Standard for Power Operated Doors Pedestrian Doors.
3. UL 325 Listed
4. NFPA 70 National Electrical Code.
5. NFPA 101 Life Safety Code
6. CUL Approved for use in Canada

C. Automatic Door equipment accommodates medium to heavy pedestrian traffic.

D. Automatic Door equipment accommodates up to the following weights for active leaf door:
1. Bi-Parting Doors: 220 lb (100 kg) per active breakout leaf.
2. Single Slide Doors 220 lb (100 kg) per active breakout leaf.

E. Operating Temperature Range: Capable of - Minus 35 Degrees F to plus 130 degrees F (minus 37 C to plus 55 degrees C) ambient.

F. Entrapment Force Requirements:
   1. Power-Operated Sliding Doors: Not more than 30 lbf (133 N) required to prevent stopped door from closing.
   2. Sliding doors provided with a breakaway device shall require no more than 50 lbf (222 N) applied 1 inch (25 mm) from the leading edge of the lock stile for the breakout panel to open.

1.6 SUBMITTALS

A. Comply with Division 01 – Submittal Procedures.

B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles fabrication, operational descriptions and finishes.

C. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, additional accessories and attachments to other work.

D. Samples: color samples of exposed finish as required.

E. Informational Submittals: Manufacturers product information and applicable sustainability program credits that are available towards a LEED rated product certification.
   1. Credit MR 4.1 and 4.2: Manufacture's or fabricator's certificate indicating percentage of post-consumer recycled content by weight and pre-consumer recycled content by weight for each product specified under this section.

F. Manufacturers Field Reports: Submit manufacturer's field reports from AAADM certified technician of inspection and approval of doors for compliance with ANSI/BHMA A 156.10 after completion of installation.

G. Operating and Maintenance Manuals: Provide manufacturers operating, owners and maintenance manuals for each item specified as required in Division 01, Closeout Submittals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: 10 years minimum of documented experience in manufacturing door equipment similar to that indicated within this specification with a proven record of successful service performance. A manufacturer with company certificate issued by AAADM.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 5 years documented experience installing and maintenance of units similar in material, design, and extent to that indicated in this specification and whose work has resulted in construction with a record of successful in-service performance. Manufacturer's authorized representative who is trained and approved for installation and maintenance of units by AAADM required for this Project.

C. Source Limitations for Automatic Entrances: Obtain automatic entrances from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Power-Operated Door Standard: ANSI/BHMA A156.10 Current year.

F. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

G. Pre-installation Conference: Conduct conference at site or a mutually agreed site if required.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed sliding tracks that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of project.

C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

1.10 WARRANTY

A. Automatic Entrance Doors shall be free of defects in material and workmanship for a period of One (1) year from the date of substantial completion.

B. During the warranty period a factory trained technician shall preform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form submitted to the owner.

C. During the warranty period all warranty work shall be performed during normal working hours.

D. A two (2) year service agreement following the expiration of the warranty period shall be executed. Including, but not limited, to, the Service agreement shall encompass quarterly, (4) per year inspection and maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. dormakaba. • Reamstown, PA • 1-844-SPEC-NOW (1-844-773-2669) • Website: www.dormakaba.us

B. Substitutions: Requests for substitution and product approval in compliance with the specification must be submitted in writing and in accordance with the procedures outlined in Division 1, Section "Substitution Procedures". Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 SLIDING AUTOMATIC ENTRANCES

C. Model: dormakaba, ESA Series ESA 300 Single slide full breakout Automatic Door. (Basis of Design)
1. Sliding Automatic Door Configuration:
a. Single Slide full break out door system.
1) Configuration: Single slide One sliding leaves and one operable panel.
2) Traffic Pattern: Two –Way
3) Emergency Breakaway Capability: Interior sliding leaf and sidelite.
4) Mounting: Between jambs
5) Door# 114.

D. Model: dormakaba ESA Series ESA 300 Bi Parting full breakout with two operable sidelites Automatic Door (Basis of Design)
1. Sliding Automatic Door Configuration:
a. Bi-Parting, full breakout door system.
1) Configuration: Bi-parting, Two sliding leaves with Two breakaway sidelites.
2) Traffic Pattern: Two –Way
3) Emergency Breakaway Capability: Interior sliding leaves and sidelites.
4) Mounting: Between jambs
5) Doors# 100.1, 100.2.

E. Dimensions: Confirm door package dimensions as indicated on architectural drawings.

2.3 ALUMINUM DOORS AND FRAMES

A. Doors and Frames: Extruded Aluminum, Alloy 6063-T5
1. Door panels shall have a minimum .125 inch (3.2 mm) structural wall thickness throughout entire extrusion length.
2. Door construct shall be by means of interlocking corner shear block cross bolted.
3. The sliding door system shall include two interlocks securing the leading stile of the sidelite and the butt stile of the sliding door together.
4. Vertical Stiles shall be:
a. Narrow stile: 2-5/8 inch
5. Bottom Rails shall be standard size: 10 inch nominally.
6. Intermediate Muntin shall be 1-¾ inch.

7. Weather stripping shall meet AAMA 701-11 Class A, slide in type, replaceable nylon retained by the aluminum extrusions to reduce energy loss. The following types of weather-stripping are required: nylon pile weather stripping on the door bottoms; dual pile weather-stripping at sliding door lead edges; weather-stripping between the carrier and header on the sliding doors; dual pile weather-stripping at the interlock rails between the sliding door and sidelites; dual pile weather-weather-stripping between the sidelites doors and the door jambs.

B. Glass: Door 114 (Interior) Glazing shall comply with ANSI Z97.1 thickness as indicated.
1. Glazing Active Door Panels [1/4" (6 mm) tempered unless otherwise specified.
2. Glazing Sidelite Door Panels [1/4" (6 mm) tempered unless otherwise specified
3. Glazing Installation: Review Division 8 Section for glazing requirements.

C. Glass: Door 100.1, 100.2 (Exterior) Glazing shall comply with ANSI Z97.1 thickness as indicated.
1. Glazing Active Door Panels 5/8" (16mm) tempered LAMINATED unless otherwise specified.
2. Glazing Sidelite Door Panels 5/8" (16mm) tempered LAMINATED unless otherwise specified
3. Glazing Installation: Review Division 8 Section for glazing requirements.

2.4 DOOR OPERATORS

A. Sliding Door Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of delrin-covered, ball-bearing-center wheels operating on a continuous roller track. Support doors from carrier assembly by adjustable cantilever and pivot assembly.
1. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

B. Operator and Controller: a system with an electro-mechanical operator and microprocessor controller. Components consist of a DC permanent magnet motor, self-lubricating drive system and a wear-free digital rotary encoder all linked to a fully integrated digital microprocessor controller
1. Features:
   a. Power opening and closing.
   b. Drive System: belt
   c. Adjustable opening and closing speeds.
   d. Adjustable hold-open time between 0 and 30 seconds.
   e. Obstruction recycle.
   f. Intergraded access control capabilities.
2. Door Switches: Interior side mounted program switches consisting of:
   a. Main Switch-Auto-Close-Open, operates door in fully automatic mode, turns door off, or keeps it fully open.
   b. Exit Only Switch: on/off, only exit side activation device will initiate door opening.

c. Partial Opening Switch: on/off Energy saving opening mode limits the width opening.
d. Switch: Keyed (See SECTION 087100 for cylinders and cores).

3. Controller shall provide a means to verify presence sensor functionality and the connection between the controller and sensor(s) as required by the ANSI 156.10 standard. This closed loop monitoring system, upon detection of fault in the sensor or wiring shall cause automatic operation to cease.

2.5 ACTIVATION AND SAFETY

A. Provide controls in accordance with ANSI/BHMA standard for condition of exposure and for long-term, maintenance-free operation under normal traffic load. Only safety systems (sensors) that have been tested and approved should be used in conjunction with manufacturer systems and products.

B. Monitored Combination Motion/Presence Sensors: Self-contained units; consisting of both motion and presence sensors in a single housing; adjustable to provide detection field sizes and functions required by ANSI/BHMA A156.10.
1. Motion Sensor: K-band-frequency, doppler effect radar.
a. Provide capability for switching between bidirectional and unidirectional detection.
b. For one-way-traffic entrances, sensor on egress side shall not be active when doors are fully closed.
2. Presence Sensor(s): Active infrared sensor shall provide two over lapping zones that provide presence detection in the threshold while the door is in the open position.

C. Activation Device:
1. Touchless Wave Plate: 4-1/2 inch square activation senor plate in black. Microwave technology has an adjustable range of 2 inches to 24 inches.

D. Safety beams are not acceptable.

E. Bollard Post:
1. Hard wired vertical actuation bar.
2. Stain Steel Type 304.
3. BEA Model: 10LPR36L-HW (Basis of Design)
4. Door# 100.1

2.6 ELECTRICAL

A. Electrical 120 VAC, 60 Hz, 5 Amp service.

B. Battery Back-up: (if required) Concealed in the door header case and capable of full operation including sensor capabilities for 200 cycles.

2.7 HARDWARE

A. General: Provide manufacturers standard hardware as required for proper door operation. Break away hardware are integral parts of the door design and are supplied by the manufacturer to comply with applicable codes.
   1. ESA 300 has a limit arm on all break away panels to prohibit doors from opening past 90 degrees.

B. Locking Hardware:
   1. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
   2. Two-Point Locking for Sliding Doors: Mechanism in stile of active door leaf that automatically extends second lock-bolt into overhead carrier assembly.
      a. Keyed both sides Lock indicators if required by code. (See SECTION 087100 for cylinders and cores.

C. Threshold:
   1. Sliding Door Threshold: ESA 300 Manufacturer's standard threshold members and bottom-guide track system, with a 3/8" diameter pin in a polyethylene covered slot.
      a. Configuration: Saddle-type threshold across door opening and surface-mounted guide track system at sidelites. Door# 100.1
      b. Configuration: No threshold across door opening and recessed guide track system at sidelites. Doors# 100.2. and 114.

2.8 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Anodized Finish:
   1. Black Anodic Finish: AAMA 611, AA-M12C22A44, Class I, 0.018 mm. To match existing. Door# 114.

C. Painted Finish:
   1. Kynar paint finish, 3 coat to match architects sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames with Installer present, for compliance with requirements for installation tolerances, wall and floor construction and other conditions affecting performance of automatic entrances.

B. Examine roughing in for electrical source power to verify actual locations of wiring connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

D. Glazing: Install glazing as specified in Division 08 Section Glazing according to automatic door manufactures instructions.

E. Sealants: Comply with requirements specified in Division 07 Section "Joint Sealants" to provide weathertight installation.

F. Signage: Apply signage on both sides of each door and each sidelight as required by ANSI/BHMA A 156.10

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s representative shall provide technical assistance and guidance for installation of automatic doors.
1. Factory trained and AADM certified representative shall test and inspect each automatic door to determine compliance of the installed system to ANSI/BHMA A 156.10

3.4 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation and for weathertight closure; comply with requirements in ANSI/BHMA A156.10

3.5 CLEANING AND PROTECTION

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
1. Comply with requirements in Division 08 Section "Glazing" for cleaning and maintaining glass.

3.6 DEMONSTRATION

A. Engage a factory authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain safe operation of automatic entrances.

END OF SECTION 084229

SECTION 08 43 26 – ALL GLASS STOREFRONTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Frameless glazed interior wall and door assemblies.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.

C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.

E. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

G. WDMA I.S.1-A - Architectural Wood Flush Doors; Window and Door Manufacturers Association; 2011.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer, other entities directly affecting, or affected by, construction activities of this section.
   2. Notify Architect four calendar days in advance of scheduled meeting date.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each component in partition assembly.

C. Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
   1. Include field measurements of openings.
   2. Include Elevations Showing:
      a. Locations and identification of manufacturer-supplied door hardware and fittings.
      b. Locations and sizes of cut-outs and drilled holes for other door hardware.
   3. Include Details Showing:
      a. Requirements for support and bracing of overhead track.
      b. Installation details.
      c. Appearance of manufacturer-supplied door hardware and fittings.

D. Selection Samples: Two sets, representing manufacturer's full range of available metal materials and finishes.

E. Verification Samples: Two samples, minimum size 2 by 3 inches (50 by 75 mm), representing actual material and finish of exposed metal.

F. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

G. Certificates: Contractor to certify that installer of partition assemblies meets specified qualifications.

H. Operation and Maintenance Data: For manufacturer-supplied operating hardware.

I. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

J. Specimen Warranty.

K. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum three years of experience designing, assembling, and installing partition assemblies similar to those specified in this section.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after date of Substantial Completion.

C. Provide five year manufacturer warranty against excessive degradation of metal finishes. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance requirements, provide the following basis of design product or approved equal:
   1. MetroWall Inc; HUSH Series Frameless Glass Wall System: https://metro-wall.com/.

2.02 FRAMELESS GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

A. Frameless Glazed Interior Wall Assembly: Factory fabricated assemblies consisting of full-width and height glass panels fastened with U-channel fittings on top and bottom edge of glass wall.
   1. Configuration: As indicated on drawings.
   2. U-Channel Fittings: Extruded aluminum, Dark Bronze finish, dry glazed, and with matching end caps.
      a. Top channel is 1-1/2 inch (38 mm) high by 1 inch (25.4 mm) deep.
      b. Bottom channel is 1 inch (25.4 mm) high by 1 inch (25.4 mm) deep.
   3. Glass Thickness: 1/2 inch (12.7 mm), tempered.
   4. Designed to withstand normal operation without damage, racking, sagging, or deflection.
   5. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.

6. Finished metal surfaces protected with strippable film.
7. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.
8. STC Rating: Min. 50 STC

B. Pivoting Glass Doors: Dry glazed patch fittings.
1. Door Configuration: As indicated on drawings.
2. Height: 2 inch (51 mm).
3. Length: 6-7/16 inch (164 mm).
4. Cladding Finish: Dark Bronze
5. Glass Thickness: 1/2 inch (12.7 mm), tempered.
6. Door Hardware: Refer to 08 71 00 Door Hardware.
7. Provide accessories as required for complete installation.
8. Door Patches: Catalog No. PH20AA (Top), PH10CA (Bottom)
9. STC Rating: Min. 50 STC

2.03 FITTINGS AND HARDWARE

A. Operable Panel Hardware: Coordinate with additional requirements as specified in Section 08 7100.

2.04 MATERIALS

A. Glass & Privacy Film: Refer to 08 80 00 Glazing.

B. Aluminum Components: Conforming to ASTM B221 (ASTM B221M), Alloy 6063, T5 Temper.

C. Sealant: One-part silicone sealant, conforming to ASTM C920, clear.

2.05 FINISHES

A. Finish to be selected by architect from manufacturers full range of finish options.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that track supports are properly braced, level within 1/4 inch (6 mm) of required position and parallel to the floor surface.

C. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

D. Do not begin installation until supports and adjacent substrates have been properly prepared.

E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean substrates thoroughly prior to installation.

B. Prepare substrates using the methods recommended by the manufacturer for achieving acceptable result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with glazed interior wall and door assembly manufacturer's instructions.

B. Fit and align glazed interior wall and door assembly level and plumb.

3.04 ADJUSTING

A. Adjust glazed interior wall and door assembly to operate smoothly from sliding or pivoting positions.

B. Adjust swing door hardware for smooth operation.

3.05 CLEANING

A. Clean installed work to like-new condition.

B. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. Demonstrate operation of glazed interior wall and door assembly and identify potential operational problems.

3.07 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before date of Substantial Completion.

END OF SECTION

SECTION 08 44 13 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall, with vision glazing and glass, glass, metal, and metal infill panels.

1.02 RELATED REQUIREMENTS

A. Section 072500 - Weather Barriers: Sealing framing to water-resistive barrier installed on adjacent construction.
B. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
C. Section 088000 - Glazing.
D. Section 092116 - Gypsum Board Assemblies: Metal stud and gypsum board wall at interior of curtain wall.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
B. AAMA 501.4 - Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift 2018.
C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.
E. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2022.
F. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
H. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.
I. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).
K. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.
C. Shop Drawings: Shop drawings to be project specific. Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
D. Samples: Submit two samples 12 by 12 inches in size illustrating finished aluminum surface, glazing,infill panels, and glazing materials.
E. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
G. Test Reports: Submit results of full-size mock-up testing. Reports of tests previously performed on the same design are acceptable.
H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
I. Designer's Qualification Statement.
J. Manufacturer's Qualification Statement.
K. Installer's Qualification Statement.
L. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Delaware.
B. Full-Size Mock-up Testing: Have a specimen representative of project conditions tested by an independent testing agency for compliance with specified water penetration and water penetration criteria.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.
B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

B. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN - ALUMINUM CURTAINWALL

A. Locations: All curtainwall locations in exterior building envelope and where 1" insulating glass is scheduled, unless otherwise noted.

B. Curtainwall System:
   1. Basis of design: Kawneer 1600 System 3 Curtainwall system, or approved equal.
   2. Description: Shear block fabrication, with concealed fastener joinery.
   3. Components: Manufacturer's standard extruded aluminum mullions, 90, and 135 degree inside and outside corner posts, entrance door framing, and indicated shapes.
   4. Frame depth: 2-1/2" x 6", or 2-1/2" x 7-1/2" where required due to spans.
   5. Glazing: inside/outside glazed pressure plate format with 1" (25.4) double glazed insulating glass; captured format.
   6. Horizontals utilize a thermal separator and pressure plate to allow for glazing or re-glazing from the exterior

C. Other Manufacturers: Provide either product identified as "Basis of Design" or an equivalent product of a manufacturer below with approved submittal meeting the design criteria..
   1. YKK AP America Inc: www.ykkap.com.
   2. Oldcastle Building Envelope: www.obe.com..
   3. EFCO Corporation: www.efcocorp.com.

D. Substitutions: See Section 016000 - Product Requirements.
   1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Inside/Outside glazed, with pressure plate and mullion cover.
   2. Vertical Mullion Face Width: 2-1/2 inches.
   3. Vertical Mullion Depth: 6 inches or 7-1/2 inches as required for span.
   4. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
   6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
   7. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
   8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
   9. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
      a. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.

B. Design Wind Loads: Comply with the requirements of ASCE 7

a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.

2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
3. Interstory Differential Lateral Movement: Meeting pass/fail criteria of AAMA 501.4 for Use Group I, Standard Occupancy, when tested at design displacement of 0.010 times greater adjacent story height, maximum, and 1.5 times design displacement, through three complete cycles.
4. Movement: Accommodate the following movement without damage to components or deterioration of seals:
   a. Expansion and contraction caused by 180 degrees F surface temperature.
   b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
   c. Movement of curtain wall relative to perimeter framing.
   d. Deflection of structural support framing, under permanent and dynamic loads.

C. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 12 psf.
   2. Test Method: ASTM E331.

D. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.27 psf pressure difference across assembly.

E. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 70, minimum, measured in accordance with AAMA 1503.
   2. Overall U-value Including Glazing: 0.42 Btu/(hr sq ft deg F), maximum.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Cross-Section: As indicated on drawings.

B. Glazing: See Section 088000.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

C. Perimeter Sealant: Type 1 specified in Section 07 9200.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

E. Glazing Accessories: See Section 088000.

2.05 FINISHES

A. Superior Performing Organic Coatings: AAMA 2605 multiple coat, thermally cured polyvinylidene fluoride system.

1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness of 0.9 mil; color and gloss as indicated on drawings.

B. Color: To be selected by Architect from manufacturer's full range.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.

B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Install firestopping at each floor slab edge.

H. Provide low-expansion foam insulation in shim spaces at perimeter of assembly to maintain continuity of thermal and air barrier.

I. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 088000, using interior or exterior glazing method.

J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

B. Test installed curtain wall for water leakage in accordance with ASTM E1105 with a uniform test pressure difference of 8.00 lbf/sq ft.

1. Field test (3) curtainwall assemblies in place. Location of field test as directed by Architect.
2. In window fails, perform additional tests at Contractor's expense.
3. Upon successful completion of testing, curtain wall may remain in place.

C. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.
B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.
C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with
D. AAMA 609 & 610.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 44 13

SECTION 08 63 00 - METAL FRAMED SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal-framed skylights.

1.02 RELATED REQUIREMENTS

A. 05 12 00 “Structural Steel” for steel framing.
B. 08 80 00 “Glazing”
C. 07 92 00 “Joint Sealants” for sealants installed at metal-framed skylight perimeters.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)
   1. ASTM C 719-14 (2019), Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).
   2. AS5TM C 920-18, Standard Specification for Elastomeric Joint Sealants.
   3. ASTM E 283/E 283M-19, Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   4. ASTM E 330/E 330M-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
   5. ASTM E 331-00 (2016), Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, And Curtain Walls by Uniform Static Air Pressure Difference.
B. National Fenestration Rating Council (NFRC).
   1. ANSI/NFRC 100-2020, Procedure for Determining Fenestration Product U-factors.
   2. ANSI/NFRC 200-2020, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
   3. ANSI/NFRC 500-2020, Procedure for Determining Fenestration Product Condensation Index Ratings.

1.04 PERFORMANCE REQUIREMENTS

A. General: Provide metal-framed skylights capable of withstanding loads and thermal and structural movements indicated without failure. Failure includes the following:
   1. Deflection exceeding specified limits.
   2. Thermal stresses transferred to the building structure.
   3. Skylight framing members transferring stresses, including those caused by thermal and structural movement, to glazing.
   4. Weakening of fasteners, attachments, and other components.
B. Deflection Limits: As follows:
   1. Deflection Normal to Glazing Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
C. Structural Loads: Provide metal-framed skylights, including anchorage, capable of withstanding the effects of design loads when supporting full dead loads.
   1. Design Loads: See structural drawings.
D. Structural Performance: Provide metal-framed skylights, including anchorage, capable of withstanding pressures indicated without material and deflection failures and permanent

deformation of structural members exceeding 0.2 percent of span when tested according to ASTM E 330.

E. Air Infiltration: Provide metal-framed skylights with maximum air leakage of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of surface when tested according to ASTM E 283 at a minimum static-air-pressure differential of 6.24lb/sq. ft. (300 Pa).

F. Water Penetration: Provide metal-framed skylights that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind pressure, but not less than 15 lb/sq. ft. (718 Pa).

G. Condensation Resistance: Provide aluminum-framed systems that when tested with fixed glazing, have a frame condensation-resistance factor (CR) of not less than 46 when tested according to NFRC 500 when clear over clear insulated glass is used.

H. Thermal Performance: Provide metal-framed skylights that meet applicable energy code requirements , including but not limited to
   1. NFRC 100 rated U-factor of 0.50 or less.
   2. NFRC 200 rated SHGC of 0.40 or less.

I. Thermal Movement: Provide metal-framed skylights that allow for thermal movements resulting from the following maximum change (range) in ambient temperatures by preventing buckling, sealant failure, and other detrimental effects.
   1. Temperature Change (Range): 100 degrees F.

1.05 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions and profiles of components, and finishes for metal-framed skylights.

B. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other work as required.

C. Samples for Initial Selection: Manufacturer’s color charts consisting of sections of units showing the full range of colors available for factory-finished aluminum.

D. Samples for Verification: Provide color sample of selected finish on 2"x3" aluminum sheet.

E. Installer Certificates: If required, signed by manufacturer certifying that installers comply with requirements.

F. Product Test Reports: From a qualified testing agency indicating skylights comply with requirements, based on comprehensive testing of current products.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing metal-framed skylights similar to those indicated for this Project and who is acceptable to manufacturer.

B. Professional Engineer Qualifications: A professional engineer who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of skylights that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated.

1.07 PROJECT CONDITIONS

A. Field Measurements: Where metal-framed skylights are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate

measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating skylights without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.08 WARRANTY

A. Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
   1. Structural failures.
   2. Failure of systems to meet performance requirements.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of skylights from sources other than condensation, resulting from defects in skylight materials or workmanship. (Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage). Water leakage resulting from improper installations not part of this warranty.

B. System Warranty Period: 5 years from date of shipment from the manufacturer.

C. Finish Warranty: Provide written warranty signed by manufacturer agreeing to repair or replace work exhibiting peeling, chipping, chalking, fading, abnormal aging or deterioration, and failure to perform as required.
   1. Warranty Period for Anodized Finish: 1 year from date of shipment from the manufacturer.
   2. Warranty Period for Powder Coat Finish: 5 years from date of shipment from the manufacturer.
   3. Warranty Period for Kynar 500 Finish: 5 years from date of shipment from the manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framed Skylight system:

B. Basis of Design Manufacturer: Wasco, Part of the VELUX Group, Wells, ME (800-388-0293).
   1. Basis of Design Pinnacle 350/600 system.
   2. Subject to demonstrated conformance to the requirements of this section, the equivalent products of other manufacturers are acceptable.

C. Substitutions
   1. See Section 01 60 00 – Materials and Equipment Product Requirements.
   2. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.02 FRAMING MATERIALS

A. Framing Members: Extruded aluminum alloy 6063-T5 or T6, ASTM B 221 with minimum effective thickness of 0.109 inches.

B. Exterior Pressure Caps: Extruded aluminum alloy 6063-T5 or T6, ASTM B 221 with minimum effective thickness of 0.090 inches.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing; compatible with adjacent materials.
D. Exposed Flashing and Closures: Aluminum sheet alloy and temper of 1100-H14, thickness as require for proper performance.
   1. Minimum Thickness: 0.032 inch Apron Flashing.
   2. Minimum Thickness: 0.062 inch Closures.
E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories; compatible with adjacent materials.
   1. Aluminum Retaining Cap Fasteners and Framing Members Fasteners: ASTM A 193/A 193M, Series 300 stainless-steel screws; type as recommended by manufacturer.
   2. Connections to Supporting Structure: Series 300 Stainless Steel or ASTM A 307, hot dipped galvanized steel fasteners by installer.
F. Framing-System Sealants: Single-component, non-sag, high performance, non-priming, gun-grade elastomeric polyurethane sealant furnished by skylight manufacturer.
   1. Sealant complies with ASTM C920, Type S, Grade NS, Class 25, Use T, NT, M, A, G, and O. Canadian Specification CAN/CGSB-19.13-M87, Classification MCG-2-25-A-N.
   2. Sealant conforms to USDA approval standards.
G. Bituminous Paint: Cold-applied asphalt mastic paint complying with SSPC-Paint 12, except containing no asbestos, and formulated for 30-mil thickness per coat.

2.03 GLAZING MATERIALS

A. Sloped Glass: Refer to specification Section 08 80 00 Glazing.
   1. Glass must meet the requirements of the AAMA Glass Design for Sloped Glazing for the project.
B. Glazing Gaskets: Manufacturer's proprietary pressure-glazing gaskets of elastomer type and hardness selected by the skylight manufacturer to comply with requirements. Glazing gaskets to be extruded thermoplastic elastomer by the skylight manufacturer.
C. Spacers, Edge Blocks, and Setting Blocks: Manufacturer's standard permanent non-migrating type of elastomer type and hardness selected to comply with requirements. Spacers, Edge Blocks, and Setting Blocks to be extruded thermoplastic elastomer by the skylight manufacturer.
D. Glazing Weatherseal Sealant: Neutral-curing silicone sealant recommended by skylight and sealant manufacturers for this use and furnished by skylight manufacturer.
   1. Sealant is capable of withstanding 50 percent movement in both extension and compression (total of 100 percent movement) when tested for adhesion and cohesion under maximum cyclic movement according to ASTM C 719.
   2. Sealant complies with ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to substrates including other sealants with which it comes in contact, O.
   3. Color: Black.
E. Flashing Sealant: Single-component, non-sag, high performance, non-priming, gun-grade elastomeric polyurethane sealant furnished by skylight manufacturer.
   1. Sealant complies with ASTM C920, Type S, Grade NS, Class 25, Use T, NT, M, A, G, and O.
   2. Sealant conforms to USDA approval standards.

2.04 FABRICATION

A. Framing Components: As follows:
   1. Factory fit and assemble components, where practical.

Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.

2. Fabricate components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.
3. Fabricate components to accommodate expansion, contraction, and field adjustment, and to provide for minimum clearance and shimming at skylight perimeter.
4. Fabricate components to ensure that glazing is thermally and physically isolated from framing members.
5. Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
6. Fit and assemble components to greatest extent practicable before finishing.
7. Reinforce members as required to retain fastener threads.
8. Attach retainer bars with gasketed stainless steel fasteners spaced at a maximum of 12 inches on center.
9. Weld components before finishing and in concealed locations to greatest extent practicable to minimize distortion.
10. Before shipping, shop assemble, mark, and disassemble components that cannot be permanently shop assembled.

B. Provide continuous aluminum frame with weatherproof splice joints and locked and sealed or fully welded corners. Locate weep holes in the frame at each rafter connection to drain condensation.

C. Prepare framing to receive anchor and connection devices and fasteners.

D. Field Glazing: Locate and size extruded elastomeric setting blocks and spacers in accordance with the glazing manufacturer's recommendations. At no point shall the glazing come in contact with the skylight frame or fasteners.

2.05 ALUMINUM FINISHES

A. General: Comply with NAAMM "Metal Finishes Manual" recommendations for application and designations of finishes.

B. Finish designations prefixed by AA conform to the system for designations of aluminum finishes established by the Aluminum Association.

1. Clear-Anodized Finish, Class I: AA-C22A41 complying with AAMA 611.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting skylight performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Metal Protection: As follows:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.03 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing skylight components.
   1. Fit frame joints to produce hairline joints free of burrs and distortion.
   2. Rigidly secure non-movement joints.
   3. Accommodate thermal and mechanical movements.
   4. Install framing components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.
   5. Coordinate installation of flashings at skylight perimeters to maintain continuity of water barriers.
   6. Set continuous curbs and flashings in a full sealant bed, unless otherwise indicated. Comply with requirements in Division 7 Section "Joint Sealants."

B. Erection Tolerances: Install skylight components true in plane, accurately aligned, and without warp or rack. Adjust framing to comply with the following tolerances:
   1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 10 feet; 1/4 inch over total length.
   2. Alignment: Where surfaces abut in line and at corners and where surfaces are separated by less than 3 inches, limit offset from true alignment to less than 1/32 inch; otherwise, limit offset from true alignment to 1/8 inch.

C. Field Glazing: Locate and size extruded elastomeric setting blocks and spacers in accordance with the glazing manufacturer's recommendations. At no point shall the glazing come in contact with the skylight frame or fasteners

D. Install secondary-sealant weatherseal according to sealant manufacturer's written instructions to provide weatherproof joints. Install joint fillers behind sealant as recommended by sealant manufacturer.

3.04 CLEANING

A. Clean Skylights inside and outside, immediately after installation and after sealants have cured, according to manufacturer's written recommendations.
   1. Remove temporary protective coverings and strippable coatings from pre-finished metal surfaces. Remove labels and markings from all components.

B. Remove excess sealant according to sealant manufacturer's written recommendations.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors.
2. Door hardware for aluminum doors.
3. Door hardware for wood doors.
4. Door hardware for other doors indicated.
5. Keyed cylinders as indicated.

B. Related Sections:

1. Division 6: Rough Carpentry.
2. Division 8: Aluminum Doors and Frames
3. Division 8: Hollow Metal Doors and Frames.
4. Division 8: Wood Doors.
5. Division 26 Electrical
6. Division 28: Electronic Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. NFPA 80 -Fire Doors and Windows
4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware

D. Intent of Hardware Groups
1. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted 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.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

B. Approval of products is at the discretion of the architect and their consultant

1.3 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.

a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representatives for each manufacturer.
d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule
4. As installed “Wiring Diagrams” and “Point to Point” for each piece of hardware connected to power, both low voltage and 110 volts.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.

a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

a. Provide UL listed hardware for labeled and 20-minute openings in conformance with requirements for class of opening scheduled.
b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer’s Warranty:

1. Closers: Ten years
2. Exit Devices: Three Years
3. Locksets & Cylinders: Three years
4. All other Hardware: Two years.

1.8 OWNER’S INSTRUCTION:

A. Instruct Owner’s personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner’s requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner’s consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers listed are basis of design and are listed in the Hardware Schedule. Approval of products and models are at the discretion of the architect and their consultant.

Item:	Manufacturer:	
Hinges	Stanley	Bommer, Hager, McKinney
Continuous Hinges	Stanley	Select, ABH
Locksets	Best	None
Cylinders & Cores	Best	None
Exit Devices	Precision	Von Duprin, Detex
Closers	Dorma 8600	LCN 4040, Norton 7500
Push/Pull Plates	Trimco	Burns, Rockwood
Push/Pull Bars	Trimco	Burns, Rockwood
Protection Plates	Trimco	Burns, Rockwood
Overhead Stops	Dorma	ABH, Glynn Johnson, Rixson
Door Stops	Trimco	Trimco, Rockwood
Flush Bolts	Trimco	ABH, Rockwood
Coordinator & Brackets	Trimco	ABH, Rockwood
Threshold & Gasketing	National Guard	Reese, Pemko

2.2 MATERIALS:

A. Hinges: Shall be Five Knuckle Ball Bearing hinges

1. Template screw hole locations
2. Bearings are to be fully hardened.
3. Bearing shell is to be consistent shape with barrel.
4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
5. Equip with easily seated, non-rising pins.
6. Non Removable Pin screws shall be slotted stainless steel screws.
7. Hinges shall be full polished, front, back and barrel.
8. Hinge pin is to be fully plated.
9. Bearing assembly is to be installed after plating.
10. Sufficient size to allow 180-degree swing of door
11. Furnish five knuckles with flush ball bearings
12. Provide hinge type as listed in schedule.
13. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
14. Furnish heavy weight hinges with 5” height for doors 3’-6” and over
15. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
16. UL10C listed for Fire rated doors.
17. Basis of Design:
    a. Stanley FBB and 168 series. Substitutions as approved by architect.
    b. Stanley CEFBB series electrified hinges. Substitutions as approved by architect.

B. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Enough size to permit door to swing 180 degrees
8. Basis of Design:
    a. Stanley 661HD and 662HD series. Substitutions as approved by architect.

C. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Fit ANSI A115.1 door preparation
5. Functions and design as indicated in the hardware groups
6. 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
7. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel
8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
9. Auxiliary deadlatch to be made of one-piece stainless steel, permanently lubricated
10. Provide enough curved strike lip to protect door trim.
11. Properly size lock strikes for pairs of doors, short lip.
12. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
13. Lock shall have self-aligning, thru-bolted trim
14. Levers to operate a roller bearing spindle hub mechanism
15. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
16. Spindle to be designed to prevent forced entry from attacking of lever
17. Provide locksets with 7-pin removable and interchangeable core cylinders
18. Each lever to have independent spring mechanism controlling it
19. Core face must be the same finish as the lockset.
20. Basis of Design:
    a. Best 45H with 16H trim. Substitutions as approved by architect.
    b. Best 45HW with 16H trim. Substitutions as approved by architect.

D. Mortise Deadbolt:
1. Tested and approved by ANSI A156.5, Operational Grade 1.
2. Provide 9001-Quality Management and 14001-Environmental Management.
3. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty
4. 2-3/4 inch (70mm) backset

5. 1 inch throw stainless steel deadbolt.
6. Provide locksets with 7-pin I/C core.
7. Basis of Design:
   a. Best 48H series. To match existing.

E. Exit Devices shall:

1. Tested and approved by BHMA for ANSI 156.3, Grade 1
2. Provide 9001-Quality Management and 14001-Environmental Management.
3. Provide a deadlocking latchbolt
4. Non-fire rated exit devices shall have cylinder dogging.
5. Exposed components shall be of architectural metals and finishes.
6. Lever design shall match lockset lever design
7. Provide strikes as required by application.
8. Fire exit devices to be listed for UL10C
9. UL listed for Accident Hazard
10. Shall consist of a cross bar or push pad, the actuating portion of which extends across, shall not be less than one half the width of the door leaf.
11. Provide vandal resistant or breakaway trim
12. Aluminum vertical rod assemblies are acceptable only when provide with the manufacturers optional top and bottom stainless steel rod guard protectors
13. Basis of Design:
    a. Precision 2000 series. Substitutions as approved by architect.
    b. Precision MLR (Motorized Latch Retraction) series. Substitutions as approved by architect.

F. Cylinders:

1. Provide the necessary interchangeable core cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.
4. Best small format interchangeable core system.

G. Door Closers:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16 inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1½“minimum bore.
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.
12. Basis of Design:

a. Dorma 8900 series with full cover. Substitutions as approved by architect.

H. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

I. Over Head Stops: Provide a surface mounted concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.

J. Push Plates: Provide with four beveled edges ANSI J301, .050 thickness, size as indicated in hardware set. Furnish oval-head countersunk screws to match finish.

K. Pulls with plates: Provide with four beveled edges ANSI J301, .050 thickness Plate s with ANSI J401 Pull as listed in hardware set. Provide proper fasteners for door construction.

L. Push Pull Bars: Provide ANSI J504, .1" Dia. Pull and push bar model and series as listed in hardware set. Provide proper fasteners for door construction.

M. Kickplates: Provide with four beveled edges ANSI J102, .050 thickness,10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

N. Mop plates: Provide with four beveled edges ANSI J103, .050 thickness 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
1. Provide cutouts for hardware as listed in the hardware sets.
2. Provide Warnock Hersey labeled plates for 3 hour metal fire doors where allowed by local authority.

O. Door Bolts: Flush bolts for wood or metal doors.

1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.

P. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.

1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
2. Provide mounting brackets for soffit applied hardware.
3. Provide hardware preparation (cutouts) for latches as necessary.

Q. Power Supply: Provide power supply for (ELR) Electric Latch Retraction exit devices and Motorized Latch Retraction (MLR) as recommended by manufacturer.

1. Motherboard will accept up to four plug-in Control Modules. Provide the appropriate necessary control module to operate the number of ELR or MLR exit devices used at each opening. The Control Module shall include a Time delay Feature, variable (0-4 minutes) latch retraction period in response to a momentary input.
2. UL Listed for class II output.
3. Include circuit breakers for protection of motherboard
4. Control module shall include Fire alarm terminal and Auxiliary contacts for remote signaling.
5. Optional card for Battery Backup power tap module to operate a Card reader or when ELR or MLR devices require battery backup (Lead Acid Batteries are not included and is to be furnished by others)
6. Provide power supplies by the same manufacturer as the exit device.

R. Power Transfer: Power transfer device shall be a steel housing and flexible tube. Secure and inconspicuous channel is to bring power from the frame to the door.
1. Basis of Design:
   a. ABH PT1000 series.
2. Tube shall accept up to 5/16” wire bundle and accommodate a door swing of 120 Deg.
3. Wires as required by others

S. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

T. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.

1. Weatherstrip shall be resilient seal of Neoprene.
2. UL10C Positive Pressure rated seal set when required.

U. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of Neoprene.
2. UL10C Positive Pressure rated seal set when required.

V. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½” for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions. Thresholds to have an anti-slip surface (SIA).

W. Provide one wall mounted Telkee, Lund or MMF series key cabinet complete with hooks, index and tags to accommodate 50% expansion. Coordinate mounting location with architect.

X. Key Control Software: Provide one, Keystone® 600N key management control software. Shall include general features

1. Password restricted logins.
2. List all keys and items currently due back (or due back by any day designated)
3. Lists all cores and their location, building and doors, and cross-references people to cores, doors, and building they access.
4. Comprehensive list of reports available as an on-screen menu.
5. Built-in easy to use backup program.
6. Program always displays date of last backup.
7. Dynamic searching capabilities for all records.
8. On-screen indicator shows when historical info. Is present for a record.
9. On-screen indicator appears when notes are present on a record.
10. Able to operate in an NTFS network environment with TCPIP protocol
11. Multiple users can access program at the same time.
12. Software shall include a “Best” Automated Pin Segment Calculator and a Manual Pin Segment Calculator for authorized “Best” building lock shop facilities.
13. Software program is to be compatible with Windows NT, 2000 or XP with TCPIP protocol.

Y. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occurs.

2.3 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.5, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Best Cormax 7-pin system. Furnish temporary cores for construction period with permanent cores furnished and installed at the completion of construction.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:

1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements. Furnish 3 typed copies of keying schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).

2. Recommended locations for Architectural Hardware for flush wood doors (DHI).

3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Useable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

a. Verify levers are free from binding.
b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

Hardware Group: 01 Exterior (ALD x ALF)				
Exterior Aluminum Framed Entrances				
pair to have:				
Qty	Product	Model	Fin	Man
Qty	Product	Model	Fin	Man
2ea	Continuous Hinges	661HD	689	STN
1ea	Key Removeable Mullion	SL-60	AL	SPL
1ea	Mullion Cylinder	Mortise Type	626	BES
1ea	Core	I/C	626	BES
1ea	Mullion Storage	MK-60	AL	SPL
1ea	Panic Device	3RO2103CD	626W	PRE
1ea	Trim Cylinder	Rim Type	626	BES
2ea	Dogging Cylinder	Mortise Type	626	PRE
3ea	Cores	I/C	626	BES
1ea	Panic Device	3RO2101CD	626W	PRE
2ea	Door Pulls	1191M5J	630	TRM
2ea	Door Closers /w Stop	8916FC SDS BSHD/DP89	689	DOR
1ea	Threshold	896N SIA ssms/ea	689	NGP

1ea	Mullion Seal	5100N	BLK	NGP
2ea	Door Sweeps	201NA	689	NGP
1ea	Rain Drip	16A	689	NGP
Note: Weather Seals by Aluminum Door Manufacturer				

Hardware Group: 02 Exterior (HMD x HMF)				
Exterior Hollow Metal Framed Entrances				
pair to have:				
Qty	Product	Model	Fin	Man
2ea	Continuous Hinges	662HD	689	STN
1ea	Key Removeable Mullion	KR822 x MC822	PTD	PRE
1ea	Mullion Cylinder	Rim Type	626	BES
1ea	Core	I/C	626	BES
1ea	Mullion Storage Kit	KMC822SK	PTD	PRE
1ea	Panic Device	3RO2103CD	626W	PRE
1ea	Trim Cylinder	Rim Type	626	BES
1ea	Core	I/C	626	BES
1ea	Panic Device	3RO2101CD	626W	PRE
2ea	Dogging Cylinders	Mortise Type	626	BES
3ea	Cores	I/C	626	BES
2ea	Door Pulls	1191M5J	630	TRM
2ea	Door Closers /w Stop	8916FC SDS	689	DOR
2ea	Kick Plates	K0050 10” x 2” LDW .050 B4E	630	TRM
1ea	Threshold	896N SIA ssms/ea	689	NGP
1ea	Mullion Seal	5100N	BLK	NGP
2ea	Door Sweeps	201NA	689	NGP
1set	Weather Seals	5050 Perimeter	BLK	NGP
1ea	Rain Drip	16A	689	NGP

Hardware Group: 03				
Mechanical Rooms				
each to have:				
Qty	Product	Model	Fin	Man
3ea	Hinges	FBB168 4½” x 4½”	652	STN
1ea	Panic Device	3ROF2114 x 4914B	630	PRE
1ea	Door Closer w/ Stop	8916FC SDS	689	DOR
1ea	Kick Plate	K0050 10” x 2” LDW .050 B4E	630	TRM
1set	Gasketing	5050 Perimeter	BLK	NGP

Hardware Group: 04				
Group Learning Rooms				
each to have:				
Qty	Product	Model	Fin	Man
3ea	Hinges	FBB168 4½” x 4½”	652	STN
1ea	Classroom Lockset	45H7R16H	630	BES
1ea	Core	I/C	626	BES
1ea	Door Closer	8916FC AF86	689	DOR
1ea	Kick Plate	K0050 10” x 2” LDW .050 B4E	630	TRM
1ea	Wall Stop	1270CXSV	630	TRM
1set	Gasketing	5050	BLK	NGP

Hardware Group: 05				
Custodial & Storages Rooms				
Qty	Product	Model	Fin	Man
3ea	Hinges	FBB168 4½" x 4½"	652	STN
1ea	Storeroom Lockset	45H7D16H	630	BES
1ea	Core	I/C	626	BES
1ea	Door Closer	8916FC AF86	689	DOR
1ea	Kick Plate	K0050 10" x 2" LDW .050 B4E	630	TRM
1ea	Wall Stop	1270CXSV	630	TRM
1set	Gasketing	5050 (Door# B102)	BLK	NGP
3ea	Silencers	1229A	GRY	TRM

Hardware Group: 06				
Egress Stairwells				
each to have:				
Qty	Product	Model	Fin	Man
3ea	Hinges	FBB168 4½" x 4½"	652	STN
1ea	Panic Device	3ROF2114 x 4914B	630	PRE
1ea	Trim Cylinder	Rim Type	626	BES
1ea	Core	I/C	626	BES
1ea	Low Voltage Power Supply	RPSMLR2BB	PTD	PRE
1ea	Door Closer w/ Stop	8916FC DS	689	DOR
1ea	Kick Plate	K0050 10" x 2" LDW .050 B4E	630	TRM
1set	Gasketing	5050	BLK	NGP
1ea	Wiring Diagrams	Point to Point		
1ea	Card Reader	By Security Contractor		
Operational Description: Entry via Card Reader or via mechanical key. Egress always via touch bar of panic device.				

Hardware Group: 08				
Office & Administration Rooms				
each to have:				
Qty	Product	Model	Fin	Man
3ea	Hinges	FBB179 4½" x 4½"	652	STN
1ea	Office Lockset	45H7A16H	630	BES
1ea	Kick Plate	K0050 4" x 2" LDW .050 B4E	630	TRM
1ea	Wall Stop	1270CXSV	630	TRM
1set	Gasketing	2525	BLK	NGP

Hardware Group: 13				
Multi-User Restrooms				
each to have:				
Qty	Product	Model	Fin	Man
3ea.	Hinges	CB168 4 ½" x 4 ½"	630	STN
1ea.	Deadlock	48H7R	626	BST
1ea.	Core	I/C	626	BST
1set.	Door Push/Pull Set	1035-1 4x16	710CU	TRM
1ea.	Door Closer	8916FC IS	689	DRM

1ea.	Kick Plate	K0050 8” x 2” LDW	630	TRM
1ea.	Mop Plate	KM050 4” x 2” LDW	630	TRM
Set	Gasketing	5020C	GRY	NGP

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed entrances.
4. Interior borrowed lites.
5. Storefront framing.
6. Curtain Walls
7. Privacy Film

B. Related Sections include the following:

1. Division 8 Section "Steel Doors and frames "
2. Division 8 Section "Wood Doors"
3. Division 8 Section "Aluminum Framed Entrances and Storefronts"
4. Division 8 Section "Glazed Aluminum Curtain Walls"
5. Division 5 Section "Decorative Metal Railings" (Glass Guard Infill)

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining

and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

   a. Specified Design Wind Loads: 35 PSI, but not less than wind loads applicable to Project as required by ASCE 7 "Minimum Design Loads for Buildings and Other Structures": Section 6.0 "Wind Loads." Refer to Structural Drawings for design values

   b. Specified Design Snow Loads: Not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads." Refer to Structural Drawings for design values.

   c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action. Load Duration: 3 seconds

   d. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.

1) For monolithic-glass lites heat treated to resist wind loads.
2) For insulating glass.
3) For laminated-glass lites.

e. Minimum Glass Thickness for Exterior Lites: Not less than ¼ inch.

f. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites ¼ inch.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:

a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F.
b. Solar Heat Gain Coefficient: NFRC 200.
c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass.

1. Each color of tinted float glass.
2. Each type of patterned glass.
3. Coated vision glass.
4. Wired glass.
5. Each type of laminated glass with colored interlayer.
6. Insulating glass for each designation indicated.
7. For each color (except black) of exposed glazing sealant indicated.
8. For each color and pattern of window film.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

E. Qualification Data: For installers.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: For each of the following types of glazing products:

1. Tinted float glass.
2. Insulating glass.
3. Glazing sealants and gaskets.

H. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.

1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

E. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

F. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. (0.84 sq. m) in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. (0.84 sq. m) or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and and GANA's "Glazing Manual."

2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency: Insulating Glass Certification Council.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 WARRANTY

A. Manufacturer's Special Warranty for Glass Products: For each of the listed products, Manufacturer's standard form, made out to Owner and signed by glass manufacturer agreeing to replace units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point

to Project site, within specified warranty period of 10 years from date of Substantial Completion.

1. Coated Glass
2. Laminated Glass
3. Insulating Glass.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified. Products: Subject to compliance with requirements, provide one of the products specified.
2. Product: Subject to compliance with requirements, provide product specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
5. Basis-of-Design Product: The design for each glazing product is based on the 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 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
3. For uncoated glass, comply with requirements for Condition A.
4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).

5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

C. Tempered Patterned Glass: ASTM C 1048, Kind FT (fully tempered), Type II (patterned flat glass), Class 1 (clear), Form 3 (patterned); and of quality, finish, and pattern specified.

D. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:

1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation. Laminate lites in autoclave with heat plus pressure.

2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

E. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. All insulated gals units to be argon gas filled with LowE coating on surface #3, unless noted otherwise.
2. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.

3. Provide Kind FT (fully tempered) glass lites where safety glass is indicated or required.
4. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
5. Sealing System: Dual seal, with primary and secondary sealants.\
6. Spacer Specifications: Manufacturer's standard spacer material and construction.

2.3 GLAZING GASKETS

A. Compression Gaskets: Molded or extruded gaskets of material suitable for application and compatible with other materials and sealants used in assembly of storefront and curtainwall framing, and of profile and hardness required to maintain watertight seal:

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

D. Neutral-Curing Silicone Glazing Sealants (Butt glazing):

a. Type and Grade: S (single component) and NS (nonsag).
b. Class: 25.
c. Use Related to Exposure: NT (nontraffic).
d. Uses Related to Glazing Substrates: G, A, and, as applicable to glazing substrates indicated, O.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for glazing applications in which tape acts as the primary sealant.
2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

2.8 **PRIVACY FILM: GL-4 (Refer to A630 & A631 or more information)**

A. Basis of Design: Subject to compliance requirements, available products that may be incorporated into the work include, but are not limited to:
1. 3M FASARA Glass Finishes Gradation/Lontano SH2FGLO
2. Approved Equal

B. Product Characteristics:
1. Material:
   a. Film: Polyester
   b. Adhesive: Pressure-sensitive acrylic, permanent
   c. Release Liner: Silicone-coated polyester
2. Thickness:
   a. Film + Adhesive (microns): 81
   b. Release Liner: 1 mil (25 microns)
3. Maximum Roll Size:
   a. Standard: 50 in. x 98.4 ft. (127 cm x 30m)
4. Maximum Weight:
   a. 35 lbs. (16 kg) (approx.) for a 50 in. x 98.4 ft. roll

C. Product Performance:
1. Typical Adhesion 24 Hours After Application: Glass: 1.6 lbs/in. (7.0 N/25 mm)
2. Tensile Strength: 45-90 lbs/in. (200-400 N/25 mm)
3. Fire Resistance: When used in interior applications, all patterns have a Class A fire rating per ASTM E84 (as defined in NFPA 101 “Life Safety Code”).
4. VOC Emission Testing: Compliant as low emitting per CA Specification 01350, tested per CDPH Standard Method V1.1 or V1.2.
5. Industry-Specific Testing: IMO Certification/USCG Type Approval

6. Heat Transmission Coefficient: 6 W/m²K, all products
7. UV Blocking: Blocks at least 99% of UV light to reduce the discoloring (fading caused by sunlight) or furniture and other items.

D. Design Pattern: As noted on Finish Schedule.

2.9 **GLASS UNITS TYPES (Refer to A630 & A631 or more information)**

A. Glass Type (GL-1): 1" Low-E Insulated Glass, (¼" + ½" + ¼").

1. Outer Lite: ¼" Pilkington Clear Eclipse Advantage Radiant Low-E #2 surface
2. Air Space: ½" 90% Argon fill
3. Inner Lite: ¼" Pilkington Energy Advantage, Low-E (#3 surface)

B. Glass Type (GL-2): 1" Spandrel Glass, (¼" + ½" + ¼") Heat Strengthen

1. Outer Lite: ¼" Pilkington Clear Eclipse Advantage Radiant Low-E #2 surface
2. Air Space: 90% Argon fill
3. Inner Lite: ¼" Clear, tempered, "Charcoal" Ceramic coating on #4 surface

C. Glass Type (GL- 3): ¼" clear, tempered glass. Grade B fully tempered, Style 1 (uncoated surface),
1. Type 1 (float), Quality (glazing quality) Class 1 (transparent).

D. Refer to 088400 Plastic Glazing for acrylic / resin glazing elements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape at all horizontal applications and where required.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, **extruded-aluminum** and **formed-metal** louvers.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.
3. Section 099113 "Exterior Painting" for field painting louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

1.6 QUALITY ASSURANCE

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on a uniform pressure of **20 lbf/sq. ft. (957 Pa** acting inward or outward.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver L-3:

1. Manufacturers: Subject to compliance with requirements, **provide products by the following**:

2. Basis-of-Design Product: Subject to compliance with requirements, provide Industrial Louvers, Inc or comparable product by one of the following:

   a. Air Balance Inc.; a Mestek company.
   b. Air Flow Company, Inc.
   c. Airolite Company, LLC (The).
   d. All-Lite Architectural Products.
   e. American Warming and Ventilating; a Mestek company.
   f. Architectural Louvers; Harray, LLC.
   g. Arrow United Industries; a division of Mestek, Inc.
   h. Carnes Company, Inc.
   i. Cesco Products; a division of Mestek, Inc.
   j. Construction Specialties, Inc.
   k. Dowco Products Group; Safe Air of Illinois.
   l. Greenheck Fan Corporation.
   m. Louvers & Dampers; a division of Mestek, Inc.
   n. Metal Form Manufacturing, Inc.
   o. NCA Manufacturing, Inc.
   p. Nystrom, Inc.
   q. Pottorff.
   r. Reliable Products, Inc.
   s. Ruskin Company; Tomkins PLC.
   t. United Enertech.
   u. Vent Products Co., Inc.
   v. <**Insert manufacturer's name**>.

3. Louver Depth: **6 inches (150 mm)**.

4. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm) for blades and 0.080 inch (2.03 mm) for frames**.
5. Mullion Type: Exposed.
6. Louver Performance Ratings:

   a. Free Area: Not less than **7.0 sq. ft. (0.65 sq. m** for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.

   b. Point of Beginning Water Penetration: Not less than **900 fpm (4.6 m/s)**.

c. Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **700-fpm (3.6-m/s)** free-area **exhaust** velocity.

7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at **each exterior louver**.

1. Screen Location for Fixed Louvers: Interior face.

2. Screening Type: **Insect screening**.

B. Secure screen frames to louver frames with **machine screws with heads finished to match louver**, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
2. Finish: **Same finish as louver frames to which louver screens are attached**.

3. Type: **Rewirable frames with a driven spline or insert**.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.5 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: **2 inches (50 mm)**.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch (0.81-mm) nominal thickness.
3. Insulating Core: **Rigid, glass-fiber-board insulation**.

4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard **channel frames**, 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 type of finish applied to louvers, but black color**.

7. Attach blank-off panels with **sheet metal screws**.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use **Phillips flat-head** screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.
5. For color-finished louvers, use fasteners with heads that match color of louvers.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

C. Maintain equal louver blade spacing**, including separation between blades and frames at head and sill,** to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: **Exterior flange** unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.

2. Exterior Corners: Prefabricated corner units with mitered **semirecessed** mullions at corners.

F. Provide **subsills made of same material as louvers** for recessed louvers.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: **As selected by Architect from manufacturer's full range**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   1. Division 01 Section 017419 – Construction Waste Management.

1.2 SUMMARY

A. Section Includes:

   1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
   2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

   1. Division 05 Section "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For dimpled steel studs and runners, from ICC-ES.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645**.** Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.027 inch (0.68 mm)
b. Depth: As indicated on Drawings.

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
b. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.

2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
2) MBA Building Supplies; FlatSteel Deflection Track or Slotted Deflecto Track.
3) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
4) Superior Metal Trim; Superior Flex Track System (SFT).
5) Telling Industries; Vertical Slip Track or Vertical Slip Track II..

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly

indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
    b. Grace Construction Products; FlameSafe FlowTrak System.
    c. Metal-Lite, Inc.; The System.
    d. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.027 inch (0.68 mm).

G. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: [0.033 inch (0.84 mm).
2. Depth: As indicated on Drawings.

I. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped .

J. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

a. Type: Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Flat Hangers: Steel sheet, in size indicated on Drawings.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.

F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.027 inch (0.68 mm).
b. Depth: As indicated on Drawings.

3. Dimpled Steel Studs and Runners: ASTM C 645.

a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
b. Depth: As indicated on Drawings.

4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.

a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm)

5. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped.

G. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems.
b. Chicago Metallic Corporation; Drywall Grid System.
c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Installation Standard: ASTM C 754.

1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.

    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Z-Furring Members:

1. Erect insulation, specified in Division 07 Section "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.

2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
   1. Division 01 Section 017419 – Construction Waste Management.

1.2 SUMMARY

A. Section Includes:

   1. Interior gypsum board.

B. Related Requirements:
   1. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

   1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

   1. Install mockups for the following:

      a. Each level of gypsum board finish indicated for use in exposed locations.

   2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
   3. Simulate finished lighting conditions for review of mockups.

   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Low Emitting Materials: For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Gypsum.
2. CertainTeed Corp.
3. Georgia-Pacific Gypsum LLC.
4. Lafarge North America Inc.
5. National Gypsum Company.
6. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

E. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 3.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.
4. Basis of Design: National Gypsum Co, Gold Bond Brand XP Gypsum Board.

F. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.
    g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet, plastic, or rolled zinc.
2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

C. Aluminum Trim: Extruded accessories of profiles and dimensions 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. Fry Reglet Corp.
    b. Gordon, Inc.
    c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
4. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Laminating adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

E. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

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. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
b. Grabber Construction Products; Acoustical Sealant GSC.
c. Pecora Corporation; AC-20 FTR or AIS-919.
d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
e. USG Corporation; SHEETROCK Acoustical Sealant.

2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Acoustical joint sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc., except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: Vertical surfaces unless otherwise indicated.
2. Type X: Where required for fire-resistance-rated assembly.
3. Flexible Type: Apply in double layer at curved assemblies.
4. Ceiling Type: As indicated on Drawings.
5. Abuse-Resistant Type: As indicated on Drawings.
6. Moisture- and Mold-Resistant Type: As indicated on Drawings.
7. Glass-Mat Interior Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- (300-mm-) long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches (400 mm) o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches (300 mm) o.c.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and per Gypsum Construction Handbook as published by United State Gypsum Company (Latest Edition) and in specific locations approved by Architect for visual effect.

1. Control joints shall be employed in long expanses of gypsum board partitions at 30 foot intervals, from floor to ceiling. Additional control joints shall be provided at all door jambs and window frames in accordance with ASTM C 840 and per Gypsum Construction Handbook.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use at outside corners or where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges or where indicated.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

E. Aluminum Trim: Install in locations indicated on Drawings.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints**,** rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicate.

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

5. Level 5: Where indicated on drawings.

    a. Primer and its application to surfaces are specified in other Division 09 Sections.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 30 00 - TILING

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. Porcelain tile
2. Glazed Ceramic tile.
3. Metal edge strips.

B. Related Sections:

1. Section 079200 “Joint Sealants” for sealing joints between tile works, and adjacent constriction and fixtures.
2. Section 092900 “Gypsum Board” for cementitious backer units.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

B. Shop Drawings: Show locations of each tile type and pattern. Show colors, widths, details, accessories, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory.
3. Metal edge strips in 6-inch (150-mm) lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product, signed by product manufacturer.

D. Material Test Reports: For each tile-setting and -grouting product.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3.0 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3.0 percent of amount installed for each type, composition, and color indicated.

B. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing or overheating in accordance with manufacturer's instructions.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements, unless otherwise indicated.

2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. As indicated by drawings.

D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE PRODUCTS

A. Floor Tile (FT-1): Colorbody Porcelain Tile

1. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile; Haut Monde series or comparable product by one of the following:
   a. American Olean; Division of Dal-Tile International Inc.
   b. Crossville Ceramics Company
   c. TileBar LLC
2. Module Size: 24” x 48” (59.44 cm by 119.30 cm).
3. Thickness: 5/16 inch (7.90 mm).
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Matte.
6. Color: As indicated in Finishes Legend.
7. Grout Color: As indicated in Finishes Legend.
8. Grout Joint: As recommended by manufacturer.
9. Testing and Compliance:
   a. Water Absorption (ASTM C373): Less than 5 percent.
   b. Breaking Strength (ASTM C648): Greater than 275 pounds.
   c. Scratch Hardness (MOHS): Minimum 8.0.
   d. Chemical Resistance (C650): Resistant.

B. Wall Tile (WT-1, WT-2, WT-7): Glazed Ceramic Wall Tile

1. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile; Multitude series or comparable product by one of the following:
   a. American Olean; Division of Dal-Tile International Inc.
   b. Crossville Ceramics Company
   c. TileBar LLC
2. Module Size: 12” x 24” (29.90 cm by 60.42 cm).
3. Thickness: 3/8 inch (9.53 mm).
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Satin – Textured as indicated in Finishes Legend
6. Color: As indicated in Finishes Legend.
7. Grout Color: As indicated in Finishes Legend.
8. Grout Joint: As recommended by manufacturer.
9. Testing and Compliance:
   a. Water Absorption (ASTM C373): Less than 20 percent.
   b. Breaking Strength (ASTM C648): Greater or equal than 125 pounds.
   c. Scratch Hardness (C1895): Greater or equal than 4.0.
   d. Chemical Resistance (C650): Resistant.

C. Wall Tile (WT-3-6): Glazed Ceramic Wall Tile

1. Basis-of-Design Product: Subject to compliance with requirements, provide Daltile; Showscape series or comparable product by one of the following:
   a. American Olean; Division of Dal-Tile International Inc.
   b. Crossville Ceramics Company
   c. TileBar LLC
2. Module Size: 12” x 24” (30.51 cm by 61.08 cm).

3. Thickness: 3/8 inch (9.53 mm).
4. Face: Pattern of design indicated, with manufacturer's standard edges.
5. Finish: Glossy – Textured as indicated in Finishes Legend
6. Color: As indicated in Finishes Legend.
7. Grout Color: As indicated in Finishes Legend.
8. Grout Joint: As recommended by manufacturer.
9. Testing and Compliance:
    a. Water Absorption (ASTM C373): Less than 20 percent.
    b. Breaking Strength (ASTM C648): 125-130 pounds.
    c. Scratch Hardness (MOHS): 4.0 – 6.0
    d. Chemical Resistance (C650): Resistant.

2.3 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Basis of Design: Schluter-Systems: www.schluter.com
    a. Jolly
        1) Finish cap, end trim and outside corners
    b. Dilex-HKU
        1) Inside corners and cove base were wall tile meets floor tile.
2. Applications:
    a. Inside corners
    b. Outside corners
    c. Top edge
    d. Cove base
3. Height: To match tile.

2.4 SETTING AND GROUTING MATERIALS

A. Epoxy Grout: (GT-1-3)

1. Subject to compliance with specifications, provide Custom Building Products CEG-Lite 100% Solids Commercial Epoxy Grout or a comparable product by one of the following:
    a. Bonsal, W. R., Company.
    b. LATICRETE International Inc.
    c. MAPEI Corporation.
2. Color: As indicated in Finishes Legend
3. Testing and Compliance:
    a. Water Cleanability: (A118.3 Section 5.1): Greater than 80 minutes.
    b. Initial Set (A118.3 Section 5.2): Greater than 2 hours.
    c. Shrinkage (A118.3 Section 5.3): Less than 0.08 percent.
    d. Sag in Vertical Joints (A118.3 Section 5.4): No change.
    e. Compressive Strength (A118.3 Section 5.6): Greater or equal to 5,800 psi.
    f. Tensile Strength (A118.3 Section 5.7): Greater or equal to 1,700 psi.
    g. Thermal Shock Resistance (A118.3 Section 5.8): Greater or equal to 900 psi.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:

1. Latex additive (water emulsion) of type described below, serving as replacement for part or all of gauging water, combined at job site with prepackaged dry mortar mix supplied or specified by latex additive manufacturer.
2. Latex Type: Acrylic resin.
3. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

C. Modified epoxy emulsion mortar (thin set): ANSI 118.8 consisting of the following:
1. Emulsified epoxy resins and hardeners with portland cement and silica sand intended for exterior applications

D. Latex-Portland Cement Grout: ANSI A118.6, composition as follows:

1. Latex additive (water emulsion) serving as replacement for part or all of gauging water, added at job site with dry grout mixture, with type of latex and dry grout mix as follows:
2. Latex Type: Acrylic resin.
3. Dry Grout Mixture: Dry-set grout specified or supplied by latex additive manufacturer. Use latex additive without retarder with dry-set grout.

2.5 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. Exterior sealants: Refer to Division 7 Section "Joint Sealants."

D. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

1. Available Products:

a. Dow Corning Corporation; Dow Corning 786.
b. GE Silicones; Sanitary 1700.
c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
d. Tremco, Inc.; Tremsil 600 White.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Cementitious backer Sheet. Polymer–modified fiber reinforced units complying with ANSI A118.9, of thickness and width indicated below, and in maximum lengths available to minimize end-to-end butt joints.

1. Thickness: Not more than 3/8 inch thickness
2. Products: Subject to compliance with requirements, provide one of the following products:
    a. 3/8" "Hardie" 500
    b. ¼" Permabase; National Gypsum Co.:

C. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTM D 87.

2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

1. Available Products:

    a. Bonsal, W. R., Company; Grout Sealer.
    b. Bostik; CeramaSeal Grout Sealer.
    c. C-Cure; Penetrating Sealer 978.
    d. Custom Building Products; Grout and Tile Sealer.
    e. Jamo Inc.; Penetrating Sealer.
    f. MAPEI Corporation; KER 004, Keraseal Penetrating Sealer for Unglazed Grout and Tile.
    g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
    h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
    i. TEC Specialty Products Inc.; TA-256 Penetrating Silicone Grout Sealer.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with **thinset mortar** comply with surface finish requirements in ANSI A108.01 for installations indicated.
    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package

show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
   1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
   1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
   1. Add materials, water, and additives in accurate proportions.
   2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

F. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

G. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

H. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

I. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize

the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

J. Joint Widths: Unless otherwise indicated, install tile per manufacturer's recommendations

K. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

L. Metal Edge Strips: Install at all exposed edge of tile, outside and inside corners, top and bottom edges of wall tile transitions.

M. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 SLATE INSTALLATION

1. Install slate to comply with requirements TCA recommendations, ANSI 108.9 and as indicated on drawings
2. Provide flashing and cement backer board substrate at exterior applications.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.6 INTERIOR TILE INSTALLATION SCHEDULE

A. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243 and ANSI A108.5

a. Tile Type: Glazed ceramic tile.
b. Thin-Set Mortar: Latex-portland cement mortar.
c. Grout: Epoxy grout.

END OF SECTION 09 30 00

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes acoustical panels and exposed suspension systems for ceilings.

B. Related Sections include the following:

1. Division 09 Section "Acoustical Tile Ceilings" for ceilings consisting of mineral-base acoustical tiles used with concealed suspension systems, stapling, or adhesive bonding.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members.
2. Method of attaching hangers to building structure.

a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

E. Qualification Data: For testing agency.

F. Field quality-control test reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

H. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

I. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
2. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 1.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 1.0% by weight.

B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.

C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – **ACP. 1**

A. Basis-of-Design Product: Subject to compliance with requirements, provide USG Interiors Inc., Radar High-NRC #22121 Acoustic Panels or a comparable product by one of the following:
1. BPB USA.
2. Chicago Metallic Corporation.
3. Ecophon CertainTeed, Inc.
4. Tectum Inc.
5. Armstrong World Industries

B. Color: White.

C. LR: Not less than 0.84.

D. NRC: Not less than 0.70.

E. CAC: Not less than 35.

F. Edge/Joint Detail: Beveled Tegular

G. Thickness: 3/4 inch

H. Modular Size: 24 by 24 inches

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – **ACP. 2**

A. Basis-of-Design Product: Subject to compliance with requirements, provide USG Interiors Inc., Radar High-NRC High-CAC #22523 Acoustical Panels or a comparable product by one of the following:
1. BPB USA.
2. Chicago Metallic Corporation.
3. Ecophon CertainTeed, Inc.
4. Tectum Inc.
5. Armstrong World Industries

B. Color: White.

C. LR: Not less than 0.84.

D. NRC: Not less than 0.70.

E. CAC: Not less than 35.

F. Edge/Joint Detail: Beveled Tegular

G. Thickness: 3/4 inch

H. Modular Size: 24 by 24 inches

I. Provide Square Edge Trim at “Ceiling Cloud” Areas.

2.4 SUPPMETAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Postinstalled expansion anchors.

b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.

4. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.

E. Hanger Rods: steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

G. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

H. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Basis-of-Design Product: Subject to compliance with requirements, provide USG Interiors – Donn DX 15/16 “Exposed” Tee System or a comparable product by one of the following:

1. BPB USA.
2. Chicago Metallic Corporation.
3. Ecophon CertainTeed, Inc.
4. Armstrong World Industries.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.;
2. BPB USA; <
3. Chicago Metallic Corporation;
4. Fry Reglet Corporation;
5. USG Interiors, Inc.;

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

D. Extruded- Aluminum Knife Edge Molding & Trim: Provide manufacturers standard seamless knife edge, formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners. Finish as selected by architect from manufacturers full range of finishes.

2.7 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
b. USG Corporation; SHEETROCK Acoustical Sealant.
c. Approved equal.

C. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant[**,** with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Splay hangers only where required.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
9. Do not attach hangers to steel deck tabs.

10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
11. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.

5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.

8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections and prepare reports:

1. Suspended ceiling system.
2. Hangers, anchors and fasteners.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.

a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and

touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 51 13.01 – SEAMLESS ACOUSTIC CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes acoustical seamless plaster ceiling systems.

B. Related Sections include the following:
1. Carpentry – see section 06200
2. Gypsum Board – See Section 092500

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members.
2. Method of attaching hangers to building structure.

a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
1. Samples: Provide two 8-1/2" x 11" samples of the acoustic system in color. Samples must show the complete panel thickness and all layers to be installed.
2. Job Site Mockup: Install a 4' x 4' mock-up of the acoustic system replicating relative details and conditions. Obtain mockup acceptance before any additional applications. Accomplish work to equal or exceed standard established by accepted job site mockup

E. Qualification Data: For testing agency.

F. Field quality-control test reports.

G. Product Test Reports: Certified reports for Acoustical Performance Sound Absorption determined per ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method for 'Type E' Mounting, conducted by an accredited, independent testing agency, shall be submitted upon request and meet the following minimum requirements. Noise Reduction Coefficient (NRC) rating for the 40 mm (1 9/16") system shall be 0.85 with frequency absorption coefficients as follows:

	Frequency (Hz)	Absorption Coefficient
a.	80	0.30
b.	100	0.34
c.	125	0.46
d.	160	0.41
e.	200	0.49
f.	250	0.58
g.	315	0.60
h.	400	0.84
i.	500	0.95
j.	630	0.98
k.	800	0.98
l.	1000	0.97
m.	1250	0.92
n.	1600	0.88
o.	2000	0.85
p.	2500	0.90
q.	3150	0.85
r.	4000	0.85
s.	5000	0.87

H. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

I. Fire test data
   1. Certified reports for Surface Burning Characteristics determined per ASTM E 84 Twenty-Five Foot Tunnel Furnace Test Method, conducted by an accredited, independent testing agency, shall be submitted upon request and meet the following minimum requirements:

J. Class A Flame Spread Classification
   1. 20 Flame Spread or less
   2. 15 Smoke Development or less

K. Mold test data
   1. Certified reports for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber determined per ASTM D3273-16 and per ASTM G-21F, conducted by an accredited, independent testing agency, shall be submitted upon request and meet the following minimum requirements:
   2. 10 / 10 – Week 4 – No Defacement
   3. Rating of 0

L. Light reflectance test data
   1. Certified Reports for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating Sphere Reflectometer determined by ASTM E 1477-98, conducted by an accredited, independent testing agency, shall be submitted upon request and meet the following minimum requirements:
   2. Light Reflectance Value 'L' a minimum of 91.3.

M. VOC emission test data
   1. For each system component, Certified Reports for California Department of Public Health CDPH / EHLB / Standard Method Version 1.2, 2017, conducted by an accredited, independent testing agency, shall be submitted upon request and meet the following minimum requirements:
   2. Classroom – VOCs of Concern: ≤½ Chronic REL, Compliant; Formaldehyde: ≤9.0 µg/m3, Compliant; TVOC range: ≤ 0.5 mg/m3. No formaldehyde detected.
   3. Office – VOCs of Concern: ≤½ Chronic REL, Compliant; Formaldehyde: ≤9.0 µg/m3, Compliant; TVOC range: ≤ 0.5 mg/m3. No formaldehyde detected.

N. Maintenance Data: For finishes to include in maintenance manuals.

1.5 REFERENCES

A. ASTM C 423-22: Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method. 'Type E' or 'Type A' Mounting.

B. ASTM E 795-16: Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

C. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

D. ASTM C842, Specification and Standards for Application of Interior Gypsum Plaster.

E. ASTM E 1477-98: Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating Sphere Reflectometer.

F. VOC Test - California Department of Public Health CDPH / EHLB / Standard Method Version 1.2, 2017

G. ASTM D 3273-16: Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ship and deliver in protective packaging to prevent freight damage.

B. Allow materials to become acclimated to installation area conditions 24 hours before installation.

C. Store materials in accordance with manufacturer's recommendations in a fully enclosed space where materials will be protected against damage from direct sunlight, moisture, surface contamination, and other causes.

D. Protect materials from freezing. Product that has frozen cannot be used and is not warranted.

1.7 PROJECT CONDITIONS

1. Environmental Requirements: Comply with requirements of referenced plaster application standards per ASTM C842 and recommendations of product manufacturer for environmental conditions before, during, and after installation.
2.
3. Temperature Requirements: Where ambient outdoor temperature at the building site is less than 55º F (13º C), a temperature of not less than 55º F and not more than 80º F shall be maintained continuously in the area of the installation for a period of not less than one week prior to the application of acoustic system. Temporary heat shall be evenly distributed to prevent concentrated uneven heat or cold on the acoustic system or its substrate. Acceptable temperature range shall be maintained until the permanent HVAC system is activated.
4. Ventilation: Ventilate building spaces as required to remove excess moisture to promote drying of the applied materials. Use of gas heaters is not recommended as they typically increase relative air humidity, whereby the drying time is considerably extended.
5. Prevent strong fluctuations in temperature and relative humidity, care must be taken to ensure that the dew point is not located on the surface or within the acoustic system. Moisture caused by condensation in the room air can cause damage to the acoustic system.
6. Protect contiguous work from soiling, splattering, moisture deterioration, and other harmful effects that may be caused by the application of the materials.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical system and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Plaster: Equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 1.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 SEAMLESS ACOUSTIC CEILING

A. Basis-of-Design Product: Baswa 40mm Phon Classic Fine or a comparable product by one of the following:
1. Baswa Acoustic
2. Pyrok, Inc
3. Asona Sonacoustic
4. Rockfon
5. Ecophon

B. Color: White. The towel-applied finish coats of Base and finish coat shall be provided in white.

C. The trowel-applied finish coats of Base and finish coat shall be tinte.. Color shall be selected by the Architect or as noted in the Finish Schedule.

D. System thickness: 40MM

E. LR: Not less than 0.84.

F. NRC: Not less than 0.85.

G. CAC: Not less than 35.

H. A spray protection membrane shall be applied to the finished surface after system has completely dried for a minimum of 12 hours. The non-bridging coating resists stains and improves cleanability without negatively affecting acoustical absorption. Application and coverage shall be per manufacturer’s approved application guidelines.

2.2 SUPPMETAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Post installed expansion anchors.

b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.

4. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.

E. Hanger Rods: steel, zinc coated or protected with rust-inhibitive paint.

F. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL CEILING

2.4 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
b. USG Corporation; SHEETROCK Acoustical Sealant.
c. Approved equal.

C. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant[**,** with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Verify that all mechanical and electrical services within the area of application have been roughed in at the appropriate depth relative to the thickness of the system; tested and approved, prior to commencement of application.

3.2 PREPARATION

A. Substrate Material
1. New drywall substrates receiving the full acoustic system shall be a Level One finish; taped only and all penetrations sealed tightly.
2. New drywall substrates receiving Base and Finish Coats only, located in a different plane than those areas receiving the full acoustic system, shall be a Level Four finish; taped,

coated, and sanded. Substrate shall be primed with drywall latex primer tinted to match final finish color.

3. New drywall substrates receiving Fill, Base and Fine Coats only, located in the same plane as areas receiving the full acoustic system, shall be a Level Four finish; taped, coated, and sanded. Substrate shall be primed with drywall latex primer to match final finish color.
4. Existing substrates with glossy paint, metal surfaces, previously painted drywall, masonry, and concrete, shall be primed with Sherwin Williams Preprite Bonding Primer or equal, installed per paint manufacturer's specifications.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Splay hangers only where required.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
9. Do not attach hangers to steel deck tabs.

10. Do not attach hangers to steel roof deck. Attach hangers to structural members.

11. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on molding and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. INSTALLATION
1. General Information and Requirements
   a. Application of acoustic plaster ceiling must be performed in accordance with manufacturer requirements included specialty finishing tools.

   b. Lighting
      1) Inherent in all hand troweled product applications, minor acceptable trowel marks or imperfections in the finished surface may occur and become exposed or exaggerated under critical lighting. Ensure that the lighting used during the entire installation process replicates the actual finished lighting. All skylights, clerestory windows and other openings which naturally light the area of the installation shall be uncovered during the entire installation to represent finished conditions.

   c. Drying Times
      1) Ensure acoustic plaster systems are fully & thoroughly dry prior to proceeding with any additional work.

   d. Finish Coat Installation
      1) Application of the base shall be facilitated in one operation at each area of installation.
   e. Once Base coat is dry, Finish coat shall be facilitated in one operation at each area of installation.

2. Access Doors
   a. Provide 24" x 24" access panels from same manufacturer to close finish match to ceiling.

   b. Securing to acoustic plaster ceiling
      1) Light fixtures, ornamentation, speakers, cover plates, or any other items cannot be attached to the acoustic system. Ensure items are secured to a, proper blocking, or other approved attachment system independent of the acoustic plaster ceiling according to manufacturer details.

3. Installation procedures
   a. Install acoustic plaster ceiling according to manufacturer's acoustic's planning documents, installation instructions, and details. Installation shall start only after all other work in the area of the installation has been completed.

   b. System panels
      1) Apply 2mm thick layer of plaster-based adhesive to the mineral wool back face of the panel. Panel is pressed firmly onto and fully adhered to the stable substrate. Ensure that panels are set as level and as smooth to each other as practicable.
4. Curved surfaces: On domed, curved and warped surfaces, provide the back face of the mineral wool of the panel as factory-kerfed at 3 inches on center, in one or two directions, to facilitate ease of shaping in either the convex or concave directions.
   a. Stagger joints between panels and install with short side of panel parallel to critical light source.

5. Trim
   a. Install white vinyl trim pieces. Trims shall be installed with manufacturer approved materials.

6. Secondary Coat
   a. Fill seams between panels with manufacturer seam filler. Cover all white vinyl trim. Sand Fill smooth when completely dry.
   b. Do not tint secondary coat.

7. Secondary Coat at Domed, Vaulted, and Curved Areas
   a. Apply a 2.0 – 3.0mm thick layer of secondary coat over domed, vaulted, or curved area and over all white vinyl trim where extreme critical light conditions exist or radius is less than 2 feet. Trowel smooth. Sand smooth when completely dry prior to applying Base.

8. Trowel-applied Coat Base (Standard Natural White)
   a. Prior to applying the Base coat, ensure product is thoroughly mixed and all pails are continuously batched together to provide even, consistent color over the entire area.
   b. Apply a 2.0 – 3.0mm thick layer and trowel smooth. Sand smooth when completely dry.
   c. Note the acoustic plaster ceiling hand-crafted finish products. Inherent in all hand-crafted products, minor acceptable trowel marks and other imperfections in the finished surface may occur which are only visible at certain times of day or under

certain critical lighting conditions. The finish should be critically viewed only under end-use lighting conditions

d. Apply a 2.0 – 3.0mm thick layer and trowel smooth. Sand smooth when completely dry.
e. Note that BASWA systems are hand-crafted finish products. Inherent in all hand-crafted products, minor acceptable trowel marks and other imperfections in the finished surface may occur which are only visible at certain times of day or under certain critical lighting conditions. The finish should be critically viewed only under end-use lighting conditions.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 54 00 – SPECIALTY CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
1. Acoustic Linear Metal Ceilings
2. Linear Metal Soffits
3. Acoutic Felt Baffles
4. Rigid, open-frame, suspended grids and suspension systems for ceilings (Including cloud systems).
5. Acoustical Infill Panels.

B. Related Requirements:

1. Section 09 51 13 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.

C. Products furnished, but not installed, under this Section include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Cell Grids: Set of 12-inch (300-mm) square module Samples of each type, finish, and color.
2. Beam Grids: Set of 12-inch (300-mm) long Samples of each type, finish, and color; a 12-inch (300-mm) long spliced section; and a 6-inch (150-mm) long per leg corner section.

E. Delegated-Design Submittal: For design of attachment devices.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling layout
2. Lighting fixtures.
3. Air outlets and inlets.
4. Speakers.
5. Sprinklers.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

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. Suspended Decorative Grids: Quantity of each suspended decorative grid component, exposed molding, and trim equal to **2** percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver suspended decorative grid components to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle suspended decorative grids and accessories carefully to avoid damaging units and finishes in any way.

PART 2 - PRODUCTS

2.1 LMC-01 SUSPENDED ACOUSTIC LINAR METAL CEILING / LMC-02 LINEAR METAL SOFFIT - EXTERIOR

A. Basis of design: Armstrong Ceilings “Metalworks Classic”. Manufacturers offering products that meet the specification and design intent of the basis of design may include, but are not limited to:
1. CertainTeed Corporation: www.certainteed.com.
2. USG: www.usg.com
3. Rockfon: Rockfon.com

4. Arktura: Arktura.com

B. Panel Materials
1. Electrogalvanized Steel 0.028
2. Size: 4 in
3. Edge Profile: Linear
4. Perforation: Perforated
5. NRC: 0.70
6. Flame Spread: ASTM E1264; Class A (FM)
7. Light Reflectance White Panel: 0.83
8. Dimensional Stability: Standard

C. Color & Finish: To be selected by architect from Manufacturers full range of finish options.

D. Hanging kit, cables, and other required suspension as supplied, recommended or approved by manufacturer to accommodate the field conditions to meet the design intent (location, heights) as noted on reflected ceiling plans. LMC-02 provide rigid wind uplift resistant suspension system.

2.2 ACB-1 ACOUSTIC CEILING BAFFLES

A. Basis-of-Design Product: Turf products "BEAM" ceiling panel as identified on finish schedule. Manufacturers with equal products meeting basis of design specifications and design concept on finish schedule may include, but are not limited to:

a) Basis of Design Manufacturers: Subject to compliance with requirements, provide Turf Design, Inc. BEAM CEILING BAFFLE or a comparable product by one of the following:
1. Armstrong World Industries, Inc.
2. Arktura LLC
3. Fräsch
4. Acoufelt

b) Suspension Systems:
1. Armstrong World Industries, Inc.
2. Arktura LLC
3. Fräsch
4. Acoufelt

B. CEILING UNITS
a) Ceiling Panels
1. Surface Texture: Soft
2. Composition: Polyester (PET) felt 60% pre-consumer recycled
3. Finish(s): TBD. Architect to select from manufacturer's full range of colors.
4. Felt Thickness: 9 mm
5. Baffle Thickness: 3 inches

1. Panel Length Size(s): Refer to drawings
2. Panel Depth Size(s):
- 8-inch (Nominal): 7.5-inch (Actual)

6. Acoustical Performance: NRC 1.50
7. Flame Spread: Class A

2.3 SUSPENDED DECORATIVE GRIDS, GENERAL

A. Sheet Metal Characteristics: Provide sheet metal selected for surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discolorations, or other imperfections.

1. Aluminum Sheet: Roll-formed aluminum sheet, complying with ASTM B 209 (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635/C 635M.

    a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 879/A 879M, 13Z (40G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.

    b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.

B. Grid Fabrication: Components are formed from metal indicated. Manufacturer's standard units of size, shape, and profile indicated; finished to comply with requirements indicated.

C. Cover Profiles and Trim: Provide manufacturer's standard cover profiles and trim for exposed members, and as indicated or required, for edges of grids, at changes in ceiling height, and for other conditions, of same metal and finish as suspended decorative grids.

D. Metal Suspension-System Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635/C 635M requirements. Provide systems complete with runners or beams, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, web covers, load-resisting struts, fixture filler pans, clips and adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

E. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.

F. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.

2. Size: Select wire diameter so its stress at 3 times hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than 0.106-inch (2.69-mm) diameter wire.

G. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

H. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

I. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

J. Exposed Metal Edge Moldings, Covers, Trim, and Fixture Filler Panels: Provide exposed members as indicated or required to conceal edges of and penetrations through ceiling, to conceal edges of beams, to cover runner webs, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching suspended decorative grids unless otherwise indicated.

1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which suspended decorative grids attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of suspended decorative grids.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of suspended decorative grids to balance border widths at opposite edges of each space. Comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install suspended decorative grids to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard

suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

4. Secure hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for structure to which hangers are attached and for hanger type involved.

5. Do not support grids directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. Do not attach hangers to steel deck tabs.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

E. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

F. Install edge moldings and trim of type indicated at perimeter of each suspended decorative grid and where necessary to conceal edges of grids.

1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, level with ceiling system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.

2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

G. Install suspended decorative grids in coordination with suspension system and exposed moldings and trim. Comply with installation tolerances according to CISCA's "Metal Ceilings Technical Guidelines."

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
2. Fit adjoining units to form flush, tight joints.
3. Where grid edges are visible, install cover profiles unless other trim is indicated.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections of completed installations of grid hangers, anchors, and fasteners in successive stages. Do not proceed with installations of grid hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Extent of Each Test Area: When installation of grid systems on each floor has reached 20 percent completion but no panels have been installed.

a. Within each test area, testing agency selects one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and tests them for 200 lbf (890 N) of tension; it also selects one of every two postinstalled anchors used to attach bracing wires to concrete and tests them for 440 lbf (1957 N) of tension.
b. When tested fasteners and anchors do not comply with requirements, testing agency tests those fasteners and anchors not previously tested until 20 pass consecutively and then resumes initial testing frequency.

B. Suspended decorative grid hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

C. Prepare tests and inspection reports.

3.5 CLEANING

A. Clean exposed surfaces of suspended decorative grids, including trim and edge moldings, after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace grid components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and deformed grids.

END OF SECTION

SECTION 096400 - WOOD FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Factory-finished wood flooring.
2. Wood floor underlayment.

PREINSTALLATION MEETINGS

B. Preinstallation Conference: Conduct conference at **Project site**

1. Review methods and procedures related to resilient athletic flooring installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wood flooring.
2. Include manufacturer's written installation instructions for each type of substrate.

B. Shop Drawings: For each type of floor assembly and accessory. Include plans, sections, and attachment details. Include expansion provisions and trim details.

C. Samples: For each exposed product and for each color and texture specified, approximately **4 inches (300 mm) long**and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and finishes available for wood flooring.

1. Include Samples of accessories involving color and finish selection.

E. Samples for Verification: For each type of wood flooring and accessory, with stain color and finish required, approximately **12 inches (300 mm) long** and of same thickness and material indicated for the Work and showing the full range of normal color and texture variations expected.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wood flooring and finish systems.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wood Flooring: Equal to **5** percent of amount installed for each type, color, and finish of wood flooring indicated.

1.5 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Mockup as apart of construction is acceptable.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood flooring materials in unopened cartons or bundles.

B. Protect wood flooring from exposure to moisture. Do not deliver wood flooring until after concrete, masonry, plaster, ceramic tile, and similar wet-work is complete and dry.

C. Store wood flooring materials in a dry, warm, ventilated, weathertight location.

1.7 FIELD CONDITIONS

A. Conditioning period begins not less than seven days before wood flooring installation, is continuous through installation, and continues not less than seven days after wood flooring installation.

1. Environmental Conditioning: Maintain ambient temperature between 65 and 75 deg F (18 and 24 deg C) and relative humidity planned for building occupants in spaces to receive wood flooring during the conditioning period.
2. Wood Flooring Conditioning: Move wood flooring into spaces where it will be installed, no later than the beginning of the conditioning period.

a. Do not install flooring until it adjusts to relative humidity of, and is at same temperature as, space where it is to be installed.

b. Open sealed packages to allow wood flooring to acclimatize immediately on moving flooring into spaces in which it will be installed.

B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.

C. Install factory-finished wood flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 FACTORY-FINISHED WOOD FLOORING

A. Solid-Wood Flooring, Factory Finished: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; with backs channeled.

1. Basis of Design Product: Subject to compliance with requirements, provide Resawn Timber Co; Virtuoso European White Oak system or a comparable product in accordance with the following performance requirements.
   a. Species: European**White oak**
   b. Grade: A>.
   c. Cut: Quarter/rift sawn.
   d. Thickness: **3/4 inch (19 mm)**.
   e. Face Width: **5-1/8 inches (130 mm)**.
   f. Lengths: Random-length strips complying with applicable grading rules.
   g. Edge Style: Microbeveled edges & ends>.
   h. Finish: UV urethane.
      1) Color: Matte

2.2 ACCESSORY MATERIALS

A. Subfloor & Substrate: **As specified in Section 061000 "Rough Carpentry" and Section 061600 "Sheathing."**

B. Wood Underlayment: **As specified in Section 061600 "Sheathing."**

C. Asphalt-Saturated Felt: ASTM D4869/D4869M, Type II.

D. Wood Flooring Adhesive: Mastic recommended by flooring and adhesive manufacturers for application indicated.

E. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer.

F. Fasteners: As recommended by manufacturer, but not less than that recommended in **NWFA's "Wood Flooring Installation Guidelines."**

G. Thresholds and Saddles: To match wood flooring. Tapered on each side.

H. Reducer Strips: To match wood flooring; **2 inches (51 mm)** wide, tapered, and in thickness required to match height of flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of wood flooring.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Concrete Slabs: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels in accordance with manufacturer's written installation instructions.

1. Moisture Testing: Perform tests so that each test area does not exceed **1000 sq. ft. (304.8 sq. m)** and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   a. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level measurement.
   b. Perform additional moisture tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. Concrete Slabs:

1. Grind high spots and fill low spots to produce a maximum 1/8-inch (3-mm) deviation in any direction when checked with a 10 ft. (3 m) straight edge.
2. Use trowelable leveling and patching compounds, in accordance with manufacturer's written installation instructions, to fill cracks, holes, and depressions in substrates.
3. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF WOOD FLOORING

A. Comply with flooring manufacturer's written installation instructions, but not less than applicable recommendations in **NWFA's "Wood Flooring Installation Guidelines."**

B. Wood Underlayment: [**Install in accordance with requirements in Section 061600 "Sheathing."**] <**Insert requirements.**>

C. Provide expansion space at walls and other obstructions and terminations of flooring **of not less than 1/4 inch (19 mm)**

D. Vapor Retarder: Comply with the following for vapor retarder installation:

1. Wood Flooring Nailed to Wood Subfloor: Install flooring over a layer of asphalt-saturated felt.
2. Wood Flooring Nailed to Sleepers over Concrete: Install flooring over a layer of polyethylene sheet with edges overlapped over sleepers and turned up behind baseboards.
3. Wood Flooring Installed Directly on Concrete: Install a layer of polyethylene sheet in accordance with flooring manufacturer's written installation instructions.

E. Solid-Wood Flooring: Blind nail or staple flooring to substrate.

1. Plank Flooring: For flooring of face width more than 3 inches (76 mm):

a. Hardwood: Install countersunk screws at each end of each piece in addition to blind nailing. Cover screw heads with wood plugs glued flush with flooring.

3.4 PROTECTION

A. Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

1. Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096400

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient rubber bases.
2. Stair treads and risers.

B. Related Sections:

1. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

D. Product Schedule: For resilient products: Use same designations indicated on Drawings.

E. Samples for Initial Selection: For each type of product indicated.

F. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.

G. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C)

C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 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. Furnish not less than 10 linear feet (3 linear m) > for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT COVE BASE – B-1

A. Resilient Base:

1. Basis of Design Manufacturers: Subject to compliance with requirements, provide Roppe Pinnacle Rubber Base with Standard Toe or a comparable product by one of the following:
   a. Shaw Contract
   b. Flexco, Inc.
   c. Allstate Flooring

B. Wall Base: ASTM F1861.

1. Roppe; Pinnacle Rubber Wall Base
2. Approved Equal.

C. Type (Material Requirement): TS (rubber, thermoset).

D. Group (Manufacturing Method): I (solid, homogeneous).

E. Style: Cove (with top-set toe) unless noted otherwise.

F. Minimum Thickness: 1/8" (ASTM F386)

G. Height: 4"

H. Lengths: Coils in manufacturer's standard length.

I. Outside Corners: Field mitered.

J. Inside Corners: Field mitered.

K. Product Performance Properties: As Follows
1. ASTM F1861 – Resilient Wall Base: Type TS, Group 1, Styles A & B
2. ASTM E648 (NFPA 253) – Critical Radiant Flux: Class I, ≥ 0.45 W/cm²
3. ASTM E662 (NFPA 258) – Smoke Density: Passes, ≤ 450
4. ASTM E84 – Flammability: Class B
5. ASTM F925 – Chemical Resistance: Excellent
6. ASTM F137 – Flexibility: Excellent, No Crack or Break ¼" Mandrel
7. ASTM F1515 – Light Stability: $\triangle E \leq 8$

L. Color: as indicated on Finish Legend.

2.2 MILLWORK RESILIENT BASE – MB-1

A. Millwork Resilient Base:

1. Basis of Design Manufacturers: Subject to compliance with requirements, provide Roppe Contours Profiled Wall Base PV6085 or a comparable product by one of the following:
   a. Shaw Contract
   b. Flexco, Inc.
   c. Allstate Flooring

B. Wall Base: ASTM F1861.

C. Type (Material Requirement): TP (rubber, thermoplastic).

D. Group (Manufacturing Method): II (solid, homogeneous).

E. Style: Fashion #85

F. Minimum Thickness: 0.25"

G. Height: 6.25”

H. Lengths: Coils in manufacturer’s standard length.

I. Outside Corners: Field mitered.

J. Inside Corners: Field mitered.

K. Color: as indicated on Finish Legend.

L. Product Performance Properties: As Follows:
1. ASTM F1861 – Resilient Wall Base: Type TP, Group 2, Style D
2. ASTM E648 (NFPA 253) – Critical Radiant Flux: Class I, ≥ 0.45 W/cm²
3. ASTM E662 (NFPA 258) – Smoke Density: Passes, ≤ 450
4. ASTM E84 – Flammability: Class A
5. ASTM F925 – Chemical Resistance: Excellent
6. ASTM F137 – Flexibility: Excellent
7. ASTM F1515 – Light Stability: $\triangle E \leq 8$

2.3 RUBBER STAIR ACCESSORIES – RTR-1 (Treads with integrated risers)

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Manufacturer:
1. Basis of Design: Subject to compliance with requirements, provide Roppe – Rubber treads with integrated riser with Kevlar or an approved equivalent.

C. Stair Treads with Risers (RTR-1): ASTM F2169.

1. Class: 1
2. Color: Symmetry - TBD
3. Style: Hammered #95 with Kevlar
4. Thickness: 13/64”
5. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal-length units.

D. Stringers: Existing to remain, painted. Refer to finish legend for color.

E. Locations: Provide rubber stair accessories in areas indicated in drawings.

F. Substrate Preparation Products: Substrates should be prepared to properly receive resilient flooring products being specified. Trowelable leveling and patching compounds that are latex modified, Portland cement based or blended hydraulic cement-based formulation. Recommended substrate preparation products:
1. Excelsior NP-230, Non-Porous Substrate
2. Excelsior CP-300, Cementitious Patch

3. Excelsior SU-310, Self -Leveling Underlayment

G. Adhesives: Adhesives should be selected based on the site conditions and use of the space being installed. Recommended adhesive products:
1. Excelsior MS-700, Modified Silane Wet-Set Adhesive
2. Excelsior EW-710, Epoxy Wet-Set Adhesive

H. Product Performance Properties: As Follows:
1. ASTM F2169 – Resilient Stair Treads: Type TS, Class 1 or 2, Group 1 and/or 2, Grade 1
2. ASTM E648 (NFPA 253) – Critical Radiant Flux: Class 1, ≥ 0.45 W/cm²
3. ASTM E662 (NFPA 258) – Smoke Density: Passes, ≤ 450
4. ASTM D2047 – Static Coefficient of Friction: ≥ 0.50
5. ASTM F925 – Chemical Resistance: Excellent
6. ASTM F1514 – Heat Stability: $\triangle E \leq 8$
7. ASTM D2240 – Hardness: ≥ 85 Shore A

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Cove Base Adhesives: Not more than 50 g/L.
b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

D. Floor Polish: Provide protective liquid floor polish products as recommended by resilient stair tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests recommended by manufacturer[and as follows]. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply three coat(s).

E. Cover resilient products until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Luxury vinyl tile.
2. Vinyl composition floor tile.
3. Rubber tile flooring.

B. Related Sections:

1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples for Initial Selection: For each type of floor tile indicated.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

E. Seam Samples: For seamless-installation technique indicated and for each flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.

F. Product Schedule: For floor tile. Use same designations indicated on Drawings.

G. Qualification Data: For qualified Installer.

H. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 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. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 - PRODUCTS

2.1 LUXURY VINYL TILE – LVT-1

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide Shaw LVT, "Crossing Paths 5.0 4392V" or a comparable product by one of the following:

1. Interface
2. J+J Flooring
3. Tarkett Commercial

B. Color: See Finish Legend

C. Pattern: See Finish Legend

D. Construction: Heavy Commerical Luxury Vinyl Tile With Fiberglass

E. Class/ASTM F1700: Class III, Type B

F. Finish: ExoGuard+

G. Nominal Dimensions: 18" x 18" (46cm x 46cm)

H. Actual Dimensions: 18.00" x 18.00" (45.72cm x 45.72cm)

I. Wear Layer Thickness: 20 mil (0.02"/0.51mm)

J. Overall Thickness: 0.197" (5mm)

K. Edge Profile: Squared Edge

L. Installation Type: Dry Back

M. Installation: Direct Glue

N. Recommended Adhesive: Per manufacturer

O. Performance Characteristics: As follows:
1. Static Load (ASTM F970): Passes (Modified), *750 lbs
2. Resistance to Heat (ASTM F1514): Passes
3. Resistance to Light (ASTM F1515): Passes
4. Resistance to Chemicals (ASTM F925): Passes
5. Smoke Density (ASTM E662, Flaming Mode): Passes
6. Radiant Panel (ASTM E648): Passes, Class I
7. Coefficient of Friction (ASTM D2047, Slip Resistance): ≥ 0.5

2.2 LUXURY VINYL TILE – LVT-2-4

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide Milliken LVT, "Fortified Foundations 5.0mm" or a comparable product by one of the following:

1. Interface
2. J+J Flooring
3. Tarkett Commercial

B. Color: See Finish Legend

C. Pattern: See Finish Legend

D. Construction: High Performance Luxury Vinyl Tile

E. Finish: ProGuard MAX Coating

F. Wear Layer Thickness: 22 mil (0.55 mm)

G. Overall Layer Thickness: 5.0 mm (0.197")

H. Edge Profile: Micro Bevel

I. Embodied Carbon: 19.3 (kg CO2e)/m2

J. Installation: Direct Glue

K. Nominal Size: 18" x 18"

L. Performance Characteristics: As Follows:
1. Critical Radiant Flux (ASTM E648): Pass – Class I
2. Smoke Density (ASTM E662): Pass - ≤ 450
3. Flexibility (ASTM F137): Pass
4. Heat Stability by Color Change (ASTM F1514): Pass
5. Light Stability (ASTM F1515): Pass
6. Static Coefficient of Friction (ASTM D2047): Pass
7. Dimensional Stability (ASTM F2199): Pass
8. Resistance to Chemicals (ASTM F925): Pass
9. Static Load Limit (ASTM F970): Pass

2.3 VINYL COMPOSITION FLOOR TILE – VCT-1.

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Flooring VCT, "Standard Excelon Imperial" or a comparable product by one of the following:

1. Azrock.

2. Tarkett, Inc.

B. Color: See Finish Legend

C. Pattern: See Finish Legend

D. Construction: Vinyl Composition Tile

E. International Specifications: ASTM F1066 – Class 2 Through Pattern, ISO 10595, Type II

F. Overall/Wear Layer Thickness: 1/8" (3.2 mm)

G. Factory Finish: Fast Start

H. Installation: Adhesives per manufacturer

I. Maintenance Options: Polish

J. Size: 12" x 12" (305 mm x 305 mm)

K. Performance Characteristics: As follows:
1. Thickness (ASTM F386): Meets
2. Size (ASTM F2055): Meets
3. Squareness (ASTM F2055): Meets
4. Indentation – One Minute (ASTM F1914): Meets
5. Indentation @115°F (ASTM F1914): Meets
6. Impact (ASTM F1265): Meets
7. Deflection (ASTM F1304): Meets
8. Dimensional Stability (ASTM F2199): Meets
9. Chemical Resistance (ASTM F925): Meets
10. Resistance to Heat (ASTM F1514): Meets
11. Static Load Resistance (ASTM F970): 2000 psi
12. Fire Test Data – Flame Spread (ASTM E648): Meets
13. Fire Test Data – Smoke Evaluation (ASTM E662): Meets
14. ADA Standards for Accessible Design (Chapter 3, Section 302.1): Meets
15. Static Coefficient of Friction (ASTM d 2047/UL 410): Meets

2.4 RUBBER TILE FLOORING – RTF-1

A. Products: provide one of the following, or code-compliant approved equal.
1. Roppe Rubber Tile – Hammered 995 (Basis of Design)

B. Colors and Patterns: As follows:
1. As indicated on Finish Legend

C. Nominal Dimensions: 19 11/16" (50cm) x 19 11/16" (50cm) x 1/8" (3.2mm)

D. Performance Characteristics: As Follows:
1. ASTM F1344 – Rubber Floor Tile: Type I, A & B, Grade 1
2. ASTM E648 (NFPA 253) – Critical Radiant Flux: Class I, ≥ 0.45 W/cm²

3. ASTM E662 (NFPA 258) – Smoke Density: Passes, ≤ 450
4. ASTM D2047 – Static Coefficient of Friction: ≥ 0.50
5. ASTM F970 – Static Load Resistance: Passes, < 0.005" Indentation @ 250 psi. Passes, < 0.005" Indentation @ 1,100 psi Modified
6. ASTM F2753 – Rolling Load Limit: ≤ 500 lbs./in²
7. ASTM F925 – Chemical Resistance: Excellent
8. ASTM G21 – Resistance to Fungi: Excellent
9. ASTM D3389 – Abrasion Resistance: Excellent, ≤ 1g loss (after 1000 cycles)
10. ASTM F1514 – Heat Stability: $\triangle E \leq 8$
11. ISO 4918 – Castor Chair Test: Excellent, No Damage or Separation after 25,000 Cycles
12. ASTM D2240 – Durometer Hardness Indentation: ≥ 85 Shore A
13. ASTM E2179 – Sound Reduction (6" Concrete Slab): $\triangle$IIC 9
14. ASTM E492 – Impact Insulation Class (6" Concrete Slab/Ceiling Assembly): IIC 51

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

   a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
   b. Rubber Floor Adhesives: Not more than 60 g/L.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

   a. Color: Match floor tile.

2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.

   a. Use chemical-bonding compound that has a VOC content of 350 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

1. Use sealant that has a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Joint-Sealant Color: Match floor tile.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until they are same temperature as space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis and in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply three coat(s).

E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

F. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.

1. Sealer: Apply two base coats of liquid sealer.
2. Finish: Apply three coats of liquid floor finish.

G. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 66 23 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Epoxy matrix terrazzo with ground and polished finish.
2. Precast epoxy terrazzo wall base.
3. Divider strips.

B. Related Section:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete subfloor with steel trowel finish.
2. Section 07 92 00 - Joint Sealants: Sealing joints between terrazzo work and adjacent construction and fixtures.
3. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, included but not limited to divider strips, control joint strips, expansion joints, and sealer; include printed copy of current NTMA recommendations for type of terrazzo specified.

B. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:

1. Divider strips.
2. Control-joint strips.
3. Accessory strips.
4. Abrasive strips.
5. Precast terrazzo jointing and edge configurations.
6. Terrazzo patterns.
7. Wall base

C. Samples for Initial Selection: Manufacturer's color plates showing the full range of colors and patterns available for each terrazzo type indicated.

D. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and marble-chip and aggregate types, sizes, and proportions. Prepare samples of same thickness and from same material to be used for the Work in size indicated below:

1. Terrazzo: 6-inch- (150-mm-) square Samples.
2. Precast Terrazzo: 6-inch- (150-mm-) square Samples.
3. Accessories: 6-inch- (150-mm-) long Samples of each exposed strip item required.

E. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.

F. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

G. Qualification Data: For qualified Installer.

H. Material Certificates: For each type of terrazzo material or product, from manufacturer.

I. Maintenance Data: For terrazzo to include in maintenance manuals. Include procedures for stain removal, stripping, and sealing.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.

1. Minimum five years of documented experience.
2. Associate member firm of NTMA.

B. Installer Qualifications: A qualified installer who is acceptable to terrazzo manufacturer to install manufacturer's products.

1. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.
2. Engage an installer who is a contractor member of NTMA.
3. Minimum five years of documented experience.

C. Source Limitations: Obtain primary terrazzo materials from one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

D. Source Limitations for Marble Chips and Aggregates: Obtain each color, grade, type, and variety of granular materials from one source with resources to provide materials of consistent quality in appearance and physical properties.

E. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for terrazzo including accessories.

a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.

2. Locate where directed by Architect.
3. Mock-ups may not remain as part of the completed Work at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to terrazzo including, but not limited to, the following:

a. Inspect and discuss condition of substrate and other preparatory work performed by other trades, including but not limited to joint details, job site conditions, and vapor barrier details.
b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
c. Review special terrazzo designs and patterns.
d. Review dust-control procedures.
e. Review plans for concrete curing and site drying to enable timely achievement of suitable slab moisture conditions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

C. Keep products away from fire or open flame.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

C. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

E. Control and collect dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

1. Provide dustproof partitions and temporary enclosures to limit dust migration and to isolate areas from noise.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Subject to compliance with requirements, provide Terrazzo & Marble Supply Companies; Terroxy Resin Systems, or one of the following:

1. Sika Corporation; Sikafloor Terrazzo.
2. Terrazzco; TERRAZZCO Epoxy Terrazzo System, a brand of Concord Terrazzo Company, Inc.
3. Master Terrazzo Technologies LLC; Morricite.

2.2 EPOXY MATRIX TERRAZZO APPLICATIONS:

1. Floors (TRZ-1-3):
   a. Thickness: 3/8 inch, nominal
   b. Aggregate Type: Marble Chips
   c. Aggregate Size: No. 0 – 2.
2. Wall Base (TZB-1):
   a. Description: All precast components to utilize Terroxy Resin products for fabrication to ensure color consistency with the poured in place flooring.
   b. Thickness: Same as floors.
   c. Style: Straight, top edge eased.
   d. Color(s): As indicated on finish legend.
   e. Aggregate Type and Size: Same as floors.
   f. Height: 6 inches.

2.3 MATERIALS:

1. Primer: Terroxy Moisture Vapor Treatment or approved equal:

a. Physical properties of moisture mitigating primer shall have a maximum of 0.3 perms with 100% RH per ADTM E-96

2. Flexible Reinforcing Membrane: Terroxy Iso-Crack Epoxy Membrane, for substrate crack preparation and reflective crack reduction.

a. Reinforcement: Terroxy Fiberglass scrim.

3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.

a. Physical Properties without Marble Chips and Aggregates. All specimens cured for 7 days at 73-77ºF (22.8-25ºC) and 50 percent plus or minus 2 percent RH. This product shall meet the following requirements:

1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
2) Minimum Tensile Strength: 3000 psi (20.7 MPa) per ASTM D 638 for a 2-inch (51-mm) specimen made using a "C" die per ASTM D 412.
3) Minimum Compressive Strength: 10,000 psi (6.9 MPa) per ASTM D 695, Specimen B cylinder.
4) Minimum Flexural Strength: 4,500 psi (31.7 MPa) per ASTM D 790.
5) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.

a) Distilled water.
b) Mineral water.
c) Isopropanol.
d) Ethanol.
e) 0.025 percent detergent solution.
f) 1.0 percent soap solution.
g) 10 percent sodium hydroxide.
h) 10 percent hydrochloric acid.
i) 30 percent sulfuric acid.
j) 5 percent acetic acid.

b. Physical Properties with Marble Chips and Aggregates: For Epoxy Matrix blended with three volumes of Valders marble blended 60% #1 chip and 40% #0 chip, ground and grouted with epoxy resin according to Installation Specifications, finishing to a nominal 3/8” (9.5 mm) thickness. All specimens cured for 7 days at 73-77ºF (22.8-25ºC) and 50 percent RH plus or minus 2 percent RH. This finished Epoxy Matrix shall meet the following requirements:

1) Flammability: Self-extinguishing, maximum extent of burning 0.25 inch (6.35 mm) per ASTM D 635.
2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C) for temperature range of minus 12 to plus 140 deg F (minus 24 to plus 60 deg C) per ASTM D 696.
3) Bond Strength:
4) Critical Radiant Flux:
5) Fire Rating: Test for surface burning characteristics of flooring;

4. Marble Chips and Aggregates: Complying with NTMA gradation standards for mix indicated and containing no deleterious or foreign matter.

    a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
    b. 24-Hour Absorption Rate: Less than 0.74 percent.
    c. Dust Content: Less than 1.0 percent by weight.

5. Finishing Grout: Terroxy Epoxy Matrix or Terroxy Clear Resin with a broadcast of filler as recommended by Manufacturer.

B. Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and marble-chip aggregate proportions and mixing.

1. Custom Mix Color and Pattern: Match Architect's sample.

2.4 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type

1. Height: 3/8 inches (9.5 mm)
2. Material: White-zinc alloy.
3. Top Width: 1/8 inch (3.2 mm).

2.5 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: 100% solid epoxy-resin adhesive recommended by adhesive manufacturer for this use and acceptable to terrazzo manufacturer.

1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

C. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated. Color to be selected by architect to match/compliment terrazzo flooring.

D. Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

E. Surface Finish System: Level of polish to be specified by architect in accordance with desired appearance and level of reflectivity.

F. Sealer: Slip and stain resistant type Penetrating sealer that is chemically neutral with PH factor between 7 and 10; does not affect color or physical properties of terrazzo; is recommended by

sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:

1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

    a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
    b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
    c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

2. Verify that concrete substrates are visibly dry and free of moisture.

3. Moisture Testing:

    a. Test for moisture by anhydrous calcium chloride method according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

    b. Test for moisture by relative humidity probe and digital meter method according to ASTM F 2170. Units shall be approved by Portland Cement Association. Provide product Rapid PH as manufactured by Wagner Electronics or approved equal. Proceed with installation only after substrates have a maximum relative-humidity-measurement reading of 70 to 75 percent in 24 hours and the ambient temperature has been above 50 degrees F for a minimum of 10 days. Core drill holes and

thoroughly remove all dust and debris. Vacuum and wire brush hole twice prior in inserting probe. Install protective cover and document and mark locations. Take readings and record in presence of Architect. Reinstall protective cover. Once conditions are deemed acceptable, install stainless steel disc and apply skim coat of cementitious patching compound compatible with finish flooring. Quantity: (3) for the first 1,000 square feet and (1) for every 1,000 square feet thereafter. Spacing: Surface moisture meter to identify location, as per ASTM F2170 Standard.

c. Test for moisture content as recommended in writing by terrazzo manufacturer. Proceed with installation only after substrates pass testing.

C. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.

1. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

D. Installation of terrazzo indicates acceptance of surfaces and conditions.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

A. General:

1. Comply with NTMA's written recommendations for terrazzo and accessory installation.
2. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6 mm in 3 m); noncumulative.
4. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
5. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

B. Thickness: 3/8 inch (9.5 mm) nominal.

C. Flexible Reinforcing Membrane:

1. Prepare and prefill substrate cracks with membrane material.

2. Install membrane to produce full substrate coverage in areas to receive terrazzo.

3. Reinforce membrane with fiberglass scrim.
4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.

D. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

E. Strip Materials:

1. Divider and Control-Joint Strips:

a. Locate divider strips in locations indicated.
b. Install control-joint strips back to back directly above concrete-slab control joints.
c. Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.
d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

F. Fine Grinding: Grind with stones 1500 grit or finer until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.

G. Repair: Remove and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

H. Grouting:

1. Cleanse floor with clean water and rinse.
2. Remove excess rinse water by wet vacuum, dry and fill voids as recommended by manufacturer.
3. Allow grout to cure. Grout may be left on terrazzo until other trades work is completed.

3.4 PRECAST TERRAZZO INSTALLATION

A. Install precast units using method recommended by and manufacturer unless otherwise indicated.

B. Seal joints between units with joint sealants.

3.5 CLEANING AND PROTECTION

A. Cleaning:

1. Remove grinding dust from installation and adjacent areas
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA’s written recommendations.

2. Apply sealer according to sealer manufacturer's written instructions

C. Protection: Upon completion, the work shall be ready for final inspection and acceptance by the owner or his agent. Provide final protection and maintain conditions, in a manner acceptable to terrazzo contractor, that ensure terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 66 23

SECTION 09 68 13 - CARPET TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes modular, tufted carpet tile.

B. Related Sections include the following:

1. Division 9 Section "Resilient Tile Flooring, Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
2. 09 66 23 “Resinous Matrix Terrazzo Flooring” for accessories and strip materials installed with carpet tile.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Existing flooring materials to be removed.
3. Existing flooring materials to remain.
4. Carpet tile type, color, and dye lot.
5. Type of subfloor.
6. Type of installation.
7. Pattern of installation.
8. Pattern type, location, and direction.
9. Pile direction.
10. Type, color, and location of insets and borders.
11. Type, color, and location of edge, transition, and other accessory strips.
12. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. Mockups: Before installing carpet tile, build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, dimensional stability, excess static discharge, and delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 2 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE – CPT-1 (WALK-OFF CARPET)

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide Interface Carpet Tile, “Step Repeat Tile SR899” or a comparable product by one of the following:
1. Shaw Contract
2. J+J Flooring
3. Tarkett Commercial

B. Color: See Finish Legend

C. Pattern: See Finish Legend

D. Product Construction: Tufted Textured Loop

E. Yarn System: 100% Recycled Content Nylon

F. Yarn Manufacturer: Aquafil

G. Dye Method: 100% Solution Dyed

H. Soil/Stain Protection: Protekt²

I. Preservative Protection: Intersept

J. Tufted Yarn Weight: 26 oz/yd² (882 g/m²)

K. Machine Gauge: 1/12" (47.2 ends/10cm)

L. Pile Height: 0.2" (5.1mm)

M. Pile Thickness: 0.143" (3.6mm)

N. Stitches: 10/inch (39.37 ends/10cm)

O. Pile Density: 6,545 oz/yd³ (242,687 g/m³)

P. Size: 19.69" x 19.69" (50cm x 50cm)

Q. Performance Characteristics: As follows:
1. Flooring Radiant Panel: ASTM E648 Passes
2. Smoke Density: ASTM E662 ≤ 450
3. Flammability: Passes Methenamine Pill Test (DOC-FF1-70)
4. Lightfastedness: (AATCC 16 – E) ≥ 4.0 @ 60 AFU's
5. Static: (AATCC – 134) < 3.0 KV
6. Dimensional Stability: AACHEN Din 54318 < 0.10%
7. Traffic Classification: Severe
8. Fiber Modification Ratio: 1.9 to 2.2
9. Preservative Efficacy: (AATCC 174 Parts 2&3) 99% Reduction/No Mold 7 Days (ASTM E2471) Complete Inhibition

2.2 CARPET TILE – CPT-2, 4, 5

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide Shaw Carpet Tile, "Reverence Tile 5T702" or a comparable product by one of the following:

1. Interface
2. J+J Flooring
3. Tarkett Commercial

B. Color: See Finish Legend

C. Pattern: See Finish Legend

D. Construction: Multi-Level Pattern Loop

E. Fiber: Ecosolution Q100 Nylon

F. Dye Method: 100% Solution Dyed

G. Primary Backing: Synthetic

H. Secondary Backing: Ecoworx Bio Tile

I. Protective Treatments: SSP Shaw Soil Protection

J. Recommended Adhesive: Per manufacturer

K. Product Size: 9" x 36" (23cm x 91cm)

L. Gauge: 1/10" (39.4 per 10cm)

M. Stitches: 8.5 per inch (34.0 per 10cm)

N. Finished Pile Thickness: 0.105" (2.67mm)

O. Average Density: 8,229 oz/yd³ (0.0304 g/cm³)

P. Total Thickness: 0.260" (6.6mm)

Q. Tufted Weight: 24 oz/yd² (813.7 g/m²)

R. Performance Characteristics: As follows:
1. NBS Smoke: Less Than 450
2. Electrostatic Propensity: Less Than 3.5 kv
3. CRI Green Label Plus (GLP): GLP9968
4. Pill Test: Pass
5. ADA Compliance: >0.6
6. Wear Rating (ASTM D5252): Severe

2.3 CARPET TILE – CPT-3

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide Shaw Carpet Tile, "Kickoff Tile 5T499" or a comparable product by one of the following:

1. Interface
2. J+J Flooring
3. Tarkett Commercial

B. Color: See Finish Legend

C. Pattern: See Finish Legend

D. Construction: Multi-Level Pattern Loop

E. Fiber: Ecosolution Q100 Nylon

F. Dye Method: 100% Solution Dyed

G. Primary Backing: Synthetic

H. Secondary Backing: Ecoworx Tile

I. Protective Treatments: SSP Shaw Soil Protection

J. Recommended Adhesive: Per manufacturer

K. Product Size: 9" x 36" (23cm x 91cm)

L. Gauge: 1/12" (47.2 per 10cm)

M. Stitches: 9.5 per inch (38.5 per 10cm)

N. Finished Pile Thickness: 0.113" (2.87mm)

O. Average Density: 5,735 oz/yd³ (0.212 g/cm³)

P. Total Thickness: 0.247" (6.27mm)

Q. Tufted Weight: 18 oz/yd² (610.3 g/m²)

R. Performance Characteristics: As follows:
1. Radiant Panel: Class I
2. NBS Smoke: Less Than 450
3. Electrostatic Propensity: Less Than 3.5 kv
4. CRI Green Label Plus (GLP): GLP9968
5. Pill Test: Pass
6. ADA Compliance: >0.6
7. Wear Rating (ASTM D5252): Severe

2.4 CARPET TILE – CPT-6

A. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide Shaw Carpet Tile, "Alignment Tile 5T668" or a comparable product by one of the following:
1. Interface
2. J+J Flooring
3. Tarkett Commercial

B. Color: See Finish Legend

C. Pattern: See Finish Legend

D. Construction: Multi-Level Pattern Loop

E. Fiber: Q100 Nylon

F. Dye Method: 100% Solution Dyed

G. Primary Backing: Synthetic

H. Secondary Backing: EcoWorx Tile

I. Protective Treatments: SSP Shaw Soil Protection

J. Recommended Adhesive: Per manufacturer

K. Product Size: 24 in x 24 in (61 cm x 61 cm)

L. Gauge: 1/12 in (47.2 per 10 cm)

M. Stitches: 8.0 per in (32.5 per 10 cm)

N. Finished Pile Thickness: 0.076 in (1.93 mm)

O. Average Density: 7579 oz/yd³ (0.28 g/cm³)

P. Total Thickness: 0.241 in (6.12 mm)

Q. Tufted Weight: 16 oz/yd² (542.5 g/m²)

2.5 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, non-staining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. VOC Limits: Provide adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA method 24).

C. Stainless Steel Trim TR-1,2,3
1. Basis of Design: Subject to compliance with requirements, provide Schluter Systems; RENO-TK or a comparable product by one of the following:
   a. Fry Reglet Corporation
   b. Laticrete International, Inc.

D. Stainless Steel Trim TR-4
1. Basis of Design: Subject to compliance with requirements, provide Schluter Systems; SCHIENE or a comparable product by one of the following:

a. Fry Reglet Corporation
b. Laticrete International, Inc.

E. Stainless Steel Trim TR-5
1. Basis of Design: Subject to compliance with requirements, provide Schluter Systems; VINPRO-U or a comparable product by one of the following:
a. Fry Reglet Corporation
b. Laticrete International, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 72 00 - WALL COVERINGS

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. Vinyl wall covering.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Shop Drawings: Show location and extent of each wall-covering type.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- (914-mm) long in size.

D. Samples for Initial Selection: For each type of wall covering.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: **25** or less.
b. Smoke-Developed Index: 50 or less.

2.2 VINYL WALL COVERING – WC-1

A. Basis of Design Product: Subject to compliance with requirements, provide Wolf Gordon "Angles" or a comparable product by one of the following:
1. Arc-Com Fabrics, Inc.
2. Momentum Textiles and Wallcovering
3. MDC Wallcoverings

B. Description: Provide mildew-resistant products in rolls from same production run and complying with the following:
1. FS CCC-W-408A/D and CFFA-W-101-D for Type II, Medium Duty products

C. Colors, Textures, and Patterns: As indicated on Finish Legend

D. Content: 100% Vinyl

E. Backing: Osnaburg

F. Width: 52"

G. Weight: 20 oz per linear yard

H. Repeat: 17.3" H x 24" V

I. Performance Characteristics: As Follows:
1. Fire Rating: ASTM E84 (Adhered) and IBC Section 803.1.2 – Class A
2. Flame Spread: 20
3. Smoke Developed: 45
4. Fire Rating: Passes NFPA 286

2.3 VINYL WALL COVERING – WC-2

A. Basis of Design Product: Subject to compliance with requirements, provide Wolf Gordon "Angles Max" or a comparable product by one of the following:
1. Arc-Com Fabrics, Inc.
2. Momentum Textiles and Wallcovering
3. MDC Wallcoverings

B. Description: Provide mildew-resistant products in rolls from same production run and complying with the following:
1. FS CCC-W-408A/D and CFFA-W-101-D for Type II, Medium Duty products

C. Content: 100% Vinyl

D. Backing: Osnaburg

E. Width: 52"

F. Weight: 20 oz per linear yards

G. Repeat: 52" H x 24" V

H. Performance Characteristics: As Follows:
1. Fire Rating: ASTM E84 (Adhered) and IBC Section 803.1.2 – Class A
2. Flame Spread: 20
3. Smoke Developed: 45
4. Fire Rating: Passes NFPA 286

I. Colors, Textures, and Patterns: As indicated on Finish Legend

2.4 VINYL WALL COVERING – WC-3

A. Basis of Design Product: Subject to compliance with requirements, provide Wolf Gordon Digital Custom Graphic, Type II or a comparable product by one of the following:
1. Arc-Com Fabrics, Inc.
2. Momentum Textiles and Wallcovering
3. MDC Wallcoverings

B. Description: Provide mildew-resistant products in rolls from same production run and complying with the following:
1. FS CCC-W-408A/D and CFFA-W-101-D for Type II, Medium Duty products

C. Flame Resistance: ASTM E84 (Adhered) and IBC Section 803.1.2 – Class A Flame Spread: 20

D. Total Weight: 20 oz per linear yards

E. Width: As indicated on elevations

F. Length: As indicated on elevations

G. Backing: TBD

H. Colors, Textures, and Patterns: Custom graphic – print ready files supplied by architect. Refer to finish plans and elevations for size and locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL LINER INSTALLATION

A. Install wall liner, without gaps or overlaps. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.4 WALL-COVERING INSTALLATION

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 6 inches from inside corners. Horizontal seams are not permitted.

F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.5 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 00

SECTION 09 81 00 – ACOUSTIC INSULATION

PART 1 - GENERAL 1.1 SUMMARY

A. Section Includes:

1. Acoustical insulation in walls.

2. Acoustical sealant.

B. Drawings, the provisions of the Agreement, the General Conditions, and Division 1 specification sections apply to all work of this Section.

C. Substitutions: Substitute products will be considered only under the terms and conditions of Section 016000.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. C665 - Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

2. E84 - Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

A. See Section 013000 for submittal procedures.

PART 2 - PRODUCTS

A. Batt Acoustical Insulation: ASTM C665, Type I; unfaced glass fiber batts, blankets, or rolls; minimum fire hazard classification rating of 25/50 per ASTM E84; minimum 3-inch thick, unless required otherwise to meet the STC requirements; 2-3/4 inches thick for installation in 2-1/2 inch stud cavities; 3-5/8 to 4 inches thick for installation in 3-5/8 inch stud cavities;6-1/2 inches thick for installation in 6 inch stud cavities; widths to friction-fit between studs, where indicated for installation in stud walls; formaldehyde free.

B. Mineral Fiber Batt Acoustical Insulation: Thermafiber (Wabash, IN; 888-834-2371; 260-563-2111) "SAFB" (Sound Attenuation Fire Blanket); ASTM C665, Type I; unfaced mineral fiber batts; minimum fire hazard classification rating of 0/0 per ASTM E84; minimum 3-inch thick, unless required otherwise to meet the STC requirements; 2-1/2 inches thick for installation in 2-1/2 inch stud cavities; 3-1/2 to 4 inches thick for installation in 3-5/8 inch stud cavities; 6 inches thick for installation in 6 inch stud cavities; widths to friction-fit between studs, where indicated for installation in stud walls; formaldehyde free.

C. Acoustical Insulation: ASTM C665, Type I; unfaced glass fiber batts, blankets, or rolls; minimum fire hazard classification rating of 25/50 per ASTM E84; minimum 3-1/2-inch thick, unless required otherwise to meet the STC requirements indicated or specified; formaldehyde free.

1. For Installation in Stud Walls: Widths to friction-fit between studs

2. For Installation at Partition Head Tracks and Acoustically Insulated Door Frames: Continuous strips, full width of partition or frame, as detailed.

D. Acoustical Sealant: Non-hardening, low-shrinkage; for use in conjunction with gypsum board; similar to USG "Sheetrock Brand Acoustical Sealant," Tremco "Acoustical Sealant 30CTG," Quiet Solution (Sunnyvale CA; ; 408-541-8000) "QuietSeal QS-350," or approved; maximum VOC content 250g/L.

E. Accessories: Furnish other accessories such as fasteners and retainers, not specifically described, but required for a complete installation.

PART 3 - EXECUTION

A. Do not begin work until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.2 PREPARATION

A. Verify that adjacent materials are secure, properly spaced, dry, and ready to receive installation.

B. Verify that mechanical and electrical services within spaces to be insulated have been installed and tested.

C. Furnish acoustical insulation to hollow metal installer for installation in hollow metal frames in acoustical partitions.

3.3 INSTALLATION

A. Install insulation in stud cavities in accordance with manufacturer's instructions, and as indicated.

Coordinate with other trades as necessary to complete acoustical barriers at wall penetrations.

B. Install insulation without gaps or voids.

C. Trim insulation neatly to fit spaces. Use insulation materials free of damage.

D. Sealant:

1. Install acoustical sealant continuously around perimeter of all acoustically insulated partitions; one continuous bead at each side of framing member interface with substrate.

2. Where double layer of gypsum board is indicated, provide sealant at butt joints between boards , including corner joints, and additional bead at perimeter of base layer prior to installation of finish layer.

3. Except for penetrations in fire rated construction to receive firestopping or fire rated construction joint assemblies, seal all penetrations through acoustical assemblies, including cutouts for lighting fixtures, cabinets, pipes and plumbing, HVAC ducts, and electrical boxes.

END OF SECTION 09 81 00

SECTION 09 72 00 – WALL-MOUNTED ACOUSTIC PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall-mounted acoustic panels.

B. Related Sections:

1. 092900 “Gypsum Board”
2. 061053 “ Miscellaneous Carpentry” for blocking and supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Shop Drawings: Submit shop drawings indicating plans, elevations, details of construction, and relationship with adjacent construction. Show location and extent of each acoustic wall panel type.

C. Samples: For each type of acoustic wall panel and for each color, pattern, texture, and finish specified, full width by 36-inch- (914-mm) long in size.

D. Samples for Initial Selection: For each type of acoustic wall panel.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each acoustic wall panel, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer: Minimum of 2 years manufacturing similar products.

B. Installer: Minimum of 2 years installing similar products.

1.7 DELIVERY , STORAGE, AND HANDLING

A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

B. Storage and Handling: Comply with manufacturer's recommendations for storage and handling. Protect from weather damage.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install acoustic wall panels until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install acoustic wall panel until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall panel.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by acoustic wall panel manufacturer.

1.9 WARRANTY

A. Warranty: Provide manufacturer's standard limited warranty against defects in manufacturing. Minimum 5 years

PART 2 - PRODUCTS

2.1 ACOUSTIC WALL PANELS – AWP-1

A. Basis of Design Product: Subject to compliance with requirements, provide MDC-Zintra "Etch Panels" or a comparable product by one of the following:
   1. Acoufelt
   2. FilzFelt
   3. Turf Design

B. Description: Provide 100% solution dyed polyester products from same production run and complying with the following:
   1. Material composition: 100% Solution Dyed (Color Through) Polyester
   2. Weight: 0.5 lb/ft2 (2.4 kg/m2)

3. Fire rating:
   a. ASTM-E84 – Class A classification
   b. AS ISO 9705 – 2003 – Group 1 classification
   c. EN-13501 – B-s2-d0 classification
4. Lightfastness: AATCC 16.3, Option 3: Panel color change at 40AFU is 4.5
5. Temperature: The maximum temperature exposure is 240° F (115° C)
6. Moisture absorption: Polyester fiber when exposed to an atmosphere of 120°F (49° C) at 90% relative humidity for four days showed moisture absorption of less than 0.03% by weight.
7. NRC rating: Minimum 0.45
8. Dimensions: 4’ x 9’ (48” x 108”)
   a. Width and length tolerance: +/- 1/8”
9. Thickness: 1/2"
   a. Thickness tolerance: +/- .02”
10. Style: Tesselate
11. Color: As indicated on finish legend
12. Installation: Z-Clips. Hardware quantity is responsibility of the contractor, following manufacturer's instructions.
    a. 75” -108” long panels will require (4) z-Clips sets, spaced evenly.

2.2 ACOUSTIC WALL PANELS – AWP-2-3

A. Basis of Design Product: Subject to compliance with requirements, provide MDC-Zintra “Box Tiles” or a comparable product by one of the following:
   1. Acoufelt
   2. FilzFelt
   3. Turf Design

B. Description: Provide 100% solution dyed polyester products from same production run and complying with the following:
   1. Material composition: 100% Solution Dyed (Color Through) Polyester
   2. Weight: 0.5 lb/ft2 (2.4 kg/m2)
   3. Fire rating:
      a. ASTM-E84 – Class A classification
      b. AS ISO 9705 – 2003 – Group 1 classification
      c. EN-13501 – B-s2-d0 classification
   4. NRC rating: 1.00 – 1.15
   5. Dimensions: As indicated on elevations and finish legend.
   6. Depth: 4”
   7. Style: Emerald
   8. Color: As indicated on elevations and finish legend.
   9. Installation: Beams Clips. Hardware quantity is responsibility of the contractor, following manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of projections and substances detrimental to application, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

3.3 WALL PANELS INSTALLATION

A. Comply with wall panels manufacturers' written installation instructions, approved submittals, and in proper relationship to adjacent construction applicable to products and applications indicated.

3.4 CLEANING

A. Use cleaning methods recommended in writing by wall panels manufacturer.

B. Adjust units for proper position, uniform appearance and operation.

C. Clean exposed and semi-exposed surfaces using materials acceptable to manufacturer.

END OF SECTION 09 84 11

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. This Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete.
2. Gypsum Board.
3. Steel.
4. Galvanized metal.
5. Aluminum (not anodized or otherwise coated).
6. Wood.
7. Mechanical and electrical work (MEP)

C. Related Sections include the following:

1. Division 3 Sections “Concrete” for sealers of concrete flatwork.
2. Division 5 Sections for shop priming of metal substrates with primers specified in this Section.
3. Division 6 Sections for shop priming carpentry with primers specified in this Section.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

C. Samples for Initial Selection: Upon request, for each type of topcoat product indicated.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.
5. Label each sample as to date painted.

E. Product List: For each product indicated, include the following:

1 Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.5 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.8 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. Furnish an additional 2 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Manufacturers (Interior Gypsum Wall Finishes): Subject to compliance with requirements, provide products by one of the following:

1. Sherwin-Williams Company (Basis of Design).
2. Benjamin Moore & Co.
3. Duron, Inc.
4. Finnaren & Haley Inc (F&H)
5. M.A.B. Paints.
6. Architect approved equal.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and 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 and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Non-flat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Shellacs, Pigmented: VOC not more than 550 g/L.

C. Colors: Match Architect's samples or as indicated in a color schedule.

- P-1-7: Sherwin Williams #SW Color as indicated on Finish Legend.

2.3 PRIMERS/SEALERS

A. Alkali-Resistant Primer: MPI #3: Factory-formulated water based, alkali-resistant acrylic-latex interior primer for interior plaster applications.

1. VOC Content: E Range of E2.

B. Interior Latex Primer/Sealer: MPI #50.

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

C. Interior Alkyd Primer/Sealer: MPI #45.

1. VOC Content: E Range of E2.

D. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E2.

B. Waterborne Galvanized-Metal Primer: MPI #134.

1. VOC Content: E Range of E2.

C. Quick-Drying Primer for Aluminum: MPI #95.

1. VOC Content: E Range of E2.

D. Rust-Inhibitive Primer (Water Based): MPI #107.

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

E. Vinyl Wash Primer: MPI #80.

2.5 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 2.

2.6 EPOXY PAINT

A. Water-Based Epoxy (Interior and Exterior): MPI #215. A water based, two component epoxy type, semi-gloss finish coating. Subject to compliance with requirements, provide one of the following:
1. Sherwin-Williams Company (Basis of Design)
2. Benjamin Moore; M43/M44- 84 Acrylic Epoxy Semi-Gloss.
3. M. A. B. Paint; Ply-Tile 530 Water-Reducible Acrylic Epoxy Semi-Gloss.

B. Water-Based Epoxy (Interior and Exterior): MPI #115. A water based, two component epoxy type, Gloss finish coating. Subject to compliance with requirements, provide one of the following:

1. Benjamin Moore & Co.; Acrylic Epoxy Gloss "A", Hardener "B", M43/M44.
2. ICI Paints; Devoe Coatings, Tru Glaze WB Epoxy Gloss Coating, 4408/4418
3. Porter Paints; Dura-Glaze WB, Gloss Epoxy, 9371.
4. PPG Architectural Finishes, Inc.; Aquapon, Waterborne Epoxy, 98-1/98-98.
5. Sherwin-Williams Company (The); Industrial & Marine, Water Based Catalyzed Epoxy, B70W Series.

2.7 ALKYD PAINTS

A. Exterior Alkyd Enamel (Flat): MPI #8 (Gloss Level 1).

1. VOC Content: E Range of E1.

B. Exterior Alkyd Enamel (Semi-gloss): MPI #94 (Gloss Level 5).

1. VOC Content: E Range of E1.

C. Exterior Alkyd Enamel (Gloss): MPI #9 (Gloss Level 6).

1. VOC Content: E Range of E1.

D. Interior Alkyd (Flat): MPI #49 (Gloss Level 1).

1. VOC Content: E Range of E1.

E. Interior Alkyd (Eggshell): MPI #51 (Gloss Level 3).

1. VOC Content: E Range of E1.

F. Interior Alkyd (Semi-gloss): MPI #47 (Gloss Level 5).

1. VOC Content: E Range of E1.

G. Interior Alkyd (Gloss): MPI #48 (Gloss Level 6).

1. VOC Content: E Range of E1.

2.8 ACRYLIC-RESIN COATING.

A. Breathable cement masonry paint formulated with colorfast pigments for use over cement plaster or masonry substrates. Include manufacturer's recommended primers. Coating shall be mildew resistant and breathable with perm rating of not less than 15 per ASTM E 96.

1. Thoro Products, "Thorosheen" or equal.
2. Primer: Thoroseal 1000.
3. Texture: smooth

2.9 LATEX PAINTS

A. Interior Latex (Flat): MPI #53 (Gloss Level 1).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 1.5.

B. Interior Latex (Low Sheen): MPI #44 (Gloss Level 2).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 2.

C. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 2.

D. Interior Latex (Satin): MPI #43 (Gloss Level 4).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 2.

E. Interior Latex (Semi-gloss): MPI #54 (Gloss Level 5).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 2.

F. Interior Latex (Gloss): MPI #114 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).

1. VOC Content: E Range of E1.
2. Environmental Performance Rating: EPR 2.

G. Exterior Acrylic Latex (Flat): MPI #10 (Gloss Level 1).

1. VOC Content: E Range of E1.

H. Exterior Acrylic Latex (Semi-gloss): MPI #11 (Gloss Level 5).

1. VOC Content: E Range of E1.

2.10 DRY FOG/FALL COATINGS

A. Flat, Latex Dry Fog/Fall (MPI #118): Provide a water-based, emulsion-type, fast-drying coating used on overhead metal and other surfaces for application methods by airless and/or conventional spray equipment. Overspray will dry to a sweepable powder over a short distance for easier clean up.

1. VOC Content: E Range of E1.

B. Flat Dry-Fall for Galvanized Steel (water based) MPI # 133: Provide a waterborne coating, designed for direct application to cleaned, interior overhead galvanized metal surfaces, for application methods by airless and/or conventional spray equipment. Overspray will dry to a sweepable powder over a short distance for easier clean up.

1. VOC Content: E Range of E1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Plaster: 12 percent.
5. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and re-prime substrate with compatible primers as required to produce paint systems indicated.

2. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

3. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

4. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting

D. Concrete Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

F. Ferrous Metals: Clean un-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

1. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

I. Plaster Substrates: Do not begin paint application until plaster is fully cured and dry.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

F. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

G. Overhead Structure and Exposed Ceiling Steel and Galvanized-Metal Substrates:

1. Prep substrate as required minimum. Repair existing primed surfaces.

2. Galvanized surface shall be prepared by either solvent cleaning and test for chromate passivation, with an SSPC SP 7 Brush-off blast cleaning if required or chemical-etching cleaners may be substituted for solvent washing and SSPC-SP 7 cleaning.

3. Apply primer coat to unprimed surfaces.

4. Paint exposed metal deck, structural steel, conduit, un-insulated ductwork and piping, and other mechanical and electrical work in finish and occupied rooms. Protect surfaces not to be painted. Dry-Fall painting shall not be required in mechanical-electrical equipment, custodial, storage and similar rooms.

H. Exterior Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed on exterior of building, excluding roof mounted mechanical and electrical work. Items to be painted include, but are not limited to, the following:

1. Un-insulated metal and plastic piping, including hangers and supports.
2. Louvers, grilles, vents unless pre-finished.
3. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
4. Conduit and junction boxes.
5. Electrical equipment that is indicated to have a factory-primed finish for field painting.
6. Do not paint unless noted otherwise.

    a. Pre-finished mechanical equipment and items
    b. pipe and duct insulation
    c. Pre-finished electrical devices and/or cover plates
    d. Electrical fixtures
    e. Name places
    f. Moving parts

7. Touch up damaged finishes, including field applied and pre-finished surfaces.

I. Interior Mechanical and Electrical Work: Unless otherwise noted, painting of mechanical and electrical work is limited to items exposed to view in finished spaces as defined herein.

1. Locations where MEP work to be field painted include following

    a. Occupied or Finish spaces are to include all rooms and other spaces with suspended, drywall or plaster ceiling, including toilet rooms and storage rooms. Also stairs, classroom and other rooms used by students
    b. Occupied or Finished Spaces with ceilings – Paint all exposed MEP work as described herein exposed to view.
    c. Occupied or Finished Spaces without ceilings - Paint all exposed MEP work as described herein exposed to view, including the structure above - unless noted otherwise.
    d. Occupied or Finished Spaces without ceilings (i.e., Egress Stairs, Gym, and Stage house), partial ceilings, and where indicated.
    e. Unless noted otherwise, painting of MEP work is not required of Unfinished or unoccupied spaces include mechanical and electrical equipment rooms (rooms whose primary purpose is to house HVAC or other MEP equipt), elevator equipment rooms, IT equipt and MDF rooms, storage rooms without finish ceilings, shafts and chases.

2. Items to be painted include, but are not limited to, the following:

    a. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    b. Un-insulated metal and plastic piping
    c. Piping hangers and supports.
    d. Louvers grilles vents unless pre-finished
    e. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

f. Electrical equipment that is indicated to have a factory-primed finish for field painting.
g. Conduit and junction boxes, including metallic and PVC materials, fire alarm, BAS, attachments exposed and semi-exposed to view in finish areas
h. Electrical and control panels in finish areas and exposed to view

3. Do not paint, unless noted otherwise.

a. Pre-finished mechanical equipment and items
b. pipe and duct insulation
c. Pre-finished electrical devices and/or cover plates
d. Electrical fixtures
e. Name places
f. Moving parts
g. Sight exposed interior of ductwork and other equipment

4. Touch up damaged finishes, including field applied and pre-finished surfaces.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

c. Topcoat: Light industrial coating, exterior, water based (Semi-gloss unless noted otherwise)

B. Aluminum Substrates:

1. Water-Based Light Industrial Coating System:
   a. Prime Coat: Primer, quick dry, for aluminum**, MPI #95**.

   b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat
   c. Topcoat: Light industrial coating, exterior, water based (Semi-gloss unless noted otherwise)

C. Steel Substrates:

1. Water-Based Light Industrial Coating System:

   a. Prime Coat: Primer, alkyd, anti-corrosive for metal**, MPI #79**.

   b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

   c. Topcoat: Light industrial coating, exterior, water based (Semi-gloss unless noted otherwise)

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Alkyd System: MPI INT 5.1E.

   a. Prime Coat: Quick-drying alkyd metal primer where required

   b. Intermediate Coat: Interior alkyd matching topcoat.
   c. Topcoat: Interior alkyd (Semi-gloss unless noted otherwise)

2. Water-Based Dry-Fall System: MPI INT 5.1C.

   a. Prime Coat: Quick-drying alkyd metal primer where required.
   b. Topcoat: Waterborne dry fall.

B. Galvanized-Metal Substrates:

1. Water-Based Dry-Fall System: MPI INT 5.3H.

   a. Prime Coat: Waterborne dry fall where required
   b. Topcoat: Waterborne dry fall.

2. Alkyd System: MPI INT 5.3C.

   a. Prime Coat: Cementitious galvanized-metal primer.

   b. Intermediate Coat: Interior alkyd matching topcoat.
   c. Topcoat: Interior alkyd (Semi-gloss unless noted otherwise).

C. Wood Substrates: Including wood trim, architectural woodwork and windows.

1. Latex System:

a. Prime Coat: Primer, latex, for interior wood**,** MPI #39.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.

2. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer, latex, for interior wood**,** MPI #39.

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)**,** MPI #147.

D. Dressed Lumber Substrates: Including architectural woodwork.

1. Latex System: MPI INT 6.3T.

a. Prime Coat: Interior latex-based wood primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (semi-gloss).

E. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.

a. Prime Coat: Interior latex primer/sealer
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex. (Refer to finish schedule for gloss level.)

F. Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings

1. Alkyd Over Latex Primer System: MPI INT 10.1B.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (Flat)

END OF SECTION 09 91 00

SECTION 10 11 00 - VISUAL DISPLAY SURFACES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Resinous Magnetic Markerboards.(MMB-1)
2. Fabric Wrapped Tackable Panel (FWP-1)

B. Product Data: For each type of product indicated.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show location of panel joints.
2. Include sections of typical trim members.
3. Edge profiles and panel components, including anchorage, accessories, finish colors and textures.

D. Samples for Initial Selection: For each type of visual display surface indicated and as follows:

1. Color Selections for resinous magnetic markerboards.
2. Color selections for fabric tack assemblies.
3. Samples of accessories involving color selection.

E. Samples for Verification: For each type of visual display surface indicated and as follows:

1. Visual Display Surface: Not less than 8 by 10 inches, mounted on substrate indicated for final Work.
2. Fabric Tack Surface: Not less that 8 by 10 inches of mounted on substrate indicated for final work

F. Maintenance Data: For visual display surfaces to include in maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain all visual display surface products through one source from a single manufacturer.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years experience.

C. Installer Qualifications: A contractor that employs installers and supervisors who are trained and approved by the manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display units vertically with packing materials between each unit.

C. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer. Receiver must verify materials are free from freight damage at time of delivery.

D. Storage and Handling Requirements: Store and handle materials in accordance with manufacturer’s instructions. Keep materials in manufacturer's original containers and packaging until time of installation. Store materials flat, indoors, and in a clean, dry area. Protect materials during storage, handling, and installation to prevent damage.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Environmental Requirements:
   1. Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.
   2. Deliver and install units to finished spaces after the paces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, a temporary HVAC system is operating and maintaining ambient temperatures, and humidity conditions will remain at occupancy levels during the remainder of the construction period.

1.6 WARRANTY

A. Submit manufacturer’s standard warranty where manufacturer agrees to repair or replace products that fail in materials within specified warranty period.
   1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.
b. Surfaces become slick or shiny.
c. Surfaces exhibit crazing, cracking, or flaking.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide Deko Premier Markerboards and Kinetics Noise Control, Inc.

2.2 RESINOUS MAGNETIC MARKERBOARD – MMB-1

A. Resinous Markerboard: Glass-free, magnetic, non-staining, resinous panel, factory finished edges, flexible, shatterproof and optically clear.
1. Non-staining shall mean impervious to staining from dry erase, wet erase, and permanent markers.
2. Markerboard colorant: Permanent opaque color on back.
3. Markerboard weight: 2.5LB/SF

B. Edge and Corner Detail: Crown corner with Brilliance Edge.

C. Markerboard Setting: Removable; provide with manufacturer's fit setting.

D. Size and Shape: Mini 39" x 48"

E. Color: Diamond.

F. Orientation: Landscape at 54" A.F.F. to center on product center on wall.

G. Features and Accessories:
1. Premium Marker Rail: Mechanically fastened
2. Magnetic Accessory Kit:
a. Magnetic cup
b. Magnetic eraser
c. Dry erase markers
d. Magnets
e. Microfiber cloth

2.3 FABRIC WRAPPED TACKABLE PANEL – FWP-1

A. Hi-Tack Tackable Panels:
1. Thickness: 1/2 inch (12.7 mm)
2. Size: As indicated on the drawings
3. Core: 1/2 inch (12.7 mm) thick mineral fiber board, 24 pcf (384 kg/m3) density
4. Edge Detail: Square

5. Facing: 100% polyester fabric, Anchorage 2335 by Guilford of Maine.
6. Color: To be determined from fabric manufacturer's full range of colors
7. Mounting Accessories: Factory installed Z-clips

2.4 FABRICATION

A. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
2. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.

2.5 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for manufacturer's installation tolerances, surface conditions of wall, and other conditions affecting performance. Report (in writing) any conditions detrimental to performance of work.

B. Examine walls and partitions for proper backing for visual display surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings in accordance with manufacturer's written guidelines. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas. Replace panels that cannot be cleaned to as new condition.

C. Cover and protect visual display surfaces after installation and cleaning during construction.

4.0 SCHEDULE

A. Resinous Magnetic Markerboard (MMB)

1. MMB-1: 3'-3" H x 4'-0" W

B. Fabric Wrapped Tackable Panel (FWP)

1. FWP-1: Reference Desk. As indicated on drawings.

END OF SECTION

SECTION 101416 - PLAQUES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal plaques.

B. Related Requirements:

1.2 ALLOWANCES

A. Allowances for **signage** are specified in Section 012100 "Allowances."

B. Cast Bronze Plaques are apart of the Signage Allowance.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For plaques.

1. Include fabrication and installation details and attachments to other work.
2. Show plaque mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements.

C. Samples for Initial Selection: For each type of plaque, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of plaque showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Plaques: **Half-size Sample**.
2. Exposed Accessories: **Half-size Sample** of each accessory type.

E. Product Schedule: For plaques. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For **manufacturer**.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plaques to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: **An entity that employs installers and supervisors who are trained and approved by manufacturer**.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of plaques that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Deterioration of finishes beyond normal weathering.
   b. Deterioration of embedded graphic image.

2. Warranty Period: **Five** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL PLAQUES

A. Cast Plaque : Cast-metal plaque with background texture, border, and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Plaque Material: Cast **bronze**.
2. Plaque Thickness: **0.25 inch (6.35 mm)**.
3. Finishes:

   a. Integral Metal Finish: **As selected by Architect from full range of industry finishes** >.
   b. Overcoat: **Manufacturer's standard baked-on clear coating**

4. Background Texture: **As selected by Architect from manufacturer's full range**

5. Integrally Cast Border Style: **Raised flat band**
6. Applied Frame Material, Style, and Finish: **As indicated on Drawings**
7. Mounting: **Concealed studs**.
8. Text and Typeface: **Typeface as selected by Architect from manufacturer's full range**

2.2 MATERIALS

A. Bronze Castings: ASTM B584, **lead-free alloy recommended by manufacturer and finisher for finish indicated**.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of plaques, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish **nonferrous-metal** devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    b. Fastener Heads: For nonstructural connections, use **flathead or oval countersunk**

4. Plaque Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of plaque, screwed into back of plaque, or screwed into tapped lugs cast integrally into back of plaque unless otherwise indicated.

2.4 FABRICATION

A. General: Provide manufacturer's standard plaques according to requirements indicated.

1. Preassemble plaques in the shop to greatest extent possible. Disassemble plaques only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match plaque finish.

6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted plaques to suit plaque construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Stainless Steel Brackets: Factory finish brackets **to match plaque background** finish unless otherwise indicated.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that plaque-support surfaces are within tolerances to accommodate plaques without gaps or irregularities between backs of plaques and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PLAQUES

A. General: Install plaques using mounting methods indicated and according to manufacturer's written instructions.

1. Install plaques level, plumb, true to line, and at locations and heights indicated, with plaque surfaces free of distortion and other defects in appearance.
2. Install plaques so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that plaque surfaces are clean and free of materials or debris that would impair installation.

4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of plaque. Remove loose debris from hole and substrate surface.
   a. Thin or Hollow Surfaces: Place plaque in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in plaque as template. Countersink holes in plaque if required. Place plaque in position and flush to surface. Install through fasteners and tighten.
3. Brackets: Remove loose debris from substrate surface and install bracket supports in position, so that plaque is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed plaques and plaques that do not comply with specified requirements. Replace plaques with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as plaques are installed.

C. On completion of installation, clean exposed surfaces of plaques according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain plaques in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101416

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters.

a. Cast dimensional characters.
b. Illuminated, fabricated channel dimensional characters.

1.2 ALLOWANCES

A. Allowances for **signage** are specified in Section 012100 "Allowances."

B. Dimensional Letter Signage **is** part of Signage Allowance.

1.3 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least **half size**
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: [**Full-size Sample**] [**Half-size Sample**] <**Insert size**> of[**each type of**] dimensional character.
2. Exposed Accessories: [**Full-size Sample**] [**Half-size Sample**] <**Insert size**> of each accessory type.
3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.

E. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

F. Delegated Design Submittal: For [**signs indicated in "Performance Requirements" Article**] <**Insert sign designations**>.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [**Installer**] [**and**] [**manufacturer**].

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: [**Manufacturer of products**] [**An entity that employs installers and supervisors who are trained and approved by manufacturer**].

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Deterioration of finishes beyond normal weathering.
   b. Separation or delamination of sheet materials and components.

2. Warranty Period: [**Five**] <**Insert number**> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design sign structure and anchorage of [**rooftop**] [**dimensional character**] <**Insert description**> sign type(s) <**Insert drawing designation of sign(s)**> according to structural performance requirements.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: [**As indicated on Drawings**] <**Insert design load**>.
2. Concentrated Horizontal Load: [**As indicated on Drawings**] <**Insert design load**>.
3. Other Design Load: [**As indicated on Drawings**] <**Insert design load**>
4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior [**fabricated channel dimensional characters**] <**Insert item**>, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: [**120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces**] <**Insert temperature change**>.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 DIMENSIONAL CHARACTERS

A. Cast Characters <**Insert drawing designation**>: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Character Material: Cast [**aluminum**] [**brass**] [**bronze**] [**zinc**] <**Insert material**>.
3. Character Height: [**As indicated on Drawings**] <**Insert dimension**>.
4. Thickness: [**As indicated on Drawings**] [**Manufacturer's standard for size of character**] <**Insert dimension**>.
5. Finishes:

a. Integral Metal Finish: [**Mill**] [**Antique oxidized**] [**As indicated by manufacturer's designation**] [**Match Architect's sample**] [**As selected by Architect from full range of industry finishes**] <**Insert finish**>.
b. Integral Aluminum Finish: [**Clear anodized**] [**Light bronze anodized**] [**Medium bronze anodized**] [**Match Architect's sample**] [**Anodized color as selected by Architect from full range of industry colors and color densities**] <**Insert finish**>.
c. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color [**as indicated by manufacturer's designation**] [**matching Architect's sample**] [**as selected by Architect from manufacturer's full range**] <**Insert color**>.
d. Overcoat: [**Manufacturer's standard baked-on clear coating**] [**Clear organic coating**] <**Insert requirement**>.

6. Mounting: [**As indicated on Drawings**] [**Concealed studs**] [**Projecting studs**] [**Rosette-head through fasteners**] [**Countersunk flathead through fasteners**] <**Insert requirement**>.
7. Typeface: [**Times Roman**] <**Insert requirement**>.

B. Cutout Characters <**Insert drawing designation**>: Characters with uniform faces; square-cut, smooth[**, eased**] edges; precisely formed lines and profiles; and as follows:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Character Material: Sheet or plate [**aluminum**] [**brass**] [**bronze**] [**copper**] [**stainless steel**] [**zinc**] [**acrylic**] [**acrylic with laminated aluminum facing**] [**acrylic with laminated brass facing**] [**acrylic with laminated bronze facing**] [**acrylic with laminated stainless steel facing**] <**Insert material**>.
3. Character Height: [**As indicated on Drawings**] <**Insert dimension**>.
4. Thickness: [**As indicated on Drawings**] [**Manufacturer's standard for size of character**] [**0.125 inch (3.18 mm)**] [**0.25 inch (6.35 mm)**] <**Insert dimension**>.
5. Finishes:

a. Integral Metal Finish: [**Mill**] [**Antique oxidized**] [**As indicated by manufacturer's designation**] [**Match Architect's sample**] [**As selected by Architect from full range of industry finishes**] <**Insert finish**>.
b. Integral Aluminum Finish: [**Clear anodized**] [**Light bronze anodized**] [**Medium bronze anodized**] [**Match Architect's sample**] [**Anodized color as selected by Architect from full range of industry colors and color densities**] <**Insert finish**>.
c. Integral Stainless Steel Finish: [**No. 4**] [**No. 8**] [**Match Architect's sample**] [**As selected by Architect from full range of industry finishes**] <**Insert description**>.
d. Integral Acrylic Color: [**As indicated by manufacturer's designation**] [**Match Architect's sample**] [**As selected by Architect from full range of industry colors**] <**Insert color**>.
e. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color [**as indicated by manufacturer's designation**] [**matching Architect's sample**] [**as selected by Architect from manufacturer's full range**] <**Insert color**>.
f. Overcoat: [**Manufacturer's standard baked-on clear coating**] [**Clear organic coating**] <**Insert requirement**>.
g. Painted Edges: Paint edges of acrylic characters with laminated metal facing as recommended in writing by manufacturer.

6. Mounting: [**As indicated on Drawings**] [**Concealed studs**] [**Projecting studs**] [**Rosette-head through fasteners**] [**Countersunk flathead through fasteners**] [**Concealed, painted aluminum back bar or bracket assembly**] [**Concealed, stainless steel back bar or bracket assembly**] [**Adhesive**] <**Insert requirement**>.
7. Typeface: [**Times Roman**] <**Insert requirement**>.

C. Fabricated Channel Characters <**Insert drawing designation**>: [**Metal face and side returns**] [**Open face with metal side returns**] [**Translucent face with metal side returns**], formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners; and as follows.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Illuminated Characters: [**Backlighted**] [**Frontlighted**] character construction with [**fluorescent tube**] [**fiber-optic**] [**LED**] [**neon tube**] <**Insert requirement**> lighting, including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.

    a. Power: [**As indicated on electrical Drawings**] [**120 V, 60 Hz, 1 phase, 15 A**] <**Insert requirement**>.
    b. Weeps: Provide weep holes to drain water at lowest part of exterior characters.[**Equip weeps with permanent baffles to block light leakage without inhibiting drainage.**]

3. Character Material: Sheet or plate [**aluminum**] [**brass**] [**bronze**] [**copper**] [**steel**] [**stainless steel**] [**zinc**] <**Insert material**>.
4. Material Thickness: [**As indicated on Drawings**] [**Manufacturer's standard for size and design of character**] [**0.100 inch (2.54 mm)**] [**0.032 inch (0.81 mm)**] [**Nominal 0.048 inch (1.21 mm) thick for face and 0.030 inch (0.76 mm) thick for returns**] [**0.050 inch (1.27 mm) thick for face and 0.031 inch (0.79 mm) thick for returns**] <**Insert dimension(s)**>.
5. Translucent Face Sheet: Acrylic sheet with integral color [**matching Architect's sample**] [**as selected by Architect from manufacturer's full range**] <**Insert color**>.

    a. Sheet Thickness: [**As indicated on Drawings**] [**Manufacturer's standard thickness for size of character**] [**0.125 inch (3.18 mm)**] [**0.25 inch (6.35 mm)**] <**Insert dimension**>.

6. Character Height: [**As indicated on Drawings**] <**Insert dimension**>.
7. Character Depth: [**As indicated on Drawings**] <**Insert dimension**>.
8. Finishes:

    a. Integral Metal Finish: [**Mill**] [**Antique oxidized**] [**As indicated by manufacturer's designation**] [**Match Architect's sample**] [**As selected by Architect from full range of industry finishes**] <**Insert finish**>.
    b. Integral Aluminum Finish: [**Clear anodized**] [**Light bronze anodized**] [**Medium bronze anodized**] [**Match Architect's sample**] [**Anodized color as selected by Architect from full range of industry colors and color densities**] <**Insert finish**>.

c. Integral Stainless Steel Finish: [**No. 4**] [**No. 8**] [**Match Architect's sample**] [**As selected by Architect from full range of industry finishes**] <**Insert description**>.
d. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color [**as indicated by manufacturer's designation**] [**matching Architect's sample**] [**as selected by Architect from manufacturer's full range**] <**Insert color**>.
e. Overcoat: [**Manufacturer's standard baked-on clear coating**] [**Clear organic coating**] <**Insert requirement**>.

9. Mounting: [**As indicated on Drawings**] [**Manufacturer's standard for size and design of character**] [**Projecting studs**] [**Concealed, painted aluminum back bar or bracket assembly**] [**Concealed, stainless steel back bar or bracket assembly**] <**Insert requirement**>.

a. Hold characters at [**2-inch (51-mm) distance**] [**manufacturer's recommended distance**] [**distance as selected by Architect**] <**Insert dimension**> from wall surface.

10. Typeface: [**Times Roman**] <**Insert requirement**>.

D. Molded-Plastic Characters <**Insert drawing designation**>: [**Injection molded**] [**or**] [**thermoformed**] characters having uniform faces and profiles, and as follows:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Illuminated Characters: Characters with concealed [**fluorescent tube**] [**fiber-optic**] [**LED**] [**neon tube**] lighting, including transformers, insulators, and other accessories; with provision for servicing and concealing connections to building electrical system. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.

a. Power: [**As indicated on electrical Drawings**] [**120 V, 60 Hz, 1 phase, 15 A**] <**Insert requirement**>.
b. Weeps: Provide weep holes to drain water at lowest part of exterior characters.[**Equip weeps with permanent baffles to block light leakage without inhibiting drainage.**]

3. Color: Manufacturer's standard [**integral color**] [**painted finish**] process, in color [**as indicated by manufacturer's designation**] [**matching Architect's sample**] [**as selected by Architect from manufacturer's full range**] <**Insert color**>.
4. Typeface: [**Times Roman**] <**Insert requirement**>.

2.3 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Brass Castings: ASTM B584, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C85200 (high-copper yellow brass)**] <**Insert requirement**>.

E. Brass Sheet (Yellow Brass): ASTM B36/B36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C26000 (yellow brass)**] <**Insert requirement**>.

F. Bronze Castings: ASTM B584, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C86500 (No. 1 manganese bronze)**] <**Insert requirement**>.

G. Bronze Plate: ASTM B36/B36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C22000 (commercial bronze)**] <**Insert requirement**>.

H. Copper Sheet: ASTM B152/B152M.

I. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, [**Type 304,**] [**Type 316,**] stretcher-leveled standard of flatness.

J. Zinc Castings: ASTM B240, alloy and temper recommended by sign manufacturer for type of use and finish indicated.

K. Zinc Sheet: [**ASTM B69**] <**Insert standard**>, alloy and temper recommended by sign manufacturer for type of use and finish indicated.

L. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

M. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish [**nonferrous-metal**] [**stainless steel**] [**or**] [**hot-dip galvanized**] <**Insert requirement**> devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

b. Fastener Heads: For nonstructural connections, use [**flathead**] [**or**] [**oval countersunk**] <**Insert shape**> screws and bolts with tamper-resistant [**Allen-head**] [**spanner-head**] [**or**] [**one-way-head**] <**Insert slot design**> slots unless otherwise indicated.

4. Sign Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

1. <Double click to insert sustainable design text for VOC content of adhesive.>
2. <Double click to insert sustainable design text for low emitting adhesives.>

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff

castings to remove seams, gate marks, casting flash, and other casting marks before finishing.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish [**to match sign-background color**] [**to match Architect's sample**] <**Insert requirement**> color unless otherwise indicated.
2. Stainless Steel Brackets: Factory finish brackets [**to match sign background**] [**to match Architect's sample**] [**with No. 4**] <**Insert finish**> finish unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker.

B. Color Anodic Finish: AAMA 611, [**Class I, 0.018 mm**] [**Class II, 0.010 mm**] or thicker.

C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.8 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.

3. Dull Satin Finish: No. 6.
4. Reflective, Directional Polish: No. 7.
5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2.9 LACQUER COATING FOR COPPER-ALLOY FINISHES

A. Lacquer Coating: Clear, organic, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of acrylic resin, methyl methacrylate copolymer, leveling agent, and corrosion inhibitor benzotriazole.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

    a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
    b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position, so that signage is correctly located and aligned.
5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 10 21 13 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Solid plastic toilet compartments including the following: (Hiny Hiders)
      a. Floor mounted overhead-braced toilet compartments.
      b. Privacy screens.

B. Related Sections:

   1. Section 061053 "Miscellaneous Rough Carpentry

   2. Section 102800 "Toilet, Bath, and Laundry Accessories

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

   1. Show locations of cutouts for compartment-mounted toilet accessories.

   2. Show locations of reinforcements for compartment-mounted grab bars.
   3. Show locations of centerlines of toilet fixtures.
   4. Show overhead support or bracing locations.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

   1. Each type of material, color, and finish required for units, prepared on 6-inch-(152-mm-) square Samples of same thickness and material indicated for Work.

2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: [25] [75] [200] or less.
2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 SOLID PLASTIC TOILET COMPARTMENTS

A. Basis of Design: Subject to compliance with requirements, provide Scranton Products; Hiny Hiders Toilet Partitions floor mounted overhead-braced toilet compartments and urinal screens. Manufacturers offer products meeting the design intent and basis of design specifications include, but are not limited to:

1. Accurate Partitions Corporation.
2. Ampco, Inc.

3. Bradley Corporation; Mills Partitions.
4. Comtec Industries/Capitol Partitions.
5. General Partitions Mfg. Corp.
6. Global Steel Products Corp.
7. Hadrian Manufacturing Inc.
8. Knickerbocker Partition Corporation.
9. Metpar Corp.
10. Partition Systems Incorporated of South Carolina.
11. Rockville Partitions Incorporated.
12. Santana Products, Inc.
13. Sanymetal; a Crane Plumbing company.
14. Weis-Robart Partitions, Inc.

B. Door, Panel and Pilaster Construction: Traditional Series, Solid, high-density polyethylene (HDPE panel material, not less than 1 inch (25 mm) thick, seamless, with eased edges (¼”radius) with homogenous color and pattern throughout thickness of material.
   1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
   2. Color and Pattern: One color and pattern as selected by Architect from manufacturer's full standard range.
   3. Panel Edge: Shiplap

C. Panel Color: To be selected from manufacturers full standard range, and if necessary to meet NFPA 286 standards

D. Pilaster Shoes: 3 inches (76 mm), 20 gauge stainless steel. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.

F. Headrail: Heavy-duty extruded 6463-T5 alloy aluminum with anti-grip design. Finish to be clear anodized. Fastened to headrail brackets with stainless steel tamper resistant Torx head sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.
   1. Headrail Brackets: 20 gauge stainless steel with satin finish. Secured to the wall with stainless steel tamper resistant Torx head screws.

G. Wall Brackets:
   1. Aluminum Brackets: Heavy-duty aluminum 6463-T5 alloy. Full height of partition

2.2 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Hinges: Wrap-Around Hinges: 8 inches (203 mm) and fabricated from heavy-duty extruded aluminum. Hinges are through-bolted to pilasters and doors with stainless steel tamper resistant Torx head sex bolts. Hinges operate with field adjustable nylon cams. Cams can be field set in 30, 60 or 9 degree increments.

2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
3. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Provide for both in swinging and out swinging doors
4. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
5. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.3 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 28-inch wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch .

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Palladium Rigid Vinyl Sheet (WP).

2. Bullet Resistant Panel.

B. Related Sections:

1. 092900 Gypsum Board

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

B. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.

1. Include similar Samples of accent strips and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below. Include Samples of accent strips to verify color selected.

1. Palladium Rigid Vinyl Sheet: 8 by 8 inches (203 by 203 mm) square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified installer.

B. Material Certificates: For each impact-resistant plastic material, from manufacturer.

C. Material Test Reports: For each impact-resistant plastic material.

D. Warranty: Standard IPC Limited Lifetime Warranty against material and manufacturing defects.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall Protection: Full- size sheets of rigid wall protection equivalent to 2 percent of each type, color, and texture of units installed, but not fewer than two.

B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 014000 "Quality Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Keep plastic sheet material out of direct sunlight.
3. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Deterioration of plastic and other materials beyond normal use.

2. Warranty Period:
a. Five years from date of Substantial Completion.
b. Ten years from date of receipt at the project site.

PART 2 - PRODUCTS

2.1 PALLADIUM RIGID VINYL SHEET – WP-1

A. Basis-of-Design Product: Inpro Corporation; IPC Door and Wall Protection Systems. Manufacturers that may provide products meeting the design and basis of design specifications include, but are not limited to:

a. Construction Specialties, Acrovyn.
b. Korogard Wall Protection Systems; a division of RJF International Corporation.
c. Kwalu, LLC.

B. Manufactured Units:

1. Size: 48 by 120 inches (1220 by 3650 mm)
2. Sheet Thickness: 0.040 inch (1.0 mm).
3. Color and Texture: As indicated in Finishes Legend.
4. Texture: Velvet.
5. Height: Full Wall.
6. Mounting: Adhesive.
7. Backing: Unbacked.
8. Seams: Color matched caulk.

2.2 BULLET RESISTANT PANEL

A. Manufacturers: Subject to compliance with requirements, provide Armorcore UL752 Level 2 bullet resistant fiberglass panel, or a comparable product by one of the following:
   1. Bullet Guard, a Division of Total Security Solutions, Inc.
   2. Armortex, Inc.
   3. Covenant Security Equipment

B. Nominal Weight: 3.7 lbs per square foot

C. Nominal Thickness: 5/16”

D. Performance Level:
   1. UL752 Standard for Bullet Resisting Equipment – Level 2 Paragraph 4.4
   2. National Institute of Ballistic Standards NIJ0108.01 – Level II-A
   3. One Hour Fire Rating per ASTM E119-98

E. Ammunition Tested: .357 magnum jacketed lead soft point – 158 grain, 10.2 grams, minimum 1250 feet per second.

F. Product Information: The panels are made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets. The production technique and materials used provide the controlled internal delamination to permit the capture of a penetrating projectile.

G. Product Installation: As recommended by manufacturer.

2.3 MATERIALS

A. Vinyl: Palladium® Rigid Vinyl Sheet shall be manufactured from chemical and stain resistant unplasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Accent strips when used shall be of polyvinyl chloride (PVC).

2.4 FABRICATION

A. Fabricate impact-resistant wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

1. Furnished as a complete system

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Complete all finishing operations, including painting, before beginning installation of rigid vinyl sheet materials.
3. Wall surface shall be dry and free from dirt, grease and loose paint.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Prep: Prior to installation, clean the substrate to remove dust, debris and loose particles. Ensure the substrate is sound and per project plans.

B. Acclimate product in temperatures between 65°F and 80°F [18°-27°C] and a humidity level less than 80% 24 hours in advance of installation.

C. The area of installation must temperature and humidity controlled for at least 48 hours after installation.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Installation of Palladium® Rigid Vinyl Sheet:

1. Adhere to substrate with Inpro Bond, a freeze-thaw stable, nonflammable, high strength, water based adhesive that trowels on and allows approximately 20 minutes working time before firming.

2. Adhere to substrate with XT-2000+, a freeze-thaw stable, nonflammable, high strength, water based adhesive that trowels on and allows approximately 20 minutes working time before firming.
3. Adhere to substrate with Fastbond 30, a nonflammable, high strength, water dispersed contact adhesive, with very little odor. Smooth roll surface.

3.4 CLEANING

A. Immediately after completion of installation, clean surfaces in accordance with the manufacturer's clean-up and maintenance instructions.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

SECTION 102800 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.
2. Under lavatory guards.

B. Related Sections include the following:

1. Division 10 Section "Toilet Compartments" for compartments and screens.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations as indicated on Drawings in product schedule.

C. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

1. Products of other manufacturers with equal characteristics, as judged solely by Architect, may be provided.
2. Other manufacturers' products with equal characteristics may be considered. See Division 1 Section "Substitutions."
3. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

1. Toilet and Bath Accessories:

a. Basis of Design: Bobrick Washroom Equipment, Inc.
b. Unless noted otherwise.

B. Owner-Furnished Material: Refer to Toilet Accessories Schedule in Drawings.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

E. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 TOILET & JANITOR ACCESSORIES

A. Framed Mirror:

1. Basis-of-Design Product: Bobrick.

2. Mounting and Size: Surface mounted. Mirror with welded, seamless satin stainless steel angle frame, with concealed screw mounting and hanging bracket, size 24 x 36 unless noted otherwise on drawings. Model # B-290-2436

B. Grab Bar:

1. Basis-of-Design Product: Bobrick.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant (preened grip) texture in grip area.

4. Outside Diameter: 1-1/4 inches (32 mm).
5. Configuration and Length:

    a. Vertical at 18 inch lengths - Model # B-5806 x 18”
    b. Horizontal at 24 inch lengths - Model # B-5806 x 24”
    c. Horizontal at 36 inch lengths - Model # B-5806 x 36”
    d. Horizontal at 42 inch lengths - B-5806 x 42”

C. Shelf with Mop and Broom Holders and Rag Hooks Bobrick Model # B-224 x 36”

D. Single Coat / Hat Hook: Surface Mounted, 2” x 2” square by 2” projection satin stainless steel with concealed mounting bracket. Bobrick Model # B-6717.

2.4 FABRICATION

A. General: One, maximum 1-1/2-inch diameter, unobtrusive stamped manufacturer logo, as approved by Architect, is permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.5 UNDERLAVATORY GUARDS

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. Plumberex Specialty Products, Inc.
2. TCI Products
3. Truebro Inc.

B. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbs., when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

Basis-of-Design Product: The design for the product identified is based on the product named. The use of a trade name and/or suppliers name and address in the specifications is to indicate a possible source of the product and a standard of quality. Products of the same type from other sources shall not be excluded, provided they possess like physical and functional and aesthetic characteristics Other manufacturers listed in this specification section may be substituted if they meet all design criteria. The identification numbers are cross referenced with the Drawings.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.
b. Portable fire extinguisher and fire-hose valve.
c. Portable fire extinguisher, fire hose, rack, and fire-hose valve.
d. Fire-hose valve.
e. Fire hose, rack, and fire-hose valve.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.
2. Section 211000 "Water-Based Fire-Suppression Systems" for fire-hose connections.

~~1.2 ALLOWANCES~~

~~A. Fire-protection cabinets are part of **<Insert name of allowance>**.~~

~~1.3 UNIT PRICES~~

~~A. Work of this Section is affected by **<Insert name of unit price>**.~~

~~1.4 PREINSTALLATION CONFERENCE~~

~~A. Preinstallation Conference: Conduct conference at [**Project site**]**<Insert location>**.~~

~~1. Review methods and procedures related to fire-protection cabinets, including, but not limited to, the following:~~

~~a. Schedules and coordination requirements.~~

~~1.5 ACTION SUBMITTALS~~

~~A. Product Data: For each type of product.~~

~~1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-~~

in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Samples for Initial Selection: For each type of exposed finish required.

E. Samples for Verification: For each type of exposed finish required, prepared on samples **6 by 6 inches** square.

F. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.[**Use same designations indicated on Drawings.**]

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.7 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of [**fire extinguishers**][**fire hoses, hose valves, and hose racks**] indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.22.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

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.

~~2.3~~2.2 FIRE-PROTECTION CABINET

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**][**provide products by one of the following**][**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. [**Babcock-Davis**]
2. [**Croker; a Division of Morris Group International**]
3. [**Guardian Fire Equipment, Inc**]
4. [**JL Industries; Activar Construction Products Group, Inc.**]
5. [**Larsen's Manufacturing Company**]
6. [**Modern Metal Products**]
7. [**MOON American, Inc.**]
8. [**Nystrom, Inc.**]
9. [**Potter Roemer LLC; a Division of Morris Group International**]
10. [**Strike First Corporation of America**]
11. <**Insert manufacturer's name**>

B. Fire-Protection Cabinet Type: Suitable for fire [**extinguisher**][**extinguisher and hose valve**][**hose, rack, valve, and extinguisher**][**hose, rack, and valve**][-**hose valve**].

C. Cabinet Construction: [**Nonrated**][**One-hour fire rated**][**Two-hour fire rated**].

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from **0.043-inch-** thick cold-rolled steel sheet lined with minimum **5/8-inch-** thick fire-barrier material. Provide factory-drilled mounting holes.

D. Cabinet Material: [**Cold-rolled steel sheet**][**Aluminum sheet**][**Stainless steel sheet**].

1. Shelf: Same metal and finish as cabinet.

E. Recessed Cabinet:

1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box, to act as [**plaster stop**][**drywall bead**].
2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

F. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: **1-1/4- to 1-1/2-inch** backbend depth.
2. Rolled-Edge Trim: [**2-1/2-inch**][**4-inch**][**4-1/2-inch**]<**Insert dimension**> backbend depth.

G. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

H. Cabinet Trim Material: [**Steel sheet**][**Aluminum sheet**][**Extruded-aluminum shapes**][**Stainless steel sheet**][**Copper-alloy brass sheet**][**Copper-alloy bronze sheet**][**Same material and finish as door**].

I. Door Material: [**Steel sheet**][**Aluminum sheet**][**Extruded-aluminum shapes**][**Stainless steel sheet**][**Copper-alloy brass sheet**][**Copper-alloy bronze sheet**].

J. Door Style: [**Fully glazed, frameless, backless, acrylic panel**][**Fully glazed panel with frame**][**Full acrylic bubble, frameless**][**Full acrylic bubble with frame**][**Full acrylic bubble with frameless, rotating turntable**][**Horizontal duo panel with frame**][**Vertical duo panel with frame**][**Center glass panel with frame**][**Solid opaque panel with frame**][**Flush opaque panel, frameless, with no exposed hinges**].

K. Door Glazing: [**Clear float glass**][**Tempered float glass (clear)**][**Tempered float glass (bronze tint)**][**Break glass**][**Tempered break glass**][**Wire glass**][**Acrylic sheet**][**Break acrylic bubble**][**Molded acrylic bubble**].

1. Acrylic Sheet Color:

    a. [**Clear**][**Bronze**] transparent acrylic sheet.
    b. Clear transparent acrylic sheet painted [**white**][**red**][**black**] on unexposed side.

2. Acrylic Bubble Color: [**Clear**][**Bronze**][**Red**], transparent.

L. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide [**projecting lever handle with cam-action latch**][**projecting door pull and friction latch**][**recessed door pull and friction latch**][**manufacturer's standard**].
2. Provide [**continuous hinge, of same material and finish as trim,**][**concealed hinge,**][**pivot hinge,**][**manufacturer's standard hinge,**] permitting door to open 180 degrees.

M. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Break-Glass Door Handle: Manufacturer's standard, integral to glass with the words "PULL TO BREAK GLASS" applied to handle.
4. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.

5. Door Lock: [**Cam lock that allows door to be opened during emergency by pulling sharply on door handle**][**Cylinder lock, keyed alike to other cabinets**].
6. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate [**as indicated**][**as directed by Architect**]<**Insert location**>.

    a. Identify fire extinguisher in fire-protection cabinet with the words "[**FIRE EXTINGUISHER**]<**Insert identification**>."

        1) Location: Applied to [**cabinet door**][**cabinet glazing**][**location indicated on Drawings**].
        2) Application Process: [**Silk-screened**][**Engraved**][**Etched**][**Decals**][**Pressure-sensitive vinyl letters**].
        3) Lettering Color: [**Red**][**Black**][**White**].
        4) Orientation: [**Vertical**][**Horizontal**][**As indicated on Drawings**].

7. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by [**batteries**][**low voltage, complete with transformer**].

N. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: [**Factory primed for field painting**][**Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603**].
    b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Color: [**Match Architect's sample**][**As selected by Architect from manufacturer's full range**]<**Insert color**>.

2. Aluminum: **ASTM B221** for extruded shapes and aluminum sheet, with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet.

    a. Finish: [**Clear anodic**][**Color anodic**][**Baked enamel or powder coat**].
    b. Color: [**Light bronze**][**Medium bronze**][**Dark bronze**][**Match Architect's sample**][**As selected by Architect from full range of industry colors and color densities**]<**Insert color**>.

3. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

    a. Finish: [**ASTM A480/A480M No. 4 directional satin finish,**][**ASTM A480/A480M No. 8 mirrorlike reflective, nondirectional polish**]<**Insert finish**>.

4. Copper Alloy, Brass: ASTM B36/B36M alloy [**as standard with manufacturer**]<**Insert requirements**>.

a. Finish: [**Polished**][**Satin**][**As selected by Architect from full range of industry finishes**]<**Insert finish**>.

5. Copper Alloy, Bronze: ASTM B36/B36M alloy [**as standard with manufacturer**]<**Insert requirements**>.

a. Finish: [**Mirror polish**][**Satin polish**][**Satin oxidized oil rub**][**Clear baked enamel**][**Match Architect's sample**][**As selected by Architect from full range of industry finishes**]<**Insert finish**>.

6. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, [**3**][**6**] mm thick.
7. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, [**Class 1 (clear)**][**Class 2 (tinted, heat absorbing, and light reducing), bronze tint**].
8. Break Glass: Clear annealed float glass, ASTM C1036, Type I, Class 1, Quality q3, 1.5 mm thick, single strength.
9. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.
10. Wire Glass: ASTM C1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 6 mm thick.
11. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), [**1.5**][**3**][**6**] mm thick, with [**Finish 1 (smooth or polished)**][**Finish 2 (patterned, textured)**].

~~2.4~~2.3 SECURITY FIRE-PROTECTION CABINET

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**][**provide products by one of the following**][**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. [**Babcock-Davis**]
2. [**Croker; a Division of Morris Group International**]
3. [**Guardian Fire Equipment, Inc**]
4. [**JL Industries; Activar Construction Products Group, Inc.**]
5. [**Larsen's Manufacturing Company**]
6. [**Nystrom, Inc.**]
7. [**Potter Roemer LLC; a Division of Morris Group International**]
8. <**Insert manufacturer's name**>

B. Security Fire-Protection Cabinet Type: Suitable for fire [**extinguisher**][**extinguisher and hose valve**][**hose, rack, valve, and extinguisher**][**hose, rack, and valve**][**hose valve**].

C. Cabinet Construction: [**Nonrated**][**One-hour fire rated**][**Two-hour fire rated**].

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls lined with minimum **5/8-inch-** thick fire-barrier material.

D. Cabinet Material: [**0.068-inch- thick steel sheet**][**0.097-inch- thick steel**

sheet][**0.078-inch- thick stainless steel sheet**].

1. Shelf: Same metal and finish as cabinet.

E. Recessed Cabinet:

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

F. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: **1-1/4- to 1-1/2-inch** backbend depth.
2. Rolled-Edge Trim: **2-1/2-inch** backbend depth.

G. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

H. Cabinet Trim Material: [**Steel sheet**][**Stainless steel sheet**][**Same material and finish as door**].

I. Door Material: [**0.097-inch- thick steel**][**0.078-inch- thick stainless steel**][**0.109-inch- thick stainless steel**] sheet.

J. Door Style: Solid opaque panel with frame.

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated, and as follows:

1. Recessed door pull.
2. Continuous Hinge: Same material and finish as trim, permitting door to open 180 degrees.
3. Mechanical Deadlock:

a. Lockbolt retracted and extended by five-tumbler [**paracentric**][**mogul**] cylinder; keyed one side.

1) Lockbolt: **1-1/2 inches high by 3/4 inch** thick; **5/8-inch** throw.

b. As specified in Section 119814 "Detention Door Hardware."

4. Mechanical Snaplatch:

a. Automatic snaplatch when closed; latchbolt retracted by five-tumbler [**paracentric**][**mogul**] cylinder; keyed one side.

1) Lockbolt: **1 inch high by 7/16 inch** thick; **5/16-inch** throw.

b. As specified in Section 119814 "Detention Door Hardware."

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to security fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate [**as indicated**][**as directed by Architect**]<**Insert location**>.

    a. Identify fire extinguisher in security fire-protection cabinet with the words "[**FIRE EXTINGUISHER**]<**Insert identification**>."

        1) Location: Applied to [**cabinet door**][**location indicated on Drawings**].
        2) Application Process: [**Silk-screened**][**Engraved**][**Etched**][**Decals**][**Pressure-sensitive vinyl letters**].
        3) Lettering Color: [**Red**][**Black**][**White**].
        4) Orientation: [**Vertical**][**Horizontal**][**As indicated on Drawings**].

3. Keys: Three per door lock.

M. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: [**Factory primed for field painting**][**Baked enamel or powder coat**].
    b. Color: [**Match Architect's sample**][**As selected by Architect from full range of industry colors**]<**Insert color**>.

2. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

    a. Finish: [**ASTM A480/A480M No. 4 directional satin finish**][**ASTM A480/A480M No. 8 mirrorlike reflective, nondirectional polish**]<**Insert finish**>.

~~2.5~~2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch** thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

~~2.6~~2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

~~3.1 EXAMINATION~~

~~A. Examine roughing-in for hose [**valves**][**racks**] and cabinets to verify actual locations of piping connections before cabinet installation.~~

~~B. Examine walls and partitions for suitable framing depth and blocking where [**recessed**][**and**][**semirecessed**] cabinets will be installed.~~

~~C. Proceed with installation only after unsatisfactory conditions have been corrected.~~

~~3.2 PREPARATION~~

~~A. Prepare recesses for [**recessed**][**and**][**semirecessed**] fire-protection cabinets as required by type and size of cabinet and trim style.~~

~~3.3 INSTALLATION OF FIRE-PROTECTION CABINETS~~

~~A. General: Install fire-protection cabinets in locations and at mounting heights indicated[**or, if not indicated, at height indicated below:**][**or, if not indicated, at heights acceptable to authorities having jurisdiction.**]~~

~~1. Fire-Protection Cabinet Mounting Height: [**42 inches**]<**Insert dimension**> above finished floor to top of fire extinguisher.~~

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
4. Fire-Rated Cabinets:

a. Install cabinet with not more than **1/16-inch** tolerance between pipe OD and knockout OD. Center pipe within knockout.
b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

C. Identification:

1. Apply [**decals**][**vinyl lettering**] at locations indicated.
2. Apply [**decals**][**vinyl lettering**] on field-painted fire-protection cabinets after painting is complete.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, [**hand-carried**][**wheeled**] fire extinguishers[**and mounting brackets for fire extinguishers**].

B. Owner-Furnished Material: [**Hand-carried**][**Wheeled**] fire extinguishers.

C. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."
2. Section 233813 "Commercial-Kitchen Hoods" for fire-extinguishing systems provided as part of commercial-kitchen exhaust hoods.

~~1.2 ALLOWANCES~~

~~A. Fire Extinguishers are part of <**Insert name of allowance**>.~~

~~1.3 UNIT PRICES~~

~~A. Work of this Section is affected by <**Insert name of unit price**>.~~

~~1.4 PREINSTALLATION MEETINGS~~

~~A. Preinstallation Conference: Conduct conference at [**Project site**]<**Insert location**>.~~

~~1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:~~

~~a. Schedules and coordination requirements.~~

~~1.5 ACTION SUBMITTALS~~

~~A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher[**and mounting brackets**].~~

~~B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.[**Use same designations indicated on Drawings.**]~~

~~1.6 INFORMATIONAL SUBMITTALS~~

~~A. Warranty: Sample of special warranty.~~

~~1.7 CLOSEOUT SUBMITTALS~~

~~A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.~~

~~1.8 COORDINATION~~

~~A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.~~

~~1.9 WARRANTY~~

~~A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.~~

~~1. Failures include, but are not limited to, the following:~~

~~a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.~~
~~b. Faulty operation of valves or release levers.~~

~~2. Warranty Period: [**Six**]<**Insert number**> years from date of Substantial Completion.~~

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each [**fire-protection cabinet**][**and**][**mounting bracket**] indicated.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**][**provide products by one of the following**][**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. [**Amerex Corporation**]
    b. [**Ansul; brand of Johnson Controls International plc, Building Solutions North America**]
    c. [**Babcock-Davis**]
    d. [**Badger Fire Protection; a Carrier company**]
    e. [**Buckeye Fire Equipment Company**]
    f. [**Croker; a Division of Morris Group International**]
    g. [**Guardian Fire Equipment, Inc**]
    h. [**JL Industries; Activar Construction Products Group, Inc.**]
    i. [**Kidde; Carrier Global Corporation**]
    j. [**Larsen's Manufacturing Company**]
    k. [**MOON American, Inc.**]
    l. [**Nystrom, Inc.**]
    m. [**Potter Roemer LLC; a Division of Morris Group International**]
    n. [**Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America**]
    o. [**Strike First Corporation of America**]
    p. <**Insert manufacturer's name**>

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
3. Valves: [**Manufacturer's standard**][**Nickel-plated, polished-brass body**].
4. Handles and Levers: [**Manufacturer's standard**][**Stainless steel**].
5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B[**, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging**].

B. Stored-Pressure Water Type : UL-rated 2-A, **2.5-gal.** nominal capacity, with water in stainless steel container; with pressure-indicating gage.

C. Stored-Pressure Antifreeze Water Type : UL-rated 2-A, **2.5-gal.** nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as **minus 40 deg F** in stainless steel container; with pressure-indicating gage.

D. Stored-Pressure Water-Mist Type : UL-rated 2-A:C, **2.5-gal.** nominal capacity, with water in enameled-steel container; with pressure-indicating gage.

E. Pressurized, AFFF-Foam Type : UL-rated [**2-A:10-B, 1.6-gal.**][**3-A:20-B, 2.5-gal.**] nominal capacity, with AFFF foam in stainless steel container; with pressure-indicating gage.

F. Pressurized, FFFP-Foam Type : UL-rated 3-A:20-B, **2.5-gal.** nominal capacity, with FFFP foam in stainless steel container; with pressure-indicating gage.

G. Wet-Chemical Type : UL-rated 2-A:1-B:C:K, [**1.6-gal.**][**2.5-gal.**] nominal capacity, with potassium [**acetate**][**citrate**][**carbonate**]-based chemical in stainless steel container;

with pressure-indicating gage.

H. Regular Dry-Chemical Type : UL-rated <**Insert capacity**> nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

I. Regular Dry-Chemical Type in Steel Container : UL-rated [**2-B:C, 1-lb**][**10-B:C, 2.5-lb**][**10-B:C, 5-lb**][**40-B:C, 5.5-lb**][**40-B:C, 6-lb**][**60-B:C, 10-lb**][**120-B:C, 20-lb**] nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.

J. Regular Dry-Chemical Type in Aluminum Container : UL-rated [**2-B:C, 1-lb**][**10-B:C, 2.5-lb**][**10-B:C, 5-lb**][**40-B:C, 5.5-lb**][**60-B:C, 10-lb**][**120-B:C, 20-lb**] nominal capacity, with sodium bicarbonate-based dry chemical in enameled-aluminum container.

K. Regular Dry-Chemical Type in Brass Container : UL-rated [**40-B:C, 6-lb**][**60-B:C, 10-lb**][**120-B:C, 20-lb**] nominal capacity, with sodium bicarbonate-based dry chemical in chrome-plated-brass container.

L. Multipurpose Dry-Chemical Type : UL-rated <**Insert capacity**> nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

M. Multipurpose Dry-Chemical Type in Steel Container : UL-rated [**1-A:10-B:C, 2.5-lb**][**2-A:10-B:C, 5-lb**][**3-A:40-B:C, 5-lb**][**3-A:40-B:C, 6-lb**][**4-A:60-B:C, 10-lb**][**10-A:120-B:C, 20-lb**] nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

N. Multipurpose Dry-Chemical Type in Aluminum Container : UL-rated [**1-A:10-B:C, 2.5-lb**][**2-A:10-B:C, 5-lb**][**3-A:40-B:C, 5-lb**][**3-A:40-B:C, 6-lb**][**4-A:60-B:C, 10-lb**][**10-A:120-B:C, 20-lb**] nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

O. Multipurpose Dry-Chemical Type in Brass Container : UL-rated [**2-A:10-B:C, 5-lb**][**3-A:40-B:C, 6-lb**][**4-A:60-B:C, 10-lb**][**4-A:80-B:C, 10-lb**][**10-A:120-B:C, 20-lb**] nominal capacity, with monoammonium phosphate-based dry chemical in chrome-plated-brass container.

P. Purple-K Dry-Chemical Type in Aluminum Container : UL-rated [**10-B:C, 2.5-lb**][**30-B:C, 5-lb**][**120-B:C, 20-lb**] nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

Q. Purple-K Dry-Chemical Type in Brass Container : UL-rated [**80-B:C, 10-lb**][**120-B:C, 20-lb**] nominal capacity, with potassium bicarbonate-based dry chemical in chrome-plated-brass container.

R. Carbon Dioxide Type : UL-rated [**5-B:C, 5-lb**][**10-B:C, 10-lb**][**10-B:C, 15-lb**][**10-B:C, 20-lb**] nominal capacity, with carbon dioxide in [**manufacturer's standard enameled-metal**][**enameled-steel**][**enameled-aluminum**] container.

S. Dry-Powder Type : [**FM approved,**]UL-rated Class D, **30-lb** nominal capacity, with [**sodium chloride**][**copper**]-based powder in enameled-steel container; with pressure-

indicating gage.

T. Halon Type : [**5-B:C, 2.5-lb**][**10-B:C, 5-lb**] nominal capacity, in enameled-steel container; with pressure-indicating gage.

1. UL-rated.

U. Clean-Agent Type in Aluminum Container : UL-rated [**1-B:C, 1.4-lb**][**2-B:C, 2.5-lb**][**5-B:C, 5-lb**] nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.

V. Clean-Agent Type in Brass Container : UL-rated [**1-A:10-B:C, 11-lb**][**2-A:10-B:C, 15.5-lb**] nominal capacity, with HCFC Blend B agent and inert material in chrome-plated-brass container; with pressure-indicating gage.

W. Clean-Agent Type in Steel Container : UL-rated [**5-B:C, 4.75-lb**][**1-A:10-B:C, 10-lb**][**2-A:10-B:C, 14-lb**] nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard[**galvanized**] steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or [**red**][**black**] baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**][**provide products by one of the following**][**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

    a. [**Amerex Corporation**]
    b. [**Ansul; brand of Johnson Controls International plc, Building Solutions North America**]
    c. [**Babcock-Davis**]
    d. [**Badger Fire Protection; a Carrier company**]
    e. [**Buckeye Fire Equipment Company**]
    f. [**Croker; a Division of Morris Group International**]
    g. [**Guardian Fire Equipment, Inc**]
    h. [**JL Industries; Activar Construction Products Group, Inc.**]
    i. [**Kidde; Carrier Global Corporation**]
    j. [**Larsen's Manufacturing Company**]
    k. [**Nystrom, Inc.**]
    l. [**Potter Roemer LLC; a Division of Morris Group International**]
    m. [**Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America**]
    n. [**Strike First Corporation of America**]
    o. **<Insert manufacturer's name>**

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: [**Vertical**][**Horizontal**].

2.4 WHEELED FIRE EXTINGUISHERS

A. Wheeled Fire Extinguishers: Type, size, and capacity for locations indicated, complete with carriage.

1. Manufacturers: Subject to compliance with requirements, [**provide products by the following**][**provide products by one of the following**][**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

a. [**Amerex Corporation**]
b. [**Ansul; brand of Johnson Controls International plc, Building Solutions North America**]
c. [**Badger Fire Protection; a Carrier company**]
d. [**Buckeye Fire Equipment Company**]
e. [**Croker; a Division of Morris Group International**]
f. [**Guardian Fire Equipment, Inc**]
g. [**JL Industries; Activar Construction Products Group, Inc.**]
h. [**Potter Roemer LLC; a Division of Morris Group International**]
i. [**Pyro-Chem; brand of Johnson Controls International plc, Building Solutions North America**]
j. <**Insert manufacturer's name**>

B. Source Limitations: Obtain wheeled fire extinguishers and fire extinguishers from single source from single manufacturer.

1. Carriage: Fabricated from enameled-steel pipe, complete with hanger assembly, long-range nozzle, hose, and [**semipneumatic solid-rubber tires**][**wide-rim wheels**].

a. Hose: [**15 feet**][**50 feet**][**100 feet**].

C. Pressurized, FFFP-Foam Type: UL-rated 20-A:160-B, **33-gal.** nominal capacity, with FFFP foam in stainless steel container.

D. Regular Dry-Chemical Type: UL-rated [**160-B:C, 50-lb**][**240-B:C, 150-lb**][**160-B:C, 250-lb**] nominal capacity, with sodium bicarbonate-based dry chemical in [**regulated**][**stored**][**direct**]-pressure, enameled-steel container.

E. Multipurpose Dry-Chemical Type: UL-rated [**20-A:160-B:C, 30-lb**][**30-A:160-B:C, 50-lb**][**40-A:240-B:C, 125-lb**][**40-A:160-B:C, 250-lb**] nominal capacity, with monoammonium phosphate-based dry chemical in [**regulated**][**stored**][**direct**]-

pressure, enameled-[**steel**][**aluminum**][**steel or -aluminum**] container.

F. Purple-K Dry-Chemical Type: UL-rated [**160-B:C, 50-lb**][**320-B:C, 125-lb**][**160-B:C, 250-lb**] nominal capacity, with potassium bicarbonate-based dry chemical in [**regulated**][**stored**][**direct**]-pressure, enameled-steel container.

G. Carbon Dioxide Type: UL-rated [**20-B:C, 50-lb**][**20-B:C, 100-lb**] nominal capacity, with carbon dioxide in [**manufacturer's standard enameled-metal**][**enameled-steel**][**enameled-aluminum**] container.

H. Dry-Powder Type: [**FM approved,**]UL-rated Class D, [**sodium chloride-based powder, 150-lb**][**copper-based powder, 250-lb**] nominal capacity, in regulated-pressure, enameled-steel container; with pressure-indicating gage.

I. Clean-Agent Type: UL-rated [**4-A:40-B:C, 65-lb**][**10-A:80-B:C, 150-lb**] nominal capacity, with HCFC Blend B agent and inert material in stored-pressure, enameled-steel container; with pressure-indicating gage.

PART 3 - EXECUTION

~~3.1 EXAMINATION~~

~~A. Examine fire extinguishers for proper charging and tagging.~~

~~1. Remove and replace damaged, defective, or undercharged fire extinguishers.~~

~~B. Proceed with installation only after unsatisfactory conditions have been corrected.~~

~~3.2 INSTALLATION~~

~~A. General: Install fire extinguishers[**and mounting brackets**] in locations indicated and in compliance with requirements of authorities having jurisdiction.~~

~~B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.~~

~~1. Mounting Height: Top of fire extinguisher to be at [**42 inches**]<**Insert dimension**> above finished floor.~~

END OF SECTION 104416

SECTION 10 73 16 - PREFABRICATED CANOPIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Building supported, pre-engineered metal canopies including fascia channels, decking, tension rods, and attachment hardware.

1.02 REFERENCES

A. Aluminum Association (AA)DAF 45 - Designation System for Aluminum Finishes.

B. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

C. ASTM International (ASTM)

1. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
2. B429 - Standard Specification for Aluminum-Alloy Extruded Pipe and Tube.

1.03 SYSTEM DESCRIPTION

A. Design Requirements: Design canopy system to withstand all applicable loads, including but not limited to wind load, rain live load, dead load, and snow load, for the job location in accordance with ASCE 7-10 and applicable codes.

1.04 SUBMITTALS

A. Submittals for Review:

1. Shop Drawings
   a. Show location and extent of canopy. Include elevations, sections, and details not shown in Product Data.
   b. Show materials, fabrication, dimensions, mounting heights, connections, anchorages, installation details, attachments to other work, operational clearances, and relationship to adjoining work.
   c. Show colors and graphic layout and content.
2. Samples:
   a. 3x3 inch coating samples in specified colors.
   b. 6-inch-long fascia extrusion samples showing profile and standard finish.
   c. 6-inch-long deck samples showing profile and standard finish.
3. Certification: Provide Professional Engineer certification that the proposed canopy design and layout meets or exceeds the requirements to withstand all applicable loads.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in Delaware.

1. Comply with applicable code for submission of design calculations as required for acquiring permits.
   a. Refer to structural drawings for project design load requirements.
2. Cooperate with regulatory agency or authorities having jurisdiction (AHJ), and provide data as requested.

B. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project, with not less than 3 years of documented experience.
C. Installer Qualifications: Minimum 5 years experience in installation of metal canopy products.

1.06 WARRANTY

A. Metal canopy, including material and workmanship, shall be warranted from defects for a period of one year from date of completion of metal canopy installation.

PART 2 PRODUCTS

2.01 PRODUCTS

A. Basis of Design
   1. Manufacturer: Mapes Canopies, Lincoln, Nebraska.
   2. Basis of Design Model
      a. Cantilevered canopy: Super Lumideck Cantilever Canopy/Flat Soffit.
   3. Features
      a. Material: Aluminum, T6 – 6063.
      b. Decking: Flat soffit profile, thickness 0.078 inch.
      c. Fascia: Standard extruded 8" J style.
      d. Drainage: Canopy configured to drain water from concealed surfaces into intermediate trough and fascia drain.
      e. Finish
         1) Two coats 70% polyvinylidene fluoride, Kynar 500 or equal.
         2) Color to be chosen from manufacturer's full range.
      f. Support
         1) Cantilevered canopy: Cantilever configuration.
            (a) Include compression spacers or other means to prevent moment-induced canopy loads from crushing wall assembly veneers.
B. Equivalent systems by the following manufacturers are acceptable subject to meeting the requirements of this section.
   1. Americana Outdoors, Salem, IL.
   2. Fenwall Fabrication and Manufacturing, Tampa, FL.

PART 3 EXECUTION

3.01 INSPECTION

A. Confirm that surrounding area is ready for the canopy installation.
B. Confirm dimensions and elevations are as shown on approved shop drawings.
C. Installation shall be scheduled after all concrete, masonry and roofing in the area is completed

3.02 ASSEMBLY

A. Ship with materials precut to size for field assembly.
B. Assemble per approved shop drawings and manufacturer's instructions, using manufacturer's recommended fasteners.

3.03 INSTALLATION

A. Install in strict accordance with approved shop drawings.
B. Protect finishes during handling and erection.

3.04 CLEANING AND PROTECTION

A. Clean surfaces of dust, debris, oils, and similar other contaminants.
B. Protect installation from activities of other trades.
C. Repair or replace components exhibiting damage to materials or finishes at no cost to Owner.

END OF SECTION

SECTION 10 82 00 LOUVERED ROOFTOP EQUIPMENT SCREENS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Louvered Rooftop Equipment Screens.

1.02 PERFORMANCE REQUIREMENTS

A. Design: Design louvers, including comprehensive engineering analysis by a qualified engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors.

1. Wind Loads: See structural drawings.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

1. Demonstrate compliance with structural performance requirements and design criteria indicated.

B. Shop Drawings: For equipment screens and accessories.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show frame profiles and blade profiles, angles, and spacing.

C. Samples: For each type of metal finish required.

1. Color selectors: Two sets demonstrating manufacturer’s full range of aluminum finish colors.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect products during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage.

1. Deliver, unload, store, and erect panel products and accessory items without misshaping blades or exposing components to surface damage from weather or construction operations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.

B. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

2.02 FABRICATION, GENERAL

A. Join concealed frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.03 LOUVERED ROOFTOP EQUIPMENT SCREEN

A. Basis-of-Design Product: Architectural Louvers Co. (Harray, LLC); Model V6JN3. Comparable products meeting the design and basis of design product include, but not limited to:
   1. Construction Specialties "Vision Barrier Screens"
   2. Industrial Louver "Extruded Aluminum Inverted Blades"
   3. Greenheck "Equipment Screens"
B. Louver Blade Depth: 6 inches (150 mm).
C. Blade Spacing: 3-inch centers.
D. Blade Profile: Narrow profile plain blade without center baffle.
E. Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
F. Framing Support Nominal Thickness: Not less than 0.125 inch (3.2 mm).
G. Louver Performance Requirements:
   1. Free Area: Not less than 66.6 percent (10.7 sq. ft, 1.05 sq. m) for 48-inch by 48-inch (1220 mm by 1220-mm) louver assembly.
   2. Horizontal Drag Coefficient: Not greater than 0.35 on a cross sectional profile, allowing for a 65% reduction in wind load imposed horizontally upon supporting structural framing.
H. Hinged door as provided by equipment screen manufacturer with sub frame
   1. Match blade depth spacing and profile
   2. Heavy duty (.120") continuous aluminum hinge
   3. Aluminum angle frame
   4. Aluminum angle door stop
   5. Provide mechanical positive latching

2.04 ALUMINUM FINISHES

A. High-Performance Organic Finish: Factory-applied 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Conduct observation of field conditions before starting installation.
B. Notify Architect of deficiencies.
C. Do not start installation until deficiencies are corrected.

3.02 INSTALLATION

A. Locate and place equipment screens level, plumb, and at indicated alignment with adjacent work.
B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.
C. Provide perimeter reveals and openings of uniform width to allow for thermal expansion, as indicated.
D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

END OF SECTION

SECTION 113013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Refrigeration appliances.

B. Related Requirements:

1.2 ACTION SUBMITTALS

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of appliance.

C. Field quality-control reports.

D. Sample Warranties: For manufacturers' special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.5 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period **except as qualified below:**

   1. Warranty Period: **Two** years from date of Substantial Completion.

B. Microwave Oven: **Limited warranty, including parts and labor for first year and parts thereafter,** for on-site service .

   1. Warranty Period: **Two** years from date of Substantial Completion.

C. Refrigerator/Freezer, Freezer, and Icemaker, Sealed System: **Limited warranty, including parts and labor for first year and parts thereafter,** for on-site service on the product.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain **residential appliances from single source**].

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in **the DOJ's 2010 ADA Standards for Accessible Design**

C. Microwave Oven
1. Mounting: **Undercabinet**
2. Type: **Conventional** >.
3. Dimensions:

    a. Width: **24 inches**
    b. Depth: **19-1/2 inches (495 mm)**
    c. Height: **14 inches (356 mm)**

4. Capacity: **1.5 cu. ft. 0.04 cu. m**.
5. Oven Door: Door with observation window **and pull handle**
6. Microwave Power Rating: **Manufacturer's standard**.

    a. Convection Element Power Rating: [**Manufacturer's standard**] [**1450 W**] <**Insert power rating**>.

7. Electric Power Supply: **120 V, 60 Hz, 1 phase, 15 A**.
8. Controls: Digital panel controls and timer display.
9. Other Features: **Turntable** >.
10. Material: **Stainless steel**.

    a. Color/Finish: **Black**.

2.3 REFRIGERATION APPLIANCES

A. Refrigerator/Freezer **Two-door refrigerator/freezer with freezer on top** and complying with AHAM HRF-1.
1. Type: **Freestanding**.
2. Dimensions:

    a. Width: **36 inches (914 mm**.
    b. Depth: **27 inches (686 mm)**.

c. Height: **73 inches (1854 mm)**.

3. Storage Capacity:

a. Refrigeration Compartment Volume: **15.6 cu. ft.**.
b. Freezer Volume: **5.13 cu. ft. (0.15 cu. m)**.
c. Shelf Area: **Three glass** shelves

4. General Features:

a. Door Configuration: **Overlay**.
b. Built-in water-filtration system.
c. Dual refrigeration systems.

5. Refrigerator Features:

a. Interior light in refrigeration compartment.

6. Energy Star: Provide appliances that qualify for the EPA/DOE Energy Star product-labeling program.
7. Front Panel(s): **Stainless steel**.

a. Panel Color: **Black**.

8. Appliance Color/Finish: **Stainless steel**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF RESIDENTIAL APPLIANCES

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113013

SECTION 12 24 13 - WINDOW TREATMENT – ROLLER SHADES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Roller shades with fascia and light filtering fabrics for exterior windows and interior vision panels and sidelights as scheduled.

B. Refer to appended Rollershade Schedule for scope.

1.02 REFERENCES

A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

B. NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.

1.03 SUBMITTALS

A. Product data: Provide manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
3. Storage and handling requirements and recommendations.
4. Mounting details and installation methods.
5. Motorized Shades: Power requirements. including typical wiring diagrams showing integration of EDU controllers with building management system, audiovisual systems, and lighting control systems as applicable.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.

C. Samples for Initial Selection: For each colored component of each type of roller shade indicated.

D. Window Treatment Schedule: Submit Window Treatment Schedule using same room designations indicated on Drawings. Match format of window treatment appended to this section.

E. Maintenance Data: Include in maintenance manuals:

1. Methods for maintaining roller shades/blinds and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Operating hardware.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has successfully completed and serviced installations similar in scope to that indicated for this Project.

B. Source Limitations: Obtain each type of window treatment through one source from a single manufacturer.

C. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

D. Fire-Test-Response Characteristics: Provide window treatment materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method

indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

E. Mock-Up: Provide a mock-up (manual shades only) of one roller shade assembly for evaluation of mounting, appearance and accessories.

1. Locate mock-up in window designated by Architect.
2. Do not proceed with remaining work until, mock-up is accepted by Architect.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in window treatment schedule.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install window treatment until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.07 WARRANTY

A. Products: Minimum 10 years from substantial completion or manufacturer’s standard warranty.

B. Installation: One year from substantial completion.

PART 2 - PRODUCTS

1.08 ROLLER SHADES

A. Basis-of-Design Manufacturer: Mecho, 42-03 35th Street, Long Island City, NY 11101. Phone: 718-729-2020. Email: marketing@mechoshade.com. Web: https://www.mechoshade.com/.

B. Shade Fabrics

1. Light Filtering shades
   a. Basis-of-Design: EuroTwill 6000.
      1) 3% transparent open basket weave.
      2) Straight bottom hem.

C. Operation

1. Manual
   a. Roller mechanism: Mecho/5.
   b. Features
      1) Continuous loop bead chain, nickel-plated metal or stainless steel.
      2) Clutch.
      3) Cord tensioner.
      4) Bracket lift operator.

D. Components: Provide following as required for operation.

1. Mounting Brackets

a. Material: Standard 1018 plated steel.
b. Sizes to be compatible with window shade size and clutch capacity.
c. Bracket style to be compatible with mounting requirements and site conditions.

2. Fascias
    1) Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
    2) Fascia shall be able to be installed across two or more shade bands in one piece.
    3) Fascia shall fully conceal brackets, shade roller and fabric on the tube.
    4) Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
3. Rollers
    a. Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging.
    b. Designed to be easily removable from support brackets, with manufacturer's standard method for attaching shade material.
    c. Provide capacity for one roller shade band per roller.
4. Clutches: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
    a. Position of Clutch Operators: Right sides of rollers, as determined by hand of user facing shade from inside, unless otherwise indicated or dictated by field conditions.
5. Lift Assist Mechanisms: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
6. Bottom Bars
    a. Weighted internal-type bottom bars concealed by pocket of shade material as required for smooth, properly balanced shade operation.
    b. Material: Steel or extruded aluminum.

E. Other requirements
1. Direction of Roll: Regular, from back of roller.
2. Operating Function: Stop and hold shade at any position in ascending or descending travel.
3. Cord Tensioner Mounting: As required per installation.
4. Colors: One standard color as selected by Architect from manufacturer’s standard range.

1.09 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
B. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
1. Lifting Mechanism: With permanently lubricated moving parts.
C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
1. Shade Units installed outside, typical. If inside mount is required, edge of shade must not exceed ¼ inch from face of jamb.
2. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
3. Fabricate shade cloth to hang flat without buckling or distortion.
D. Installation Brackets: Shall allow for easy removal and reinstallation of shade, operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal non-corrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
F. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

PART 3 - EXECUTION

1.10 EXAMINATION
A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

1.11 ROLLER SHADE INSTALLATION AND ADJUSTING
A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

1.12 CLEANING AND PROTECTION
A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
B. Remove surplus materials, rubbish, and debris resulting from installation upon completion of work, and leave areas of installation in neat, clean condition.
C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which ensure that roller shades are without damage or deterioration at time of Substantial Completion.

1.13 SCHEDULE
A. Provide roller shades at the following locations:
1. Exterior windows as indicated in the following schedules appended to this section.
a. 12 24 13b, Rollershade Schedule.
2. All interior vision panels and side lites as follows except as noted.
a. Exceptions: Transoms and vision panels whose bottom edges are above 7'-0" AFF do not require window treatments.
3. Elsewhere as noted on drawings.

END OF SECTION

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hydraulic passenger elevators.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
4. Section 051200 "Structural Steel Framing" for the following:

    a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.

    b. Hoist beams.
    c. Structural-steel shapes for subsills that are part of steel frame.

5. Section 055000 "Metal Fabrications" for the following:

    a. Attachment plates and angle brackets for supporting guide-rail brackets.

    b. Hoist beams.
    c. Structural-steel shapes for subsills.
    d. Pit ladders.

    e. Cants in hoistways made from steel sheet.

6. 096500 Resilient Flooring for finish flooring in elevator cars.
7. Section 099113 "Exterior Painting" for field painting of hoistway entrance doors and frames.
8. Section 099123 "Interior Painting" for field painting of hoistway entrance doors and frames.

9. Section 142413 "Hydraulic Freight Elevators" for hydraulic elevators used primarily for carrying freight and inaccessible to the general public.

10. Section 221429 "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
11. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
12. [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System"**] for smoke detectors in elevator lobbies to initiate emergency recall operation[**and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation**] and for connection to elevator controllers.

13. Section 31200 "Earth Moving" for excavating well hole to accommodate cylinder assembly.

1.3 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station and standby power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard five year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

D. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, "Draft of Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Furnish well casing and coordinate delivery with related excavation work.

C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

2. Warranty Period: **5** year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

B. Basis-of-Design Product: Subject to compliance with requirements, provide **Thyseen Krupp Eleavtor MRL 3500** or comparable product by one of the following:
1. KONE Inc.
2. Otis Elevator Co.
3. Schindler Elevator Corp.
4. Schumacher Elevator Co.
5. ThyssenKrupp Elevator.

C. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:
1. Elevator Number(s): E1

2. Type: Under-the-car single cylinder.

3. Rated Load: **3500 lb (1589 kg)**

4. Rated Speed: **125 fpm (0.64 m/s)**

5. Operation System: **Single automatic**

a. Standby-powered lowering.
b. Automatic dispatching of loaded car.

6. Security Features: **Keyswitch operation**

a. Inside Width: **68 inches (1626 mm)** from side wall to side wall.
b. Inside Depth: [**94 inches (1295 mm)**]from back wall to front wall (return panels).
c. Inside Height: **94 inches (2388 mm)** to underside of ceiling.
d. Front Walls (Return Panels): **Polished stainless steel** with integral car door frames.

e. Car Fixtures: **Polished stainless steel, No. 8 finish**.
f. Side and Rear Wall Panels: **Plastic laminate**
g. Reveals: **Polished stainless steel, No. 8 finish**.

h. Door Faces (Interior): **Polished stainless steel, No. 8 finish**.

i. Door Sills: **Aluminum, mill finish**.
j. Ceiling: **plastic-laminate.**
k. Handrails: [**1-1/2 inches (38 mm) round**] [**1/2 by 2 inches (13 by 50 mm) rectangular**] **mirror-polished stainless steel, No. 8 finish** at **sides and rear** of car.
l. Floor prepared to receive resilient flooring (specified in Section 096500 "Resilient Flooring").

m. Floor Thickness, Including Setting Materials: **1/4"** above plywood subfloor.

7. Hoistway Entrances:

a. Width: **42 inches (1067 mm**
b. Height: **84 inches (2134 mm**.
c. Type: **Single-speed side sliding**.

d. Frames **Polished stainless steel, No. 8 finish**.

e. Doors [**Polished stainless steel, No. 8 finish**.

f. Sills **Aluminum, mill finish**

8. Hall Fixtures: **Polished stainless steel, No. 8 finish**.
9. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from **polished stainless steel, No. 8 finish**
b. Provide hooks for protective pads complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump shall be **submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts**.

2. Motor shall have **solid-state**starting.
3. Motor shall have variable-voltage, variable-frequency control.

B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.

1. Cylinder units shall be connected with dielectric couplings.

2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

D. Hydraulic Fluid: Elevator manufacturer's standard[**fire-resistant** fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

G. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below 60 deg F (16 deg C).

1. Products: Subject to compliance with requirements, **provide one of the following**]:

a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.

H. Car Frame and Platform: Welded **or bolted** steel units.

I. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.

B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Single-Car Standby-Powered Lowering: On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.

2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
3. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of callscan be adjusted.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

a. Security access system equipment is **not in the Contract.**

2. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at **hall push-button stations**. Key is removable **in either position**.

3. by keyswitch at main lobby, that causes **car** to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.6 DOOR REOPENING DEVICES

A. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

A. General: Provide **enameled-steel car enclosures to receive removable** wall panels, with **removable** car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
2. Subfloor: Exterior, C-C Plugged grade plywood, not less than 7/8-inch (22.2-mm) nominal thickness.
3. Floor Finish: SECTION 09 65 00 - RESILIENT FLOORING
4. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
5. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
6. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to **1/2-inch (13-mm) fire-retardant-treated particleboard** with **plastic-laminate panel backing and** manufacturer's standard protective edge trim. Panels have a flame-spread index of [**25**] [**75**] or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from **plastic-laminate elevator** manufacturer's full range.
7. Fabricate car with recesses and cutouts for signal equipment.
8. Fabricate car door frame integrally with front wall of car.
9. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated **from stainless-steel sheet**.
10. Sight Guards: Provide sight guards on car doors.
11. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
12. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.

13. **Metal** Ceiling: Flush panels, with **four low-voltage downlights in** each panel. **Align ceiling panel joints with joints between wall panels.**
14. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to **UL 10B**.

1. Fire-Protection Rating: **1 hour with 30-minute temperature rise of 450 deg F (250 deg C)**].

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Enameled-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
2. Primed-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.

3. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.

4. Stainless-Steel Doors Flush, hollow-metal construction; fabricated **from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning**.

5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with **long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers or LEDs**.

B. Car-Control Stations: Provide manufacturer's standard **recessed or semirecessed** car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide **flush-mounted cabinet** in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in [**Section 283111 "Digital, Addressable Fire-Alarm System"**] [**Section 283112 "Zoned (DC Loop) Fire-Alarm System."**]

E. Car Position Indicator: Provide **illuminated,** digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: **Provide one hall push-button station at each landing**

1. [**units with flat faceplate for mounting with body of unit recessed in wall**.
2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide **one of** the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.

2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.

3. Units mounted in both jambs of entrance frame[

4. Units mounted in both car door jambs**; may be used only for single elevators**].

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

I. Hall Position Indicators: Provide **illuminated,** digital-display-type position indicators, located above **each** hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.

1. Integrate ground-floor hall lanterns with hall position indicators.

J. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.

1. Metal surface is **satin polished** after texturing.

F. Stainless-Steel Bars: ASTM A 276, Type 304.

G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

H. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

I. Plastic Laminate: High-pressure type complying with NEMA LD 3, **Type HGS for flat applications**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between **protective** casing and pit floor with 4 inches (100 mm) of nonshrink, nonmetallic grout.

B. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

C. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

D. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

E. Install piping above the floor, where possible. Install underground piping in casing.

F. Lubricate operating parts of systems as recommended by manufacturers.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

H. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.

I. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

J. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. Place hall lanterns either above or beside each hoistway entrance.
2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for **each** elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate**, and maintain** elevator(s).

B. Check operation of elevator with Owner's personnel present before date of Substantial Completion **and again not more than one month before end of warranty period**. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include <**12**> months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.

2. Perform emergency callback service during normal working hours with response time of 24 hours or less.
3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of 24 hours or less.

END OF SECTION 142400

DIVISION 21 SECTION 21 05 00
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. Furnish and install a new backflow preventer on the existing fire protection service. Hydraulically Calculate per NFPA-13 the fire protection pipe sizes taking into consideration the pressure drop of the new backflow preventer. Replace all pipe sizes in the existing fire protection system with larger pipes to accommodate the pressure drop of the backflow preventer.

I. Install new system risers and extend new fire protection system to serve all areas (above and below ceilings) with sprinklers in accordance with NFPA-13. Hydraulically calculate the entire new system demand and pipe sizes.

J. Install 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.

K. 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.

L. Fire protection contractor shall submit hydraulic drawings and calculations to State Fire Marshal for review and approval.

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.

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 six (6) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

I. For resubmissions, the Contractor must address in writing all of the Engineer's comments on the original submission to verify compliance.

1.9 SHOP DRAWINGS

A. Prepare and submit shop drawings for all mechanical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.

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. Alarm Check Valves
3. Backflow Preventers
4. Blind Flange
5. Coordinated Drawings
6. Drip Pans
7. Exterior Equipment/Piping Supports
8. Fire Protection System including Hydraulic Calculations, Equipment and Devices
9. Fire Stopping - Methods and Materials
10. Gong
11. Identification System
12. Material and Equipment List
13. Operations and Maintenance Manuals
14. Pipe Materials Including Itemized Schedule
15. Preliminary and Final Pipe Pressure Tests
16. Pressure Gauges
17. Pressure Relief Valves
18. Sprinkler Heads
19. Strainers
20. Test Certificates

21. Valves
22. Wiring Diagrams, Flow Diagrams and Operating Instructions
23. Zone Valve Assemblies

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 or Structural 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. Furnish and install pitch pockets or weather tight curb assemblies where required.

C. 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, 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 EXCAVATION AND BACKFILLING

A. General

1. Perform all necessary excavation, or installation of work under Division 21, in whatever materials or conditions encountered, using suitable methods and equipment.
2. Accurately establish required lines and grades and properly locate the work.
3. Determine the locations of all existing utilities before commencing the work.

B. Excavation: (Refer also to other portions of the specifications)

1. Excavate only the required elevations. If excavation is carried below the

foundation lines or other required limits, backfill the excess with concrete.

2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.
3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling: (Refer also to other portions of the specifications)

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

1.16 ALTERNATES

A. Refer to Division 01 Section, "Alternates" for description of work under this section affected by alternates.

1.17 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, and unexcavated spaces.

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. 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 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.

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. shower rooms, toilet rooms, kitchens, and similar spaces, etc.) 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 six (6) 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 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 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 Technical Community College – Owens Campus – Betze Library Renovations –

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.
13. Pipe Pressure Testing 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 OUTAGES

A. Provide a minimum of fourteen (14) days notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.

B. Submit Outage Request form, attached at end of this Section, to Owner for approval.

END OF SECTION

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.

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 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.

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 (Inside): 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.
b. Piping Above Grade (Outside): Galvanized Steel
c. 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.

d. 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.

e. 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

f. 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.

g. 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.

h. 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.

i. Globe Valves: 2 inches & smaller - 175 lb., bronze, screwed, UL/FM listed.

j. 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.

k. 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.

l. 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.

m. 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

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
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

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 the Janitor's Closets…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.

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.

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 F.

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 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. 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. Construct concrete anchors of poured in place concrete of dimensions indicated and include embedded fasteners.

L. Refer to structural documents for appropriate connection/attachment materials to building.

M. 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 six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in the main fire protection riser room. Additional copies shall be provided in each copy of the O&M manuals.

END OF SECTION

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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. Ball Drip Valves
2. Fire Department Connection
3. Pressure Sensing Devices, Valves
4. Alarm Check Valves
5. Pressure/Vacuum Gauges
6. Inspector's Test Station
7. Eccentric Reducers
8. Gong
9. Pressure Switches
10. Valves and Piping
11. Backflow Preventers
12. Flow Switches
13. Tamper Switches
14. Main Drains
15. Auxiliary Drains
16. Blind Flange with Escutcheon

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-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 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 =	54 psig
Residual Pressure =	46 psig
Flow =	1034 gpm
Location =	Directly outside of Library
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. Where combustible construction materials are located above ceilings, provide above ceiling fire protection in accordance with N.F.P.A-13.

J. Where the architectural documents indicate ceiling "clouds" provide sprinklers above and below the same per NFPA-13. Coordinate exact locations of sprinkler heads and piping with Architect. Submit to Architect for review/approval sprinkler head/piping layout in these areas prior to submitting to working drawings.

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. Fire department connection shall be Potter-Roemer 5750 Series, Elkhart, American Fire Hose, Guardian, Fire Protection Products, or approved equal, with individual drop clapper valves, plugs, and chains on each connection. Exposed parts shall be polished chrome plated. Threads shall match local Fire Department specifications. Where required by local Fire Department, provide Storz type Fire department connection. Escutcheon shall be lettered "AUTO SPRINKLER", as required. Locate as shown on drawings and connect to main fire line through check valve with ball drip. Discharge ball drip drain line as indicated on contract drawings.

F. 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.

G. 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.

H. Pipe and fittings shall meet the requirements of NFPA 13 and NFPA-24.

I. 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.

J. Retard Chamber shall be Victaulic Series 752. Retard Chamber shall be UL listed and FM approved. Chamber shall prevent false alarms with ordinary city water pressure surges.

K. Water motor alarm shall be Victaulic Series 760, Globe Fire Sprinkler Corp., Tyco Fire Products, Viking Corp., or approved equal. Alarm shall be UL listed and FM approved. Alarm shall be hydraulically driven and tested 100 percent at low flow, 5 psig. Gong assembly and motor housing shall be finished with corrosion resistant, red enamel. Furnish unit with nylon bearings and inlet strainer. At contractor's option install electric gong. Provide power and control wiring under this Division of specifications.

2.2 SPRINKLER HEADS

A. Suspended or Drywall Ceilings:

1. Manufacturer: Victaulic, Viking, Grinnell, Reliable, or approved equal.
2. All sprinkler heads installed in suspended ceilings and drywall ceilings including bulkheads shall be Victaulic Model V38 concealed quick response sprinkler or approved equal. Cover plate shall be finished with a polyester baked enamel finish. Color selection by Architect. Provide cover assembly with each head. Frangible glass bulb shall be temperature rated for specific area hazard.

B. 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.

C. 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.

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, 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, penthouses, janitors' closets, electrical rooms, storage areas, elevator shafts, and elevator machine rooms. 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 skylights, heaters, lights, or other high temperature areas.

K. All sprinklers, piping, and pipe hangers installed in corrosive areas, Janitor's Closets, 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, elevator shaft, 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 DETECTOR 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 detector check-valve backflow preventer assemblies at sprinkler system water service connections. Units shall be specifically listed for Fire Protection use. Units shall be double detector check valve as manufactured by Watts 709 DCDA, 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 or shall be 304 stainless steel.

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 or butterfly 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.

F. Unit shall include auxiliary piping with approval backflow preventer and water meter. Meter shall indicate flow in gallons per minute.

2.9 AUTOMATIC BALL DRIP VALVES

A. Provide and install automatic ball drip valves at the Fire Department connection. Discharge ball drip valves to closest floor drain or building exterior as required, with suitable air gap. Automatic ball drip valves shall be ITT-AC Pump, Reliable Automatic Sprinkler Co., Tyco Fire Products, or approved equal.

2.10 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.

2.11 BLIND FLANGE FOR FORWARD FLOW TESTING OF BACKFLOW PREVENTER

A. A blind flange with normally closed control valve shall be provided for use in forward flow testing of backflow preventer. Blind flange shall be sized to flow entire system demand in accordance with NFPA-13 and NFPA-25, latest edition. Control valve shall be monitored with tamper switch.

B. Identify and label blind flange "Backflow Preventer Test Connection" to differentiate fitting on exterior wall from Fire Department connection.

C. Install ball drip in test pipe to allow drainage and prevent freezing.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install equipment in accordance with manufacturer's instructions.

B. Provide approved double detector check valve assembly at sprinkler system water source connection.

C. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent fire department connections to allow full swing of fire department wrench handle.

D. Locate outside alarm gong on building wall.

E. Place pipe runs to minimize obstruction to other work.

F. Place piping in concealed spaces above finished ceilings.

G. Center sprinklers in two directions in ceiling tile and provided piping offsets as required.

H. 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.

I. Flush entire piping system of foreign matter.

J. Install guards on sprinklers where subject to abuse and where specified.

K. Hydrostatically test entire system.

L. Test must be witnessed by Fire Marshal/authority having jurisdiction/ Owner's insurance underwriter/ Architect/Engineer.

M. Refer to plumbing floor plans for approximate locations of sprinkler zones control valve assemblies and routing of fire protection mains.

N. 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.

O. The fire protection contractor shall hydraulically prove the most remote area per NFPA-13.

P. Coordinate locations of sprinkler heads with lights, diffusers, ceiling types, etc.

Q. Hydrostatically test system at 200 PSI for 4 hours, per NFPA-13.

R. Provide dry pipe sprinklers at all loading docks, canopies, etc., as required by NFPA-13.

S. 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.

T. Refer to Architectural Drawings for exact location and extent of all fire rated walls and smoke barriers.

U. Sprinkler shall be provided at top and bottom of the elevator shaft as per NFPA-13, latest edition.

V. A separate control valve with tamper switch shall be installed for the top and bottom of the

elevator shaft and elevator machine room.

W. 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, fire department connection, check valves, main piping, branch piping, inspector's test, drains, sprinkler heads, ball drip valves, 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 sprinklers. Include backflow preventers.

B. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

C. Connect piping to specialty valves, specialties, fire department connections, and accessories.

D. Connect alarm devices to fire alarm.

E. 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 potable-water supplies 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 SECTION

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.	DNREC	-	Delaware Department of Natural Resources and Environmental Control
I.	FM	-	Factory Mutual
J.	IBC	-	International Building Code
K.	IEEE	-	Institute of Electrical and Electronics Engineers
L.	MSSP	-	Manufacturers Standards Society of the Valve and Fittings Industry
M.	NEC	-	National Electrical Code
N.	NEMA	-	National Electrical Manufacturers Association
O.	NSF	-	National Sanitation Foundation
P.	UL	-	Underwriters' Laboratories

Q. 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 six (6) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

I. For resubmissions, the Contractor must address in writing all of the Engineer’s comments

on the original submission to verify compliance.

1.9 SHOP DRAWINGS

A. Prepare and submit shop drawings for all plumbing equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.

C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

D. Items and Systems

1. Access Doors/Panels including layout and location
2. Automatic Temperature Control System and Equipment as it relates to plumbing system
3. Backflow Preventers
4. Backwater Valves
5. Coordinated Drawings
6. Condensate Neutralizers
7. Direct Buried Piping
8. Domestic Water Expansion Tanks
9. Domestic Water Heaters
10. Drain Valves
11. Drip Pans
12. Elevator Sump Pumps
13. Equipment Rails
14. Exterior Equipment/Piping Supports
15. Exterior Pipe Roller Support
16. Fire Stopping - Methods and Materials
17. Floor and Roof Drains
18. Gas Pressure Regulating Valves
19. Gauges
20. Hose Bibbs and Wall Hydrants
21. Hybrid Heat Pump Water Heaters
22. Identification System
23. In-Line Circulators
24. Makeup Water Meters (Mechanical and ATC Type.)
25. Material and Equipment List
26. Operations and Maintenance Manuals
27. Pipe Enclosures
28. Pipe Guides and Anchors.
29. Pipe Materials Including Itemized Schedule

30. Plumbing Fixtures & Trim
31. Preliminary Testing and Balancing Report
32. Pressure/Temperature Relief Valves
33. Pressure Regulating Valves
34. Pumps
35. Roof Curbs
36. Roof Drains
37. Screenshots of ATC System Graphics
38. Shock Absorbers
39. Strainers
40. Test Certificates
41. Thermal Insulation Materials Include Table Summary
42. Thermometers and Gauges
43. Thermostatic Mixing Valves
44. Trap Priming Station/Valves
45. Vacuum Breakers
46. Valves
47. Vibration Isolation Materials
48. Water Meters
49. Weatherproof Assembly Components
50. 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 foundations, 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. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.

F. The location of all existing equipment, piping, 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.

G. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.

H. 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.

I. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves.

J. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirely.

K. Existing piping, equipment, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

L. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.

M. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing refrigerants. Contractor shall include in his bid all cost associated with the evacuation, removal and disposal of all existing equipment containing refrigerants in accordance with EPA and Health Department requirements.

N. 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.

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 plumbing fixtures, devices and equipment removed by the Contractor.

R. 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.

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 underground pipe 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.

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, embedded in construction or in crawl space.

F. Exposed means not installed underground or concealed as defined above.

G. Invert Elevation means the elevation of the inside bottom of pipe.

H. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

I. Review - limited observation or checking to ascertain general conformance with design concept of the work and with information given in contract documents. Such action does not constitute a waiver or alteration of the contract requirements.

J. ECM: Electronically Commutating Motor.

K. 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 FUTURE ADDITIONS

A. Where future additions are indicated, install all piping to account for future additions. Furnish and install shut-off valve in ceiling adjacent to future additions. Provide cap at the end of the piping. Arrange so that in the future the cap can be removed and shut-off valve opened to serve future addition without draining system. Install bypass with balance valve and shut-off valve on domestic recirc system. Balance to future flow rate and then shut the bypass balance valve.

1.23 SYSTEM INTEGRATION

A. For all plumbing equipment specified to be provided with packaged controls and interfaced with the automatic temperature control system, provide system integration between the equipment manufacturer and the automatic temperature control subcontractor.

B. Plumbing equipment submittals requiring system integration as defined above must identify all required system integration points.

C. Plumbing equipment manufacturers must coordinate with ATC subcontractor regarding system integration prior to submitting on the equipment.

D. A system integration meeting must be arranged by the Mechanical Contractor and include, but not be limited to the systems integrator for the plumbing equipment manufacturer and the ATC Subcontractor. This portion of systems integration must occur prior to plumbing equipment being delivered to the project.

E. Once the plumbing equipment is on site, a second systems integration meeting must be arranged by the Mechanical Contractor to coordinate the packaged controls with the ATC system. The plumbing equipment manufacturer's representative familiar with system integration and the ATC subcontractor familiar with programming must be present.

F. A final system integrations meeting shall occur once all equipment is in place and ready for operation. The Mechanical Contractor, the plumbing equipment systems' integrator, and the ATC Subcontractor shall meet on site to jointly program, schedule, verify points, interlock devices, and fully set up all systems integration components.

G. All systems integration coordination, programming, and graphics must be completed prior to requesting commissioning and/or inspections by the Engineer of Record.

1.24 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.

1.25 COORDINATION WITH COLLEGE I.T. DEPARTMENT

A. All equipment that interfaces with the internet shall be coordinated with the Delaware Technical and Community College I.T. Department to verify that the same is suitable for use on the Campus IT infrastructure. Coordinate with the Delaware Technical and Community College I.T. Department regarding the allowable frequency bands to avoid interference with the College I.T. infrastructure.

1.26 EXTRA MATERIALS

A. Provide one set of seals for each type and model of pump provided on the project.

B. For battery operated plumbing fixtures, furnish a set of spare batteries for each fixture.

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	85.5 percent	84 percent
1-½ HP	86.5 percent	85 percent
2HP	86.5 percent	85 percent
3HP	89.5 percent	86 percent
5HP	89.5 percent	87 percent

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 VARIABLE FREQUENCY DRIVE MOTOR BEARING PROTECTIVE RINGS

A. For all motors driven by a variable frequency PWM drive include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents. Grounding rings shall be manufactured by AEGIS SGR or approved equal.

B. Furnish units with two (2) year warranty.

C. Size and select Bearing Protective Rings per the manufacturer requirements based on the motor size, shaft diameter, and shaft shoulder length. For motors with slingers furnish and install NEMA /IEC kit as required.

D. Furnish and apply Colloidal silver shaft coating to all shafts with Bearing Protective Rings to improve shaft voltage discharge capability.

2.6 ENCLOSURES

A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:

1. Dry Interior Locations: NEMA 1.
2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.
3. Corrosive Locations, 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.

E. Paint perimeter of all housekeeping pads yellow.

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 six (6) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Operations and Maintenance Manuals as hereinafter specified.

E. All lines piping installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and service. Refer to Division 22 Section, Plumbing Piping, Fittings, Valves, Etc. Color code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.

F. Submit list of wording, symbols, letter size, and color coding for plumbing identification. Submit samples of equipment identification cards, piping labels, labels, and valve tags to Engineer for review prior to installation.

G. Provide at least 8 hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner. Additional instruction time for the automatic temperature control (ATC) system is specified in Division 23 Section, Instrumentation and Controls of HVAC and Plumbing Systems.

H. Contractor shall demonstrate Sequences of Operation of all plumbing equipment in presence of Owner’s representative, Engineer, and ATC subcontractor.

3.11 WALL AND FLOOR PENETRATION

A. All penetrations of partitions, ceilings, roofs and floors by piping or conduit under Division 22 shall be sleeved, sealed, and caulked airtight for sound and air transfer control. Penetrations of mechanical room partitions, ceilings, and floors shall be as specified in Division 07 Section, “Fire Protection, HVAC and Plumbing Penetration Firestopping”.

B. All penetration of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 07 Section, “Fire Protection, HVAC and Plumbing Penetration Firestopping”.

C. Where piping extends through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these specifications.

D. Provide pipe escutcheons for sleeved pipes in finished areas.

E. Piping sleeves:

1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.
2. Twenty-two (22) gauge galvanized steel elsewhere.

F. Extend all floor sleeves through floor at least 2-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.

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 LUBRICATION

A. All bearings, motors, and all equipment requiring lubrication shall be provided with accessible fittings for same. Before turning over the equipment to the Owner, the Contractor shall fully lubricate each item of equipment, shall provide one year's supply of lubricant for each, and shall provide Owner with complete written lubricating instructions, together with diagram locating the points requiring lubrication. Include this information in the Operations and Maintenance Manuals.

B. In general, all motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal accessible or extended grease fittings and drain plugs.

3.15 OPERATIONS AND MAINTENANCE MANUALS

A. The Contractor shall have prepared six (6) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals and deliver these copies of the manuals to the Owner. The manuals shall be as specified herein. The manuals must be approved and will not be accepted as final until so stamped.

B. The manuals shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: Operations and Maintenance Manual Delaware Technical Community College – Owens Campus – Betze Library Renovations – 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.
15. Insert color graphic with embedded parameters for ATC system into Record and Information Booklet.
16. Pipe Pressure Testing 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 the anticipated date of substantial completion for Engineer review and approval. Substantial completion requires that Operations and Maintenance Manuals are reviewed and approved.

3.16 INSTALLATION AND COORDINATION DRAWINGS

A. Prepare, submit, and use composite installation and coordination drawings to assure proper coordination and installation of work. Drawings shall include, but not be limited, to the following:

1. Complete Plumbing, Sprinkler and HVAC Piping Drawings showing coordination with lights, electrical equipment, HVAC equipment and structural amenities.

B. Draw plans to a scale not less than 3/8-inch equals one foot. Include plans, sections, and elevations of proposed work, showing all equipment, and piping in areas involved. Fully dimension all work including lighting fixtures, conduits, pullboxes, panelboards, and other electrical work, walls, doors, ceilings, columns, beams, joists and other architectural and structural work.

C. Identify all equipment and devices on wiring diagrams and schematics. Where field connections are shown to factory-wired terminals, include manu¬facturer's literature showing internal wiring.

3.17 PIPING SYSTEMS TESTING

A. The entire new plumbing piping systems shall be tested hydrostatically before insulation covering 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 & Storm Water Piping	As specified below

B. All gas piping shall be pressure tested in accordance with NFPA-54. 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 storm, waste, vent and water piping shall be tested by the Contractor and approved by the Engineer before acceptance. All storm, soil, and waste piping, located underground, shall be tested before backfilling. The costs of all equipment required for tests are to be included in the contract price.

D. The entire new drainage system and venting system shall have all necessary openings plugged and filled with water to the level of the highest stack above or at the roof. The system shall hold this water for thirty (30) minutes without showing a drop greater than 1inch. Where a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system, except a vertical stack 10 feet above the highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure, or a pump may be used to supply the required pressure. The pressure shall be maintained for thirty (30) minutes. All testing shall be in accordance with the local Plumbing Code and witnessed by the Plumbing Inspector or authority having jurisdiction.

E. Upon completion of roughing-in and before setting equipment and fixtures, the entire new water piping system shall be tested at a hydrostatic pressure of not less than one hundred (100) pounds per square inch gauge and proven tight at this pressure. Where a portion of the water piping system is to be concealed before completion, this portion shall be tested

separately in a manner described for the entire system.

F. Testing and acceptance thereof shall be in accordance with local requirements and shall meet approval of authority having jurisdiction. Submit certificates and approved permits and insert one (1) copy in the Operations and Maintenance Manuals.

3.18 EQUIPMENT BY OTHERS

A. This Contractor shall make all system connections required to equipment furnished and installed under other divisions or furnished by the Owner. Connections shall be complete in all respects to render this equipment functional to its fullest intent.

B. It shall be the responsibility of the supplier of this equipment to furnish complete instructions for connections. Failure to do so will not relieve this contractor of any responsibility for improper equipment operation.

3.19 OUTAGES

A. Provide a minimum of fourteen (14) days' notice to schedule outages. The Contractor shall include in their bid outages and/or work in occupied areas to occur on weekends, holidays, or at night. Coordinate and get approval of all outages with the Owner.

B. Submit Outage Request form, attached at end of this Section, to Owner for approval.

END OF SECTION

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE: _____

END OUTAGE -- TIME: _____ DATE: _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____

(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ NO ___ BY: _____ DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER : _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ NO: ___ NAME: _____

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.

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. Pipe & Fittings: Cast iron soil pipe, Hubless cast iron soil pipe and fittings must be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International as compliant with CISPI 301.

b. Hubless pipe and fittings shall be joined using Heavy Duty Shielding Coupling, ASTM C 1540 Type 304 Stainless Steel corrugated shield and bands, and polychloroprene (neoprene) based rubber sleeve conforming to ASTM C564.

i. Approved Manufacturers:
1) Husky SD 4000
2) Clamp All 125
3) MG
4) Mission Rubber Company

c. Service Weight pipe and fittings must be marked with the Cast Iron Soil Pipe Institute collective trademark and listed by NSF International as compliant with ASTM A 74. Gaskets must be polychloroprene (neoprene) based rubber Service Weight type conforming to ASTM C564.

i. Approved Manufacturers:
1) AB&I
2) Charlotte
3) Tyler

2. Sanitary and Vents Above Floor Inside Building:

a. Pipe & Fittings: Cast iron No-Hub pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International as compliant with CISPI 301, ASTM C564. Installation and support shall be in accordance with Cast Iron Soil Pipe Institute recommendation. Joints shall be made with neoprene gaskets and 304 stainless steel clamp and shield assemblies. Sealing sleeve shall be polychloroprene (neoprene) based rubber sleeve conforming to ASTM C564.

b. Hubless Cast Iron Soil Pipe and Fittings

i. Hubless pipe and fittings must be listed by NSF International as compliant with CISPI 301.

ii. Manufacturers:
1) AB&I
2) Charlotte

3) Tyler

c. Medium Duty Shielding Coupling, ASTM C 1540, Type 304 Stainless Steel corrugated shield and bands, and polychloroprene (neoprene) based rubber sleeve conforming to ASTM C564.
   i. Approved manufacturers:
      1) Clamp-All
      2) Mission Rubber Company
      3) Husky HD 2000

3. Indirect Waste Piping:

   a. Pipe & Fittings: Hard drawn Type L copper tubing with cast brass drainage fittings. ASTM B88-78 and ANSI B16.1877. All exposed indirect waste piping shall be chrome plated or primed and painted with silver paint.

4. Storm Water Below Grade or Under Building to Point 5 Feet from Building Line:

   a. Pipe & Fittings: Cast iron soil pipe and fittings, service weight, ASTM A74, 10 foot lengths where possible. Provide bell and spigot pipe with neoprene gasket compression joints, ASTM C564.
   b. Service Weight pipe and fittings must be marked with the CISPI collective trademark and listed by NSF International as compliant with ASTM A-74. Gaskets must be polychloroprene (neoprene) based rubber Service Weight type conforming to ASTM C564.
      i. Approved manufacturers:
         1) AB&I
         2) Charlotte
         3) Tyler

5. Storm Water Above Floor Inside Building:
   a. Pipe & Fittings: Cast iron no-hub, pipe and fittings, CISPI 301. Installation and support shall be in accordance with Cast Iron Soil Pipe Institute recommendations. Joints shall be made with neoprene gaskets and 304 stainless steel clamp and shield assemblies listed by.
   b. Hubless Cast Iron Soil Pipe and Fittings
      i. Hubless pipe and fittings must be marked with the Cast Iron Soil Pipe Institute and listed by NSF International as compliant with CISPI 301.
      ii. Manufacturers:
         1) AB&I
         2) Charlotte
         3) Tyler
   c. Heavy Duty Shielding Coupling, ASTM C 1540, Type 304 Stainless Steel corrugated shield and bands, and polychloroprene (neoprene) based rubber sleeve conforming to ASTM C564.
      i. Approved manufacturers:
         1) Clamp-All 125
         2) MG

3) Husky SD 4000
4) Mission Rubber Company

6. Domestic Cold Water Outside of Building Below Ground or Under Building to Point 5 Feet from Building Line:
   a. Pipe: 2-1/2 inches & smaller, soft temper type K. ASTM B88 - No joints below grade except as approved by the Engineer.
      3 inches & larger, ductile iron pipe for water, ANSI 21.50 & 21.51 with double thickness cement mortar lining, ANSI 21.4.
   b. Fittings & Joints: wrought copper solder joint fittings, ANSI B16.22. Joints for copper piping shall be ASTM B32, SOLDER, grade 95TA.
      Cast iron pressure fittings, ANSI 21.10, Class 250. Mechanical specification for mechanical joint for cast iron pressure pipe & fittings ANSI A21.11. Joints for ductile iron pipe shall be AWWA C111, rubber gasket with 3/4 inch diameter rods.

7. 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. 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.

8. 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 or piping installed on a roof shall be primed and finished with two coats of rust resistant paint with pewter gray finish. Paint shall be two part epoxy-exterior paint as manufactured by Pittsburgh Paint, Themeco, or approved equal. Painting shall be provided under another Section of these Specifications.

9. Sump Pump Discharge Piping:
   a. Piping: CPVC Plastic Pipe, ASTM 441, Schedule 80, plain ends.
   b. Fittings and Joints: CPVC plastic pipe fittings, socket type fittings, ASTMF 439 for Schedule 80 pipe.
   c. Basis of Design: Victaulic Series 318 Sump Ejector
   d. Shut-off Valves: 150 psig working pressure, 150 degree F maximum operating temperature, full port design 2 piece body design, CPVC body and ball, polytetrafluoroethylene seats, EPDM seals, tee handle, with threaded socket union, or flanged connections.
   e. Cement: CPVC solvent cement: ASTM F493.

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
5	14	12	5/8
6	16	14	3/4
8	18	16	7/8
10	20	18	7/8

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
12	20	18	7/8

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. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. 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 base mounted pump discharges shall be of the vertical type and shall be Miller "non-slam" check valves or approved equal suitable for service intended. Check valves in circulator discharges shall be horizontal type.

C. Multi-purpose valve (non-slam check valve, throttling valve, shut-off valves and calibrated balancing valve) shall be provided at discharge side of each constant speed pump. The valve shall be of heavy-duty cast iron construction with standard ANSI flanged connections and rated for a maximum working pressure of 175 psig at 240°F. The valve shall be fitted with a stainless steel stem or stem sleeve and brass seat with "O" ring seal. Valve shall be Taco "Plus One" Number 300-4.2, Bell and Gossett 3DS Triple Duty Valve, Armstrong, or as approved equal, and shall have check and plug valve features plus a memory stop with pointer and scale. Provide additional shut-off valve to allow servicing of check valve if a multipurpose valve is utilized in lieu of separate check, shut-off, and balance valve. Provide additional shut-off valve downstream of multi-purpose valve to allow servicing of multi-purpose check valve feature. Provide pre-manufactured, removable insulation covers for all multipurpose valves.

2.4 BACKWATER VALVE

A. Provide backwater valves for all floor drains and A/C condensate drains connecting directly to the storm water system and where indicated on drawings. Backwater valves shall be constructed of coated cast-iron body, hub inlet and offset spigot outlet, bronze bolted cover, automatic type valve seat and flapper which remains closed during periods

of non-operation. Provide RectorSeal Clean Check extendable backwater valves for underslab/below-grade condensate lines as indicated on drawings.

B. Extend access cover to finished floor and terminate in an adjustable floor cleanout as specified hereinbefore.

1. Josam Back Water Valve
2. Zurn Series No. Z1095-FC
3. Jay R. Smith Series No. Fig. 7012

2.5 STRAINERS

A. Strainers shall be of the basket or "Y" type and shall be heavy and durable, constructed of best grade gray iron with the bottoms drilled and plugged. Bodies shall have arrows clearly cast on the sides to show flow direction. Strainers shall be equipped with easily removable covers and brass sediment baskets made of brass not less than #22 gauge in thickness. Total area of basket perforations shall be not less than four times the cross section of the entering pipe. Flow shall be into basket, and then out through the perforations. Strainers shall be suitable for water or the intended fluid. Strainers 2 inches and smaller shall have threaded or solder ends, 2 inches and larger shall have flanged ends.

B. Strainer screens shall be stainless steel with perforations and shall be 1/16-inch for pipe sizes 5 inches and less, 1/8-inch (40 percent open area) perforations for pipe sizes 6-inch and greater.

C. Provide valved and capped (with chain) blowdowns in each strainer. Blowdown valves shall be Appolo 78-100/200 series or as approved equal.

D. Strainers shall be manufactured by Watts, Mueller, Armstrong, Yarway, Spirax/Sarco or as approved equal.

2.6 UNIONS, FLANGES, AND COUPLINGS

A. Unions in steel pipe 2-inches and smaller shall be malleable iron with brass inserted seats designed for a working pressure of 150 psig.

B. Unions in copper pipe 2-inches and smaller shall be sweat fittings with bronze seats designed for a working pressure of 125 psig.

C. Flanges for steel pipe over 2 inches shall be 150 psig, forged steel, and slip on type. Gaskets shall be 1/16 inch thick pre-formed neoprene.

D. Flanges for copper pipe over 2 inches shall be bronze. Gaskets shall be 1/16 inch thick preformed neoprene.

2.7 MANUAL AIR VENTS

A. Manual air vents shall be similar to the hereinafter specified gauge valves. Provide 1/4-inch size on ¾-inch pipe and smaller, ½ -inch size on 1-inch pipe and larger. Install at all high points of piping. Valves shall be Crane No. 88, Honeywell or as approved equal, with threaded ends, bronze body, bronze or brass bonnet and bronze stem.

2.8 THERMOMETERS

A. Unless otherwise indicated, thermometers shall be ASTM E1, in a glass type, organic filled, 9-inch scale size, corrosion-resistant metal case, with "any-angle" mounting with positive locking device. Trerice Industrial Thermometers, Weksler Instruments, Ernst Gage Co., Miljoco, or approved equal. Insertion stem length shall suite the pipe size and configuration. Thermometer wells shall be brass with brass union hubs in copper and in ferrous piping. Where piping is insulated or otherwise covered, use wells with lagging extension. Where wells are installed in pipe tees at turns, increase pipe size so that well does not restrict flow. Accuracy shall be 2 percent.

B. Unless otherwise indicated, thermometer ranges shall be as follows:

1. Domestic cold water: 0 degrees F to 100 degrees F, 1 degrees F Division.
2. Domestic hot and hot water recirculating: 30 degrees F to 180 degrees F, 2 degrees F Division.

C. Provide heat conducting compound in wells.

2.9 PRESSURE GAUGES

A. Unless otherwise indicated, pressure gauges shall be the bronze bourdon tube type, 4-1/2-inch dial, stem mounting, cast aluminum adjustable pointer, 1 percent accuracy over middle half of scale range, 1-1/2 percent over balance: Trerice Model 600C; Weksler Instruments, Ernst Gage Co., Miljoco, or as approved equal.

B. Gauges shall have pressure, vacuum, compound, or retard ranges as required, select ranges so that the normal readings are at the approximate midpoint and maximum system pressures do not exceed full scale.

C. Furnish and install a gauge valve at each pressure gauge. Gauge valves shall be Crane Model No. 88, Needle Valve, Ernst Gage Co. FLG 200, Wexler Instrument Corp. Type BBV4, or approved equal, rated for pressure intended.

D. Gauge connections for pressure gauges, thermometers, or control instruments shall be made using tee fittings, except that gauge connections up to 1-inch size in steel may be using threaded extra heavy pipe couplings welded directly to the main, provided that the main is at least 2-inch size for 2-inch connections, 3-inch size for 3/4-inch connections, and 4-inch size for 1-inch connections. Minimum gauge connection shall be 2-inch ips.

E. Provide snubbers on all gauges. Snubbers shall be No. 872 by Trerice, RS1/RS6 by Wexler

Instruments, Miljoco or as approved equal.

2.10 PIPING SPECIALTIES

A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of all 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.

2.11 ESCUTCHEONS

A. Provide chromium plated escutcheons properly fitted and secured with set screws on all exposed piping which passes through walls, floors or ceilings of finished spaces.

B. All escutcheon plates shall be chrome plated spun brass of plain pattern, and shall be set tight on the pipe and to the building surface. Plastic escutcheon plates will not be accepted.

2.12 DIELECTRIC CONNECTIONS:

A. Furnish and install electrically insulated dielectric unions, waterway fittings, or flanges, as manufactured by Victaulic Company, EPCO Sales, Inc., at the following locations:

1. Where steel piping systems join copper piping.
2. Where copper tube connects to domestic water storage tanks, water heaters, heat exchangers, expansion tanks, and other steel vessels.
3. Avoid the installation of steel nipples, cast iron or steel valves and specialties, or other ferrous components in predominately copper piping systems. Where such installation is necessary, isolate the component with dielectric connections. Do not mix steel pipe and copper tube in the same run of pipe or in the same section of a piping system.
4. Dielectric Waterway: Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. UL classified in accordance with NSF-61 for potable water service, and shall meet the low lead requirements of NSF-372. Basis

of Design: Victaulic Series 647.

2.13 SLEEVES

A. Sleeves shall be provided around all pipes through walls, floors, ceilings, partitions, roof structure members or other building parts. Sleeves shall be standard weight galvanized iron pipe two sizes larger than the pipe or insulation so that pipe or insulation shall pass through masonry or concrete walls or floors. Provide 20 gauge galvanized steel sheet or galvanized pipe sleeves for all piping passing through frame walls.

B. Sleeves through floors shall be flush with the floor except for sleeves passing through Equipment Rooms which shall extend ¾-inch above the floor. Refer to Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment for mechanical equipment room penetrations additional requirements. Space between the pipe and sleeve shall be caulked. Escutcheon plates shall be constructed to conceal the ends of sleeves. Each trade shall be responsible for drilling existing floors and walls for necessary sleeve holes. Drilling methods and tools shall be as hereinbefore specified.

C. Sleeves through walls and floors shall be sealed with a waterproof caulking compound.

D. Firestop at sleeves that penetrate smoke barriers smoke partitions and/or rated walls/floors.

2.14 PRESSURE REDUCING VALVES

A. Provide pressure reducing valves as indicated, of size and capacity selected by the installer to maintain operating pressure on the system. Body shall be bronze construction, renewable stainless steel seat, non-corrosive disc, water tight cage assembly, adjustable pressure ranges and inlet strainer Watts Regulator Model 223-S, Armstrong, Bell and Gossett, Apollo, or as approved equal. Maximum working pressure shall be 300 psig.

B. Provide pressure gauge adjacent to all pressure reducing valves to verify proper set point.

2.15 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.

2.16 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 boiler gas pressure regulators the minimum and maximum distances away from the boilers per the boiler manufacturer's requirements.

2.17 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

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 and 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. Grooved Joints: Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the

contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

B. 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.

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.
9. Lead and antimony-based solders shall not be used for potable water systems. Brazing and silver solders are acceptable.

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.

F. 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.

4. Install concrete filled, steel, schedule 40, painted pipe bollards around gas meter regulator.
5. Gas pressure regulators shall be installed and located per the manufacturer's requirements. For boilers, the gas pressure regulators shall not be installed closer than 10 feet from the boilers, unless the manufacturer requires otherwise. Vent all gas pressure regulator vent pipes to the building exterior prior NFPA-54 and CSD-1 requirements.

G. 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 six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in each mechanical equipment room including each air handling unit mechanical equipment room. Additional copies shall be provided in each copy of the O&M manuals.

3.12 CLEANING PIPING AND EQUIPMENT REQUIREMENTS

A. All water, plumbing piping, and pumped condensate systems shall be cleaned by filling with a solution of one (1) pound of trisodium phosphate to each 50 gallons of water and circulating this solution for a period of six (6) hours during which time the system shall reach operating temperature. The systems shall then be flushed with fresh water and refilled with fresh water purged of all air.

B. All water, 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 SECTION

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, rainleaders, vapor barrier performance is

extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a vapor barrier coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeance shall be 0.03 perms or less at 45 mils dry at test by ASTM E96.

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
Above Grade Trap Priming Lines	½ -inch thickness
All Above Grade Floor Drain Piping Serving AHU Condensate Drains include Drain Sumps and Auxiliary Drain Pipes from Auxiliary Pans	1-inch thickness
All Domestic Hot and Cold Water Piping, including Hot Water Re-circulating Piping	1-inch thickness
All Drain Piping from Cooling Coils/Evaporators	½-inch thickness
All Horizontal and Vertical Roof Drain Piping Including Sumps	1-inch thickness
Electric Water Cooler Drains	1-inch thickness
Existing Floor Drain or Stormwater Piping that collects condensate	1-inch thickness
Vertical and horizontal roof drain piping where the same handles A/C condensate.	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 Pump Volutes and Strainers.
2. Backflow Preventer Valve Bodies.
3. Domestic Water Meters.
4. Expansion Tanks.
5. Make-up Water Valve Bodies.
6. Make-Up Water Meters.

7. 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.

5. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

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, 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 SECTION

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. Use "Sani-Sett" setting compound for fixtures.

G. Provide all materials, equipment and perform all labor required to install plumbing system complete as specified, as drawings indicated and as required by the following:

1. State of Delaware
2. Sussex County local code
3. Town of Georgetown Code
4. All other authorities have jurisdiction.

H. Comply with the current lead-free laws per the requirements of the state in which the project is being constructed.

I. Provide stops for all plumbing fixtures and equipment. Stops are to be accessible.

J. Provide P traps on fixtures for which traps have not been included as part of furnished equipment. Trap size to equal size of fixture tailpiece.

K. All exposed metal parts of fixtures shall be chromium plated brass. Piping, fittings, valves, traps and accessories including escutcheons for piping shall be chromium plated where exposed in finished areas.

L. All faucets for the following list shall be listed for drinking-water or commercial applications by the National Sanitation Foundation (NSF) or Underwriters Laboratory (U.L.). All required faucets shall comply with NSF Standard 61 for both lead content and leaching rate. Submit documentation indicating compliance for all required faucets.

1. Lavatories

2. Drinking fountains

M. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Electrical Manufacturers' Association (NEMA).
5. Underwriters Laboratories (UL).

1.2 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-floor Plumbing Fixtures for Public Use

B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.

D. ANSI/ASMI A112.19.2 - Vitreous China Plumbing Fixtures.

E. ANSI/ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

F. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.

G. ANSI/ASME A112.19.5 -Trim for Water-Closet Bowl, Tanks, and Urinals (Dimensional Standards).

H. ANSI/ARI 1010 - Drinking-Fountains and Self- Contained, Mechanically Refrigerated Drinking Water Coolers.

I. ANSI/NFPA 70 - National Electrical Code.

J. 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 counter top lavatories and sinks.

1.5 EXTRA MATERIALS

A. Provide two sets of faucet washers and flush valve service kits to the Owner. Provide correspondence to Engineer that extra materials have been turned over to the Owner.

B. For battery operated plumbing fixtures, furnish to Owner in a suitable container a spare set of batteries for each fixture.

1.6 GRAB BAR COORDINATION

A. For handicapped plumbing fixtures coordinate location of flush valves with grab bars prior to installation.

1.7 ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. WC-8 Floor Mounted, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Model K-4406 Wellworth
b. American Standard
c. Crane
d. Sloan
e. Zurn

2. Bowl:

a. Material: Vitreous china
b. Type: Siphon Jet

c. Style: Flushometer Valve
d. Height: Standard
e. Rim Contour: Elongated
f. Spud Size; Location: NPS 1-1/2; Top

3. Flushometer Valve:

a. Diaphragm Type: Sloan Model Optima Plus #8111, Delany, Zurn or approved equal.
b. Chrome plated brass.
c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
d. Courtesy flush override button
e. Low Battery flashing LED
f. Infrared sensor range adjustment.
g. Initial set-up range indicator light.
h. Four (4) size AA batteries.
i. 1-inch I.P.S. screwdriver back check angle stop.
j. Spud coupling and flange.
k. Locking vandal resistant stop cap.
l. Adjustable tail piece.
m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
n. Sweat solder adapter with cover tube and cast set screw wall flange.
o. Split Ring Wall Support: Sloan Model J-312-A.
p. Provide 3-year limited Manufacturer's warranty.

4. Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.

B. WC-8A Floor Mounted, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kohler Model K-4405 Highline
b. American Standard
c. Crane
d. Sloan
e. Zurn

2. Bowl:

a. Material: Vitreous china
b. Type: Siphon Jet
c. Style: Flushometer Valve
d. Height: A.D.A. Compliant
e. Rim Contour: Elongated
f. Spud Size; Location: NPS 1-1/2; Top

3. Flushometer Valve:

   a. Diaphragm Type: Sloan Model Optima Plus #8111, Delany, Zurn or approved equal.
   b. Chrome plated brass.
   c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
   d. Courtesy flush override button
   e. Low Battery flashing LED
   f. Infrared sensor range adjustment.
   g. Initial set-up range indicator light.
   h. Four (4) size AA batteries.
   i. 1-inch I.P.S. screwdriver back check angle stop.
   j. Spud coupling and flange.
   k. Locking vandal resistant stop cap.
   l. Adjustable tail piece.
   m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
   n. Sweat solder adapter with cover tube and cast set screw wall flange.
   o. Split Ring Wall Support: Sloan Model J-312-A.
   p. Provide 3-year limited Manufacturer's warranty.

4. Seat: Kohler Model K-4670-C, American Standard 5901.100, solid plastic white seat with open front and check hinge.

2.2 WALL-HUNG URINALS

A. U-2A Wall Hung, Exposed, Battery Operated, Infrared Sensor Flush Valve with Manual Override Button, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Kohler Model K-4991-ET Bardon
   b. American Standard
   c. Sloan
   d. Zurn

2. Fixture:

a.	Material:	Vitreous china
b.	Type:	Washout
c.	Rim Height:	A.D.A. Compliant
d.	Spud Size; Location:	NPS 3/4; Top
e.	Outlet Size; Location:	NPS 2; Back

3. Flushometer Valve:

   a. [Diaphragm Type: Sloan Model Optima Plus #8186, Delany, Zurn or approved equal.
   b. Chrome plated brass.

c. ADA compliant battery powered infrared sensor for automatic “no hands” operation.
d. Courtesy flush override button
e. Low Battery flashing LED
f. Infrared sensor range adjustment.
g. Initial set-up range indicator light.
h. Four (4) size AA batteries.
i. 3/4-inch I.P.S. screwdriver back check angle stop.
j. Spud coupling and flange.
k. Locking vandal resistant stop cap.
l. Adjustable tail piece.
m. High back pressure vacuum breaker flush connection with one-piece bottom hex coupling nut.
n. Sweat solder adapter with cover tube and cast set screw wall flange.
o. Split Ring Wall Support: Sloan Model J-312-A.
p. Provide 3-year limited Manufacturer's warranty.]

4. Carrier: Zurn, Josam or Watts cast iron urinal carrier with fittings as required. ANSI/ASME A112.6.1A; cast iron and steel frame with tubular legs, legs for floor and wall attachment, threaded fixtures studs for fixture hanger, bearing studs.

2.3 WALL-MOUNTED LAVATORIES

A. LAV-18 One (1) Station, Hard-wired, Infrared Sensor Faucet, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bradley Express SS-1N/IR
b. Sloan ELS-41000

2. Station:

a. Single hand washing station
b. Wall Mounted
c. Infrared type faucets with concealed vandal-resistant stream formers.
d. Provide timing turn-off delay of 2-3 seconds.
e. 110/24 VAC plug-in transformer
f. Low-Flow Outlet of 0.5 GPM
g. Lavatory system shall include all waste and supply connections to wall, and thermostatic mixing valve with stop, strainer, and check valves.
h. Bowl material for each station shall be a cast polyester resin complying with ANSI Z124.3 and ANSI Z124.6. Bowl finish shall be decorative stone.
i. Lavatory system shall be secured to a rigid base concealing all supply and waste connections.
j. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
k. Certification to comply with ADA shall be furnished.

B. LAV-18A Two (2) Station, Hard-wired, Infrared Sensor Faucet, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bradley Express SS-2N/IR
    b. Sloan ELS-42000

2. Station:

    a. Double hand washing station
    b. Wall Mounted
    c. Infrared type faucets with concealed vandal-resistant stream formers.
    d. Provide timing turn-off delay of 2-3 seconds.
    e. 110/24 VAC plug-in transformer
    f. Low-Flow Outlet of 0.5 GPM
    g. Lavatory system shall include all waste and supply connections to wall, and thermostatic mixing valve with stop, strainer, and check valves.
    h. Bowl material for each station shall be a cast polyester resin complying with ANSI Z124.3 and ANSI Z124.6. Bowl finish shall be decorative stone.
    i. Lavatory system shall be secured to a rigid base concealing all supply and waste connections.
    j. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
    k. Certification to comply with ADA shall be furnished.

C. LAV-18B Three (3) Station, Hard-wired, Infrared Sensor Faucet, Handicapped

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bradley Express SS-3N/IR
    b. Sloan ELS-43000

2. Station:

    a. Triple hand washing station
    b. Wall Mounted
    c. Infrared type faucets with concealed vandal-resistant stream formers.
    d. Provide timing turn-off delay of 2-3 seconds.
    e. 110/24 VAC plug-in transformer
    f. Low-Flow Outlet of 0.5 GPM
    g. Lavatory system shall include all waste and supply connections to wall, and thermostatic mixing valve with stop, strainer, and check valves.
    h. Bowl material for each station shall be a cast polyester resin complying with ANSI Z124.3 and ANSI Z124.6. Bowl finish shall be decorative stone.
    i. Lavatory system shall be secured to a rigid base concealing all supply and waste connections.
    j. Unit shall operate at less than 5 lbs. push at 80 psi water pressure.
    k. Certification to comply with ADA shall be furnished.

2.4 MOP SINKS – SERVICE SINKS

A. JS-1 Mop Sink, Corner Unit

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Stern Williams Model Corlow-SBC

2. Fixture:

   a. Material: Terrazzo
   b. Type: Corner, Floor-mounted
   c. Receptor composed of pearl grey marble chips and white Portland unit, ground smooth, grouted, and sealed to resist stains.
   d. Stainless steel cap of one piece 20 gauge, 302 stainless steel cast integral on threshold.
   e. Provide and install stainless steel BP splash Catcher panels on adjacent walls.

3. Faucet:

   a. Chicago Faucet 897-RCF, Speakman, American Standard
   b. Rough Chrome Finish
   c. Vacuum breaker spout
   d. Stop in arms
   e. 3/4-inch hose thread outlet.
   f. Pail Hook
   g. Wall Brace
   h. Stern-Williams T-35 hose, bracket and mop hanger.

B. JS-6 Service Sink

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Kohler Model K-6716
   b. American Standard
   c. Ceco

2. Fixture:

   a. Material: Enameled, Cast Iron
   b. Type: Trap Mounted
   c. Nominal Basin Size: 24-1/4”x20-1/4”x13”
   d. Rim Guard: Stainless Steel
   e. Wall Hanger Supports
   f. Provide and install stainless steel BP splash Catcher panels on adjacent walls.

3. Faucet:

    a. Chicago Faucet 305-VBRCF, American Standard, Speakman
    b. Rough Chrome Finish
    c. Vacuum breaker spout
    d. Adjustable Stop supply arms
    e. 3/4-inch hose thread outlet.
    f. Pail Hook
    g. Vandal Proof Lever Handles

4. Strainer:

    a. Jomar Model SS-306 Snap-N-Loc basket strainer with brass locknut and tailnut.
    b. Deep cup body and basket shall be 300 series stainless steel

5. Trap:

    a. Kohler Model K-6673, American Standard
    b. 3-inch trap standard with cleanout

2.5 WATER COOLERS

A. EWC-4 Electric Water Cooler, Dual Height, Surface Mounted, Handicapped, Bottle Filling Station

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Elkay Model LZSTL8WS
    b. Halsey Taylor
    c. Haws
    d. Oasis PG8EBFSL

2. Fixture:

    a. Barrier Free
    b. Dual Height with mounting frame
    c. 8 GPH at 90°F ambient
    d. 50°F outlet drinking water with 80°F inlet water
    e. Top shall be stainless steel
    f. Bubbler valve electronically controlled
    g. Bubbler shall be vandal resistant
    h. Activated by touch pads on sides and front for electronically timed period of flow.
    i. Cabinet shall be powder coated on heavy gauge steel, color to be selected by Architect.
    j. Supplied with plug-in, 3-wire grounding type service
    k. Operation on 120 VAC, Single Phase, 60Hz

l. Lower Spout Outlet shall be mounted 36-inches maximum above floor.
m. Upper Spout Outlet shall be mounted 42-inches maximum above floor.
n. Water cooler and installation shall conform to all requirements of American Disabilities Act Guidelines and ANSI A117.l.

3. Bottle Filling Station:

a. Electronic Sensor for No-Touch activation
b. Automatic 20 second shut-off timer
c. 1.1 GPM flow rate with laminar flow
d. Water Sentry® Plus, 3,000 gallon capacity filter
e. Certified to NSF/ANSI 61, UL 399 and CAN/CSA 22.2 No. 120.
f. Provide 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 manufactured by Elkay or approved equal.
6. Provide cane apron for water cooler (required where water coolers project more than 4 inches into the corridor).

2.6 COUNTER SINKS

A. S-1A Counter Sink – Single Bowl (Handicapped)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Co. – Lustertone LRAD Series
b. Just Manufacturing Co.

2. Fixture:

a. Type: Single Bowl, Counter Mounted, Self-Rimming.
b. Overall Dimensions (L x W x D) inches:

17 x 16 x 5-1/2

c. Material: 302 Stainless Steel, 18 gauge, fully coated underside.

3. Faucet:

a. Standard: ASME A112.18/CSA B125.1
b. General: Include hot and cold water indicators; coordinate faucet inlets with supplies and fixture hold punchings; coordinate outlet with spout and sink receptor.
c. Model: Chicago Faucet Model 201-AGN8AE3-317ABCP
d. Body Type: Centerset, 8” fixed centers
e. Finish: Chrome Plated
f. Handle(s): Model 317 Wrist Blade Handles, A.D.A. Compliant
g. Mounting Type: Deck, concealed.

h. Spout Type: Swivel gooseneck.
i. Spout Outlet: E3 Aerator

4. Strainer: Jomar Model SS-306 Snap-N-Loc, or Just J-35 basket strainer and brass locknut and tailnut. Deep cup body and basket shall be 300 series stainless steel. Provide 1 ½-inch tailpiece.
5. P-Trap: Cast Brass 1 ½ -inch "P" trap.
6. Stops: Chicago Faucets Model 1005ABCP valve stops with riser supply, 3/8-inch loose key cap and removable tee handle, wall flange, chrome plated finish.

2.7 KITCHEN SINKS - EQUIPMENT

A. KE-5 Fill Faucet w/ Hose & Valve

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Chicago Faucet – Model 512-GCCP
b. T&S
c. Watts
d. Crane

2. Faucet:

a. Standard: ASME A112.18/CSA B125.1
b. General: Include hot and cold water indicators; coordinate faucet inlets with supplies and fixture hold punchings; coordinate outlet with spout and receptor.
c. Body Type: Centerset, 8” fixed centers
d. Material: Chrome Plated, Solid Brass Construction.
e. Handle(s): Vandal Proof Lever Handles, A.D.A. Compliant
f. Full Flow Filler Valve
g. Mounting Type: Wall, concealed.
h. Hose: 5 ft. Stainless steel hose.
a. Vacuum Breaker: Integral type in conformance with ANSI/ASSE 1011.

2.8 OUTLET BOXES – WATER SUPPLY

A. OB-1 Refrigerator

1. Refrigerator provided in another Division of Specifications. Provide rough-in, Outlet box and final connections under this Division.
2. Sioux Chief: Model No. 696-RG1010MF with top supply and shut-off valve with water hammer arrester. Provide flexible hose (1/2-inch) between Refrigerator and outlet box. Provide vacuum breaker on threaded outlets to prevent back siphonage. Unit shall be 16-gauge steel with white epoxy finish.
3. Provide sufficient copper tubing to allow movement of refrigerator for cleaning.

2.9 HOSE BIBBS - HYDRANTS

A. HB-1 Hose Bibb

1. Chicago Faucet No. 952 or approved equal hose and faucet. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose threaded spout, polished chrome plated where exposed in finished areas, with hand wheel and removable key, integral vacuum breaker in conformance with ANSI/ASSE 1011.
2. Hose bibbs in finished areas shall be polished chrome finish.
3. Approved Manufacturers: Chicago Faucet, American Standard, Crane, T&S Brass, or Watts.

B. HYD-1 Wall Hydrant (Exterior)

1. Provide and install recessed anti-siphon wall hydrant, 3/4-inch non-freeze, key operated wall hydrant with hinged locking cover, polished bronze box and cover and bronze casing and integral vacuum breaker. Non-Freeze, exterior wall hydrants shall be Zurn Model Z-1320-XL, Josam, Wade, J.R. Smith, Mifab, Watts or approved equal.
2. Seat and disc shall be removable from front of the hydrant. Wall thickness; see architectural drawings. Wall hydrants shall conform to ANSI/ASSE 1019 with wall plate, lock shield and removable key.

C. HYD-2 Wall Hydrant (Interior)

1. Provide and install recessed wall hydrants where indicated on the contract drawings. Recessed wall hydrants shall be Zurn Model Z-1330, Josam, Ancon, Mifab, Watts or approved equal.
2. Units shall be encased Ecolotrol “anti-siphon" wall hydrant for interior wall installation. Unit shall be suitable for hot or cold water as indicated on Contract Drawings.
3. Each unit shall be complete with integral backflow preventer, all bronze interior parts, non-turning operating coupling with hemispherical neoprene plunger and 3/4-inch solder inlet.
4. Furnish each unit mounted in a stainless steel box and hinged cover with operating key lock and "water" stamped on cover.
5. Furnish each unit with the following accessories:

    a. 3/4 inch – 90 degrees inlet elbow with union nut
    b. Cylinder lock
    c. Key operator

2.10 STORM DRAINS

A. General Requirements

1. Provide Josam 26200, Watts, or Zurn vertical expansion joint in each rain leader that does not have 90 degrees offset downstream of the roof drain. The expansion sleeve shall be bronze and shall conduct the rainwater beyond the packing. Install

expansion joints in accessible locations for repacking.

B. SD-1 Storm Drain - Primary

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Zurn Z-100
   b. MIFAB R1200
   c. Watts

2. 15-inch diameter roof drain, dura coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette aluminum locking dome. Provide with support ring, adjustable top with wide roof flange, large sump with anchor flange, bottom outlet inside caulk connection and deck clamp.

C. SD-2 Storm Drain – Overflow

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Zurn Z-100-W2
   b. MIFAB R1200-W2
   c. Watts

2. 15-inch diameter roof drain, dura coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette aluminum locking dome. Provide with support ring, adjustable top with wide roof flange, large sump with anchor flange, bottom outlet inside caulk connection and deck clamp. Provide 2" internal water dam.

D. SD-7 Downspout Nozzle

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Zurn Z-199
   b. MIFAB
   c. Watts

2. Downspout Nozzle, all nickel bronze body, threaded inlet and decorative face of wall flange and outlet nozzle. Provide removable stainless steel screen. Size to match overflow drain pipe size. Color to be selected by Architect.

2.11 FLOOR DRAINS

A. General Requirements

1. Provide Nikaloy strainers on all floor drains unless specified otherwise.

2. Provide flashing clamps on all drains penetrating waterproofing membrane.
3. Provide suitable flashing material and clamping collar for drains which are not set in place when slab is poured.
4. Provide backwater valves for all floor drains connecting directly to the storm water system. Depending on conditions of the particular installation, backwater valves may be an integral part of the drains or a separate device. Accessibility to valves must be maintained for maintenance. Provide an adequately sized extension sleeve up to floor or grade as required.
5. Backwater valves are normally closed, flapper type with bronze or brass seat and disc and stainless steel pin.
6. Provide traps for all floor drains connected to the sanitary system.
7. Provide E & S, Sioux Chief, or PPP primer valve (one valve per trap, per floor drain) on all remote floor drains. When installed on fixture in finished area, primer valve shall be concealed behind a Josam 58650, Watts, or Zurn access door. In Mechanical Rooms, mezzanines, penthouses, and all other locations indicated on the contract drawing, priming lines shall be connected to automatic trap primer.
8. In lieu of joints specified in piping section, neoprene gaskets may be used if designed for use with the drains and cleanouts employed and if approved by the local plumbing authority.
9. When floor drains collect condensate from a neutralizer kit, the floor drains shall be provided with epoxy coating.
10. Approved Manufacturers: Josam, J.R. Smith, Zurn, Wade, Ancon, Mifab, Watts.

B. FD-1 Floor Drain – Round – Nickel Bronze Strainer

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Zurn ZN-415B
   b. Watts FD-100-A

2. Floor and shower drain, dura coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with seepage slots and Type "B" polished nickel bronze strainer. Provide with ½ -inch trap primer connection.

2.12 FLOOR SINKS

A. FS-2 Floor Sink (12”x12”x6”)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Zurn Z-1900
   b. Watts FS-730

2. Sani-Flor receptor, 12-inch x12-inch x 6-inch deep cast iron body and square, slotted grate with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.

a. Two (2) removable ½ grates with each unit.
b. ½ -inch trap primer connection.
c. Stainless steel mesh bucket screen.

B. FS-4 Floor Sink (12”x12”x10”)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Zurn Z-1902
b. Watts FS-750

2. Sani-Flor receptor, 12-inch x12-inch x 10-inch deep cast iron body and square, slotted grate with white acid resisting coated interior and top, complete with aluminum anti splash interior bottom dome strainer.

a. Two (2) removable ½ grates with each unit.
b. ½ -inch trap primer connection.
c. Stainless steel mesh bucket screen.

2.13 THERMOSTATIC MIXING VALVES (INDIVIDUAL FIXTURE TYPE)

A. Furnish and install thermostatic mixing valves where at all lavatories and counter sinks.

B. Thermostatic mixing valves shall be Bradley S59-4000A, Watts, Moen, Leonard Eco-Mix, Acorn, or approved equal for installation under lavatories. Provide in-line check valves, lead free body, escutcheon plates, inlet filters, and insulation as required. Thermostatic mixing valves shall be adjusted to deliver 105 degrees Fahrenheit hot water when supplied with 140 degrees Fahrenheit hot water. Furnish with adjusting cap with locking feature.

C. The thermostatic mixing valves shall be listed for use at the scheduled flow rate of the equipment served.

D. The thermostatic mixing valves shall be ASSE standard 1070 listed.

2.14 PLUMBING FIXTURE SUPPORTS

A. Wall mounted urinal supports, Josam 17810 plate type with cast iron headers, box steel stanchions, block type cast iron feet with bearing plate.

B. Support for wall mounted urinals, lavatories, sinks, drinking fountains, etc.:

C. Where fixtures are supported from concrete or cinder block walls, install No.10 USSG Steel plate on the opposite side of the wall and bolt hangers or supports through plate. Where opposite side of wall is exposed to view, place bolts in core of blocks and fill core with cement.

D. Where lavatories with wall hangers have been specified and fixtures are supported from metal stud frame partitions, fixture brackets or mounting lugs shall be through bolted to steel channel crosspieces not less than 1-1/2-inch wide anchored to studs. Bolt heads shall be welded to channel web.

E. Concealed arm type lavatory supports, Josam 17100 with cast iron headers, box steel stanchions, block type cast iron feet and header; and chrome plated cast brass threaded escutcheons for slab type lavatories.

F. Flush mounted drinking water cooler supports, Josam 17550 plate type, box steel stanchions, block type cast iron feet.

G. Water closet chair carriers, Josam 12000 Series for horizontal and vertical installations.

2.15 HANDICAPPED LAVATORY/SINK INSULATION

A. All handicapped lavatories and sinks shall be provided with under counter pipe and trim insulation.

B. Insulation shall be fully molded "P" trap and angle valve insulated Hand-I-Lav Guard, Truebro, Pro-Extreme Model #101, 102, and 105 to suit.

C. Insulation to meet ADA #4 19.4, ANSI A117.1, ASTM C1822, Type III and International Plumbing Code.

D. Self-extinguishing ASTM D635 burn characteristics, thermal conductivity ASTM C177 K-Value ' 1.17.

E. Insulation thickness to be minimum 2 inch.

F. Where lav. Guards are provided insulation may be omitted.

2.16 FIXTURE STOPS/SUPPLIES

A. For all lavatories/sinks stops and supplies shall be Chicago Faucets No. 1017-CR43829, Angle Stop Fitting with Supply Tube and Loose Key, Chrome plated solid brass construction. 2-1/4” Metal tee handles with tapered square. Slow compression check cartridge that shall open and close 360º for fine adjustment, valves shall close with water pressure, furnish with square tapered stem. ½” NPT female thread inlet 3/8” O.D. female compression outlet. Slip wall flange. 3/8” O.D. x 12” bullnose flexible supply riser. ECAST construction with less than 0.25% lead content by weighted average. This product shall be tested and certified to industry standards: ASME A112.18.1/CSA B125.1, Certified to NSF/ANSI 61, Section 9 by CSA, California Health and Safety Code 116875 (AB1953-2006), Vermont Bill S. 152, and NSF/ANSI 372 Low Lead Content.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Install all equipment in accordance with manufacturer's instructions.

B. Setting heights of lavatories, drinking fountains, etc., shall be as directed prior to installation and shall be coordinated with Architectural Contract Documents.

C. Install floor mounted fixtures only after finished floor has been installed.

D. Provide rubber concussion washers between vitreous china fixtures and supporting brackets.

E. Protect chromium plated trim from corrosive solutions used to clean tile work.

F. Provide white, silicone caulking where fixtures come in contact with walls and floors. Sealant shall be mildew resistant type in accordance with ANSI A-136.1.

G. Install components plumb and level.

H. Unless otherwise noted, drains are to be installed at the low point of floors. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

I. Install floor drains in low points so the top of grates are at or below the finished floor level.

J. Drains not functioning properly shall be removed and re-installed properly at the expense of the contractor.

K. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

L. Install and secure fixtures in place with wall supports, wall carriers and bolts.

M. Solidly attach water closets to floor with lug screws. Lead flashing is not intended to hold fixture in place.

N. Install flush valve handles on the open side of all ADA waterclosets in accordance with ANSI requirements.

O. Fixtures shall be vitreous china unless otherwise noted. Cast iron fixtures shall have acid resisting enamel finish unless noted otherwise, color shall be white.

P. Flush valves shall be self-closing, non-hold open type with vacuum breaker and perform satisfactorily when subject to inlet water pressure varying from 15 to 75 psi. Flush valves shall be as specified, Sloan, Delaney, Zurn, Toto, or approved equal.

Q. Provide flexible risers and loose key stops for all lavatories and sinks. Provide 17 ga.

chrome plated brass tail piece and trap with cleanout for all lavatories and sinks.

R. Coordinate with plumbing piping and related fuel piping, gas venting and electrical work to achieve a complete operating system.

S. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

T. 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.

U. 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.

V. 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.

W. Coordinate with Architectural Drawings before roughing in plumbing.

X. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

Y. See site plan for extent of all piping leaving and entering building.

Z. See domestic water riser diagrams for location of valves, shock absorbers, etc.

AA. 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.

BB. 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.

CC. Unless otherwise noted, horizontal sanitary piping shall be pitched 1 percent.

DD. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

EE. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.

FF. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.

GG. For sizes of all sanitary and vent piping see plumbing fixture schedule and sanitary/vent riser diagrams.

3.2 PLUMBING SPECIALTY INSTALLATION REQUIREMENTS

A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.

B. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.

C. Secure supplies to supports or substrate.

D. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve as appropriate is not indicated.

E. Install water-supply stop valves in accessible locations.

F. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

G. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.

3.3 FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

A. Fixtures such as built-in-sink in counters and kitchen equipment may be provided under other divisions of the specifications and are complete with strainer and tailpiece. Fittings, accessories and connection of these fixtures to the plumbing system are provided under this section.

B. Rough-in and final connection includes but is not limited to all domestic water, waste, and vent systems. Furnish stops, strainers, vacuum breakers, and under counter insulation where not furnished under another Division of these specifications.

3.4 TESTING

A. After plumbing fixtures are connected, all piping and fixtures shall be tested for operation and a smoke or peppermint test shall be made on all soil, waste and vent piping.

B. After the building has been occupied and the various equipment is in actual use, the Contractor shall make an operating test of all equipment at a time directed by the Engineer to determine that all contract requirements are met.

3.5 CLEANING AND STERILIZATION

A. After final testing for leaks, all potable water lines shall be thoroughly flushed, by plumbing contractor, to remove foreign material. Before placing the systems in service, sterilize the new water lines in accordance with local health department codes and at a minimum according to the following procedure:

B. Through a 3/4-inch hose connection in each branch main and building main, pump in sufficient sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Plumbing Contractor shall provide plumbing connections and power for pumping chlorine into system.

C. Proceed upstream from the point of chlorine application opening all faucets and taps until chlorine is detected. Close faucets and taps when chlorine is evident.

D. When chlorinated water has been brought to every faucet and tap with a minimum concentration of 200 ppm chlorine, retain this water in the system for at least three (3) hours.

E. CAUTION: Over-concentration of chlorine and more than three (3) hours of retention may result in damage to piping system. It is not necessary to retain chlorine in any system for twenty-four hours to achieve sterilization. AWWA states that 200 ppm chlorine for three hours is sufficient.

F. At the end of the retention period, no less than 100 ppm of chlorine shall be present at the extreme end of the system.

G. Proceed to open all faucets and taps and thoroughly flush all new lines until the chlorine residual in the water is less than 1.0 ppm.

H. Obtain representative water sample from the system for analysis by an independent and recognized bacteriological laboratory.

I. If the sample tested for coliform organisms is negative, a letter and laboratory report shall be submitted by the service organization to the Contractor, certifying successful completion of the sterilization. Additionally, this report shall be forwarded to the Owner as well as be included in the O&M Manual.

J. If any samples tested indicate the presence of coliform organisms, the entire sterilization procedure shall be repeated.

K. Take precautions to avoid use of plumbing fixtures and domestic water systems during sterilization period. Place signs on all plumbing fixtures and outlets during sterilization period.

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 ADJUSTING

A. Adjust stops, valves, infrared fixtures for intended water flow rate to fixtures without splashing, noise, or overflow.

3.10 CLEANING

A. At completion, clean plumbing fixtures and equipment. Polish all chrome plated faucets, accessories, equipment, and piping.

B. All electric water cooler coils shall be cleaned of all construction dust and debris prior to building occupation by Owner.

3.11 FIXTURE HEIGHTS

A. Install fixtures to heights above finished floor as required by local Plumbing Code, Americans with Disabilities Act (A.D.A.), Authority Having Jurisdiction, and Architectural Contract Drawings. In the absence of a local code requirements, install fixtures to heights above finished floor as follows.

B. Water Closet

a. Standard 15 inches to top of bowl rim.
b. Handicapped 18 inches to top of seat.

C. Urinal

a. Handicapped 17 inches to top of bowl rim.

D. Lavatory

a. Standard 31 inches to top of basin rim.
b. Handicapped 34 inches to top of basin rim.

E. Drinking Fountain

a. Handicapped 34 inches to top of basin rim.

F. Water Closet Flush Valves

a. Standard 11 inches min above bowl rim.
b. Recessed 10 inches min. above bowl rim.

END OF SECTION

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, Town of Georgetown Code, the local code, and all other authorities have jurisdiction.

G. Provide stops for all plumbing equipment. Stops are to be accessible.

H. Provide pumps with manufacturer's name, model number, and rating/capacity identified.

I. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
5. National Electrical Manufacturers' Association (NEMA).
6. Underwriters Laboratories (UL).

J. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.2 REFERENCES

A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers.

B. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle.

C. ANSI/ASE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

D. ANSI A112.21.1 - Floor Drains.

E. ANSI A112.21.2 - Roof Drains.

F. ANSI A112.26.1 - Water Hammer Arrestors.

G. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

H. PDI WH-201 Water Hammer Arresters.

I. ANSI/ASHRAE 90A - Energy Conservation in New Building Design.

J. ASME Section VIIID - Pressure Vessels; Boiler and Pressure Vessel Codes.

K. ANSI/NFPA 54 - National Fuel Gas Code.

L. ANSI/NFPA 70 - National Electrical Code.

M. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum).

N. 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.

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 and risers, and 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	C.I. Pipe
3.	Floors	57000-Z-CI
4.	Walls	58600-PLG
5.	Finished Areas – Floors	57000-Z-CI
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	58600-PLG
12.	Plaster/Dry Wall	58640-COT
13.	Tile/CMU	58600-COT

2.2 SHOCK ABSORBERS

A. Provide shock absorbers equal to Josam Shokstops at all fast closing valves, at the top of all cold water risers, at each flush valve or battery of flush valves, and where indicated. Sizes and locations shall be in accordance with PDI Standard WH 201.

B. Shock absorbers shall conform to ANSI A112.26.1, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psig working pressure.

C. Approved Manufacturers: Josam, Wade, Zurn, J.R. Smith, Sioux Chief, Watts, or approved equal.

2.3 VACUUM BREAKERS

A. Provide vacuum breakers on water connections to fixtures and equipment where minimum air gaps required by Plumbing Code are not possible and on hose bibbs and other outlets to which hoses can be attached.

B. Vacuum breakers not subject to back pressure, Watts No. 288A; vacuum breakers subject

to back pressure, Watts Series 9D or for hose threads, Watts Series 8A.

C. Provide atmosphere vacuum breakers at all water connections to garbage disposers, hose spray units as required by Plumbing Code.

D. Hose connection backflow preventers shall be ASSE 1052, suitable for at least 5 gpm flow and applications with up to 10 foot head back pressure. Include two (2) check valves, intermediate atmospheric vent, and non-removable, ASME B1.20.7 garden-hose thread on outlet.

E. Hose connection vacuum breakers shall be ASSE 1011, nickel plated, with nonremovable and manual drain features, and ASME B1.20.7 garden-hose threads on outlet. Units attached to rough-bronze finish hose connections may be rough bronze.

F. Approved manufacturers: Watts, Beeco, B&K Industries, Zurn, Sparco, Conbraco or approved equal.

2.4 VACUUM RELIEF VALVES

A. Provide vacuum relief valves on cold water supply to water heaters, where indicated on the contract drawings, or where required by the authority having jurisdiction.

B. Vacuum relief valves shall be Watts Regulator Co. Series 36A, Josam, or approved equal.

2.5 DOMESTIC WATER RECIRCULATING PUMPS

A. Provide and install domestic water re-circulating pumps of the size, capacity and electrical characteristics as indicated on the contract drawings. Pumps shall be in-line circulators Model 113B as manufactured by TACO, Bell and Gossett, Thrush, Armstrong, Patterson, or approved equal.

B. Pumps shall be non-overloading throughout the range of the curves. Pumps shall have center line discharge for positive venting, flanged bodies, and same size suction and discharge.

C. Motors shall be resilient mounted, split phase motor with built-in overload protector and equipped with sleeve bearings for quite operation. Impeller shall be one piece dynamically balanced with stainless steel shaft, bronze sleeve bearing, two piece carbon/ceramic seal assembly and one piece spring coupling.

D. All circulators utilized for domestic water service shall be stainless steel or all bronze construction.

2.6 ELECTRIC HYBRID HEAT PUMP DOMESTIC WATER HEATER

A. Furnish and install electric hybrid heat pump water heaters of the size, capacity, and arrangements indicated on the Contract Drawings. Heaters shall be A.O. Smith, GE,

Rheem, Ruud, Stiebel Eltron, Lochinvar, or approved equal. Water heaters shall be UL listed. The domestic water heater and installation shall meet all requirements of the State of Maryland Boiler and Pressure Vessel Safety Act and Regulations including amendments and addenda latest edition. The domestic water heater and installation shall comply with all requirements of the local Boiler Inspector. Contractor must submit any deficiencies cited by the Boiler Inspector to the Engineer and Owner for review.

B. Tanks shall be glass lined with magnesium anode and an approved working pressure of 125 psi. Tank shall have a steel jacket with a baked enamel finish. Electric elements shall be screw in design complete with adjustable thermostatic controls. Tank shall be insulated to conform with latest ASHRAE 90.1 Standards.

C. Unit shall utilize air side heat pump water heater and electric resistance heating element to maintain tank temperature. Furnish with LCD electronic controls, LCD display, service diagnostics, temperature setting monitoring, and "away" mode.

D. Unit shall be factory furnished with multiple operating modes including hybrid mode, high demand, heat pump only, and standard electric.

E. Entire assembly shall be provided with a two (2) year Parts and Labor Warranty. Parts warranty shall be for 10 years.

F. Accessories shall include an A.S.M.E. rated temperature/pressure relief valve, drain valve, electrical junction box, washable filter, condensate collector, condensate collection tube, and terminal block.

G. Install water heaters on 4 inch high concrete housekeeping pad unless otherwise detailed on the drawings.

2.7 BACKFLOW PREVENTER (REDUCED PRESSURE PRINCIPAL TYPE)

A. Furnish and install reduced pressure principal backflow preventers at all cold water make-up connections to HVAC water systems, chemical feed stations, and where indicated on contract drawings.

B. Backflow preventers shall be of bronze body construction, inlet and discharge OS&Y gate valves, stainless steel check and relief valve seats, stainless steel relief valve shafts and flange bolts. Ball valve test cocks shall be bronze body.

C. Pressure ratings shall be up to 175 psi and temperature ratings shall be up to 210 degrees F continuous.

D. Install unit per local code requirements and authorities having jurisdiction. Unless otherwise noted, install backflow preventers between 12 inches and 60 inches above finished floor.

E. Units shall be approved by ASSE 1013, UPC, UL, and shall be No. 909 with air gap fitting and inlet/outlet gate valves as manufactured by Watts Regulator, Conbraco, Wilkens, or as approved equal. Pipe discharge to nearest floor drain/floor sink. Provide minimum 18-

inch clearance for servicing and testing.

F. Pipe discharge of backflow preventer full size to closest floor drain utilizing type "L" copper.

G. Furnish test kit for field testing units. Watts Model TK-9A Analog Differential Gauge or approved equal.

2.8 BACKFLOW PREVENTER (DOUBLE CHECK VALVE ASSEMBLY TYPE)

A. Furnish and install horizontal or vertical double check valve assembly backflow preventers at all cold water connections to incoming water service and roof hydrants and where else indicated on contract documents.

B. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module sets and seat discs shall be replaceable.

C. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall include two resilient seated isolation valves and four top mounted, resilient seated test cocks.

1. Furnish each backflow preventer with the following accessories and options:

a. bronze strainer
b. quarter turn, full port, resilient seated ball valve shut-off
c. union connections

D. Provide minimum 18-inch clearance for servicing and testing.

E. The assembly shall meet the requirement of ASSE Std 1015 and AMCA Std C510.

F. Double check valve backflow preventers shall be Watts No. 007, Conbraco, Wilkens, Ancon, or approved equal.

2.9 BACKFLOW PREVENTER (DOUBLE CHECK VALVE ASSEMBLY TYPE) (VERTICAL TYPE)

A. Furnish and install vertical double check valve assembly backflow preventers at incoming water services and where else indicated on contract documents. Backflow preventers shall be suitable and listed for vertical installation.

B. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module sets and seat discs shall be replaceable.

C. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The assembly shall include two resilient seated isolation valves and four top mounted, resilient seated test cocks.

D. Furnish each backflow preventer with the following accessories and options:

1. OS & Y Gate Valves.
2. Ball Valve Test Cocks.
3. Approval for vertical up flow installation.

E. Provide minimum 18-inch clearance for servicing and testing.

F. The assembly shall meet the requirement of ASSE Std 1012 and AMCA Std C510.

G. Double check valve backflow preventers shall be Watts No. 757, Conbraco, Wilkens, Ancon, or approved equal.

2.10 TRAP SEAL PRIMER VALVES (DIRECT CONNECT TO DOMESTIC WATER)

A. Supply type, Trap-Seal primer Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MIFAB, Inc.
b. PPP, Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS ½ (DN15) threaded union, or solder joint.
6. Gravity Drain Outlet connection: NPS ½ (dn 15) threated or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
8. Distribution Unit: Outlet quantities required.
9. Backflow Preventer: Atmospheric vented drain chamber.

2.11 TRAP PRIMING STATION-AUTOMATIC TRAP PRIMER

A. Trap priming stations shall be Precision Plumbing Products, Inc., Electronic Trap Priming manifold Model PT, MIFAB, Sioux Chief, Watts, or approved equal. The manifold shall supply a minimum of 2 ounces of potable water per opening at 20 PSIG once in each 24 hour period. The Electronic Trap Priming Manifold must be capable of equally priming from 4 through 30 individual floor drain traps.

B. The unit shall be factory assembled and prepiped, and shall include a bronze body 3/4-inch female NPT WOG rated ball valve 3/4-inch, Water Hammer Arrestor, copper barrel with brass piston and type "L" copper sweat connection, electronic brass body 3/4-inch solenoid valve, and type "L" copper manifold with brass 2-inch compression fitting and orifice

opening for precision water distribution to each floor drain trap. Unit shall be pre-piped with atmospheric vacuum breaker.

C. Electronic components shall include single point power connection at 120 volt 1 phase 60 hertz, manual over-ride switch, minimum 5 amp breaker, 24 hour geared timer with relay and 5 second dwell function. Separate water hammer arrestor can be provided outside station if integral arrestor is not available.

D. All components shall be factory assembled, tested and supplied in a 16 gauge steel enclosure suitable for surface or recess mounting, as indicated on contract drawings. In addition, all components must comply with nationally recognized standards. The Precision Plumbing Products Electronic Trap Priming Manifold shall be fully warranted for the life of the plumbing system.

E. When only a single trap primer is required, as in the case of a restroom with one floor drain in a toilet (or similar) the contractor may submit, in lieu of an electronic multiple station, a single station for review by the Engineer. The fixture serving the trap primer must be within 10' of the trap. Components shall be brass, bronze, and chrome, of the highest quality.

F. Access door shall be finished with a prime coat and fire rated where installed in a rated wall. Access door latch shall be Allen key type.

2.12 TRAP PRIMING STATION MINI-AUTOMATIC TRAP PRIMER

A. The mini trap priming stations shall be Precision Plumbing Products, Inc., Electronic Trap Priming manifold Model MPB, MIFAB, Sioux Chief, Watts, or approved equal. The manifold shall supply a minimum of 8 ounces of potable water per opening at 60 PSIG once in each 24 hour period. The Mini Trap Priming Manifold must be capable of equally priming from 1 to 4 individual floor drain traps. Utilize where three (3) or less floor drains require priming pipes.

B. The unit shall be factory assembled and prepiped, and shall include a bronze body 3/4-inch female NPT WOG rated ball valve 3/4-inch, Water Hammer Arrestor, copper barrel with brass piston and type "L" copper sweat connection, electronic brass body 3/4-inch solenoid valve, and type "L" copper manifold with brass 2-inch compression fitting and orifice opening for precision water distribution to each floor drain trap. Unit shall be pre-piped with atmospheric vacuum breaker.

C. Electronic components shall include single point power connection at 120 volt 1 phase 60 hertz, manual over-ride switch, minimum 2 amp breaker, 24 hour geared timer with relay and 12 second dwell function. Separate water hammer arrestor and can be provided outside station if integral arrestor is not available.

D. All components shall be factory assembled, tested and supplied in a 16 gauge steel NEMA 1 enclosure suitable for surface or recess mounting, as indicated on contract drawings. In addition, all components must comply with nationally recognized standards. The Precision Plumbing Products Electronic Mini Trap Priming Manifold shall be fully warranted for the

life of the plumbing system.

E. When only a single trap primer is required, as in the case of a restroom with one floor drain in a toilet (or similar) the contractor may submit, in lieu of an electronic multiple station, a single station for review by the Engineer. The fixture serving the trap primer must be within 10' of the trap. Components shall be brass, bronze, and chrome, of the highest quality.

F. Access door shall be finished with a prime coat and fire rated where installed in a rated wall. Access door latch shall be Allen key type. Furnish with distribution units as required.

2.13 TRAP SEAL PRIMER VALVES

A. Provide and install one valve per trap, per floor drain on all remote floor drains. When installed on a fixture in a finished area, primer valve shall be concealed behind an access door. In mechanical rooms, mezzanines, penthouses, and all other locations indicated on contract drawings, priming lines shall be connected to automatic trap primer station. Trap seal primer valves shall be as manufactured by E&S, Precision Plumbing Products, Sioux Chief, Mifab, Watts, or approved equal.

B. Trap seal primer valves shall be ASSE 1018, water supply fed type with the following characteristics:

1. 125 psig minimum working pressure.
2. Bronze body with atmospheric - vented drain chamber.
3. Inlet and outlet connections: ½ inch NPS threaded or solder joint.
4. Gravity drain outlet connection: ½ inch NPS threaded or solder joint.
5. Finish: chrome plated

2.14 DOMESTIC WATER METER WITH ATC INTERLOCK CAPABILITIES (DIGITAL TYPE)

A. Furnish and install a bronze magnetic drive flanged turbo-water meter on incoming water service to building and where indicated. The water meter shall be Model WPX-211 as manufactured by Niagara, Rockwell, Hersey, or approved equal. Unit shall be sized and selected so as not to exceed the scheduled maximum pressure drop at design flow.

B. Main cases for all sizes shall be cast Water Works bronze. Size, model and direction of flow shall be cast, in raised characters, on both sides of the Main cases.

Operating Characteristics		
Meter Size	Low Flow (95 percent minimum)	Normal Range (100.0 +/- 1.5 percent)
2-inch	3	4 to 160
3-inch	4	5 to 350
4-inch	10	15 to 1000
6-inch	20	30 to 2000
10-inch	55	55 to 5500

C. Meters shall have performance capabilities of continuous operation up to the rated maximum flows as outlined above without affecting long term meter accuracy or causing undue wear. Meters shall also have a 25 percent flow capacity in excess of the maximum flows listed for intermittent flow demands.

D. The measuring chamber shall be of unitized construction (i.e., complete with measuring element, calibration device and register in one assembly). The measuring chamber shall be capable of operating within above listed accuracy limits without recalibration when transferred from one main case to another. The measuring element shall be mounted on a horizontal stationary shaft with sleeve bearings and be essentially weightless in water.

E. The register shall be permanently hermetically sealed; all registers of similar size and registration to have a standard ratio gear reduction so as to permit interchange ability. The register shall be assembled to measuring chamber in a tamper proof manner so removal can be made only after measuring chamber is removed from the maincase. Sweep hand reading and odometer wheel details will conform to American Water Works Standard C-701, as most recently revised.

F. All reduction gearing shall be enclosed in the permanently hermetically sealed register. The drive magnet shall be located in the measuring element, and the follower magnet shall be located inside the permanently hermetically sealed register. An intermediate magnetically active material shall be required to distribute the magnetic flux uniformly to the follower magnet, thereby improving the service life of the register's rotating components.

G. All meters shall operate without leakage, damage or malfunction up to a maximum operating pressure of 150 pounds per square inch.

H. The 6-inch and 10-inch size meters shall have external strainers as part of the meter package. Strainers shall have cover plate for inspection and removal of debris from the bronze screen without disturbing the pipeline.

I. Flanges on 2-inch size meters shall be oval faced and drilled on the horizontal axis with a bolt circle diameter of 4 ½ -inch. Thickness shall be as required for Class 125 round flanges. Flanges for 3-inch, 4-inch, 6-inch and 10-inch size meters shall be of the Class 125 round type, flat faced, and shall conform to ANSI 16.1 for specified diameter, drilling and thickness. Companion flanges, if required with the meters, shall consist of one standard cast iron flange, tapped with American Standard internal taper pipe threads, and one flanged coupling adapter. The type and outside diameter of connecting pipe shall be provided for appropriate gasket sizing. All bolts, nuts and gaskets shall be provided.

J. Turbine meters of similar design concept must be available for purchase in all of the sizes specified above. The turbine meters must have a minimum of five (5) years of satisfactory operating experience as marketable products. Limited experimental history is not acceptable. The meter manufacturer shall submit, in writing, a price schedule of its factory maintenance program for the measuring chambers.

K. The water meter shall be fully field insulated and jacketed to prevent condensation.

L. The water meter shall be provided with a high frequency pulse output device for interface

with Automatic Temperature Control System. The Infrared Pulser shall be Model 860 as manufactured by Hersey or approved equal.

M. A Pulse to DC converter shall be supplied with the Infrared Pulser. The device shall convert pulses from a variety of liquid flow sensing devices to a 4-20mA output signal which is proportional to the flow rate. This output shall transmit flow rate data over long distances with no loss of accuracy. The converter shall be Model 1005 as manufactured by Hersey or approved equal.

N. At contractor's option a water meter provided by the ATC subcontractor may be utilized.

2.15 DOMESTIC MAKEUP WATER METER (MECHANICAL TYPE)

A. Furnish and install a bronze multi-jet water meter on boiler make-up water to building heating system. The water meter shall be Model 420 as manufactured by Sensus, Badger, Rockwell, ABB, Hersey, or approved equal. Unit shall be sized and selected so as not to exceed the scheduled maximum pressure drop at design flow.

B. Main cases for all sizes shall be brass. Size, model and direction of flow shall be cast, in raised characters, on both sides of the Main cases.

Operating Characteristics		
Meter Size	Low Flow (95 percent minimum)	Normal Range (100.0 +/- 2 percent)
1-1/4-inch	0.4	0.7 to 70

C. Meters shall have performance capabilities of continuous operation up to the rated maximum flows as outlined above without affecting long term meter accuracy or causing undue wear. Meters shall also have a 25 percent flow capacity in excess of the maximum flows listed for intermittent flow demands.

D. The measuring chamber shall be of unitized construction (i.e., complete with measuring element, calibration device and register in one assembly). The measuring chamber shall be capable of operating within above listed accuracy limits without recalibration when transferred from one maincase to another. The measuring element shall be mounted on a horizontal stationary shaft with sleeve bearings and be essentially weightless in water.

E. The register shall be permanently hermetically sealed; all registers of similar size and registration to have a standard ratio gear reduction so as to permit interchange ability. The register shall be assembled to measuring chamber in a tamper proof manner so removal can be made only after measuring chamber is removed from the maincase. Sweep hand reading and odometer wheel details will conform to American Water Works Standard C-701, as most recently revised. Provide 5 drum register to read gallons.

F. All meters shall operate without leakage, damage or malfunction up to a maximum operating pressure of 150 pounds per square inch.

G. Meters of similar design concept must be available for purchase in all of the sizes specified above. The turbine meters must have a minimum of five (5) years of satisfactory operating

experience as marketable products. Limited experimental history is not acceptable. The meter manufacturer shall submit, in writing, a price schedule of its factory maintenance program for the measuring chambers.

H. The water mater shall be fully field insulated and jacketed to prevent condensation.

2.16 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.

2.17 ELEVATOR PIT SUMP PUMP

A. Furnish and install an elevator pit submersible sump pump of the size, capacity and electrical characteristics as shown on the drawings. System shall include submersible pump, 2-inch discharge flange/piping, grate with cover, float switches, oil sensor, remote mounted control panel and control system. Pumps and accessories shall be by Stancor Oil Minder, Zoeller, Liberty, Bell & Gossett, or approved equal.

B. Pumps:

1. Pump Design: The pump shall be capable of handling clean water waste. The pump(s) shall be capable of handling liquids with temperatures to 104 degrees F continuous, 160 degrees F intermittent, and shall be capable of running dry for extended periods. Pump shall include thermal and overload protection.

C. Pump Construction:

1. The volute, seal plates, impeller and motor housing shall be constructed of high quality #304 stainless steel. The pump(s) shall be painted with a water based air dry enamel of 2.0 mil minimum thickness. All exposed hardware shall be 300 series stainless steel. The pump construction shall contain no points of critical

clearance nor require periodic adjustment or replacement to maintain operating efficiency. Discharge connection shall be a standard 2-inch NPT in the vertical position. All gaskets shall be of the compression square ring type eliminating critical slip fits and the possibility of damage during service associated with sliding o-ring sealing arrangements.

2. The impeller shall be of the non-clog design with pump out vanes on the back side. The impeller shall be dynamically balanced to ISO G6.3 specifications.
3. The unit shall utilize a single mechanical shaft seal which shall operate in an oil atmosphere. The materials of construction shall be carbon for the rotating face and ceramic for the stationary face, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and all elastomer parts to be of Buna-N. The seal shall be commercially available and not a proprietary design of the manufacture.
4. The pump shall be designed to be non-overloading throughout the entire pump curve. The rotor and stator assembly shall be of the standard frame design and secured to the pump seal plate by four threaded fasteners allowing for easy serviceability. Motor designs incorporating shrink or press fit assembly between the stator and motor housing shall not be acceptable. The motor shall be constructed with the windings operating in a sealed environment containing clean dielectric oil, making it capable of operating in a totally, partially or non-submerged condition for extended periods of time without damage due to the heat being generated. Air-filled motors shall not be acceptable. The motor windings shall be of Class "F" insulation. The motor shall meet the standard NEMA design L for single phase and NEMA design B for three phase. The motor shaft shall be of 416 stainless steel. The lower bearing shall be of the single ball type to accept radial and thrust loads, and the upper bearing of the sleeve or ball design, for radial loads. Bearings shall operate in an oil bath atmosphere for superior life. Permanently lubricated bearings are not acceptable.
5. Thermal sensors shall be used on three phase units to monitor stator temperatures. The stator shall be equipped with a thermal switch embedded in the end coil of the stator winding. This shall be used in conjunction with external motor overload protection and wired to the control panel. Single phase shall have an overload switch on the motor windings and do not require any external protection. Three (3) phase motors shall include phase loss protection.
6. The pump shall be equipped with type neoprene jacketed power cable and connected to the motor via quick disconnect spade terminals length as required. Crimp connected cords are not acceptable. Heat shrink tubes shall be used to connect power cord leads with motor leads. A master heat shrink tube shall be provided and filled with epoxy to seal the outer cable jacket and the individual strands to prevent water from entering the motor housing. A secondary rubber pressure groment shall be provided as an additional sealing point and strain relief at the point of cable entry. Cable entry designs utilizing terminal boards to connect power cord leads with motor leads shall not be acceptable.
7. The sump grate shall be custom sized to accommodate the dimensions of the sump. Grate shall be galvanized steel and have openings for all pipes/conduits as required.

D. Pump Test:

1. The pump manufacturer shall perform the following inspections and tests in

accordance with Hydraulic Institute type B standards before shipment from the factory.

2. A check of the motor voltage and frequency shall be made as shown on the name plate.
3. A motor and cable insulation test for moisture contents or insulation defects shall be made per UL criteria.
4. The pump shall be completely submerged and run to determine that the unit meets three pre-determined hydraulic performance points.
5. A written report shall be available showing the aforementioned tests have been performed in accordance with the specifications.

E. Start-Up:

1. The pump(s) shall be tested at start-up by a qualified representative of the manufacturer. A start-up report as provided by the manufacturer shall be completed before final acceptance of the pump(s).
2. Warranty: Two (2) years from substantial completion.

F. Float Level Controls:

1. Provide and install three (3) level controls as detailed on the drawings. Two (2) level controls shall be utilized for the pump operation and the remaining level control shall be utilized for high water level alarm. Level controls shall be provided in a pipe mounted configuration with 25 feet of cable. Level controls shall be pilot duty devices which shall control the function of motor load devices, contactors, motor starters and power relays, to automatically cycle pumps. Switches shall be rated at 4.5 Amps at 115 VAC RES, Provide pole and stainless steel clamps and hardware.
2. Where required, provide custom length of cables to accommodate distance between sumps and control panels where the minimum 25 feet length is insufficient.

G. Valves:

1. Provide and install discharge valves on the pump as detailed on the drawings. Ball check valves shall be provided with removable threaded plug and natural rubber ball. Valve body shall be ASTM class 30. Cast iron valve shall be able to withstand 150 psig.
2. Ball Valves:

    a. Ball valves shall be True Union Type manufactured of Type 1 Schedule 80 PVC with EPDM O-rings for superior chemical and corrosion resistance. Valves shall be quick disconnect type for ease of maintenance. Ball valves shall be suitable for pressures up to 150 psig.

H. Control Panel:

1. The pump manufacturer shall supply a completely self-contained motor control panel. The control panel shall be provide with short circuit and overload protection for the pump. Furnish control panel with 8 pin twist lock receptacle, dual solid

state oil sensor relays with reliable sensitivity settings, over current relay, sensor probe, horn, alarm silencing switch, terminal board and remote monitoring contacts. Furnish sufficient cable between pump and control panel. Furnish sufficient cable and plug for the control panel.

2. The motor controls shall be housed in a NEMA 4X enclosure. The enclosure shall be formed of 16 or 14 gauge, G-90 galvanized steel, with all surfaces phophatized then finished inside and out with ANSI 61 gray polyester powder finish. The door shall be equipped with two galvanized hinges with stainless steel hinge pins. The enclosure shall have external mounting tabs for wall mounting.
3. A magnetic starter shall be provided for each pump motor. The starter shall be equipped with a three (3) pole bimetalic overload relay with ambient compensation and Class 10, quick trip heaters. Heaters must be properly sized for motor load. The overload relay shall provide the terminals for connection of the pump motor cable.
4. A control transformer shall be provided to supply low voltage as required for the control circuit. The transformer shall be continuous duty machine tool type, size to meet the load requirements of the control circuit. The transformer primary shall be connected to the load side of the circuit breaker. One side of the secondary winding shall be grounded to the component mounting panel.
5. A terminal block shall be provided for connection of level controls, oil sensor, alarms, remote monitoring and other control wiring as required for proper pump installation.
6. Control panel shall be interlocked with floats and oil sensor to allow pumping of water while containing oil. Control panel shall be fully automatic and shall provide for an alarm and LED lights in the event of any of the following:

    a. Presence of oil in the sump.
    b. High water level.
    c. High amps.
    d. Locked rotor.

7. Furnish additional contacts/relays for remote monitoring of high water alarm and oil presence alarm on facility automatic temperature control system. Coordinate with Division 23 Section, Instrumentation and Controls of HVAC and Plumbing Systems.
8. The control panel shall be wired in accordance with all applicable requirements of the National Electrical Code. Control wiring shall be sixteen (16) AWG red for control circuits and white for neutral grounded conductors. Power wiring shall be a minimum of 14 AWG black. Each conductor shall be numbered. The ends of all wires shall be tinned with 60/40 lead tin alloy sold. All wiring shall be performed in a neat and orderly manner.

2.18 OPEN HUB DRAIN

A. Furnish and install open hub drain valves with integral ball float valve as detailed on the Contract Drawings. Open hub drains shall be Josam model 67100A series, Zurn, Mifab, Watts, or approved equal.

B. Open hub drain shall be coated cast iron backwater valve, plastic ball float, elastomer seat,

bronze cage, and bottom outlet spigot connection. Size shall be as indicated on Contract Drawings.

C. Connect to stormwater system or as indicated on the Contract Drawings.

D. Insulate and jacket all piping/equipment to prevent condensation.

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. Coordinate with plumbing piping and related electrical work to achieve a complete operating system.

G. Install domestic water heaters in accordance with manufacturer's instructions.

H. Clean and flush domestic water heaters after installation. Seal until pipe connections are made.

I. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

J. All plumbing, vents in exterior walls shall be offset a minimum of 3'-0" in ceiling at roof before penetration.

K. All plumbing vents within a 10'-0" radius of exhaust vents shall be extended to a height of 3'-0" above exhaust vent crown.

L. 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.

M. 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.

N. 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.

O. Coordinate with Architectural Drawings before roughing in plumbing.

P. All openings in ceilings and plenum walls for plumbing shall be sealed air tight and protected with fire stop.

Q. See site plan for extent of all piping leaving and entering building.

R. See domestic water riser diagrams for location of valves, shock absorbers, balance valves, etc.

S. 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.

T. Cleanouts shall be provided near base of each vertical waste or solid stack. Provide 18" minimum clearance for access.

U. Domestic hot, cold, and HW recirculating water piping shall be installed between ceiling and roof insulation.

V. Unless otherwise noted, horizontal sanitary piping pitches shall be 1 percent.

W. Unless otherwise noted, all domestic water piping and fire protection piping shall be installed on heated side of ceiling insulation.

X. All piping and installation shall comply with all local and national plumbing codes. Test piping as required by plumbing code and authority having jurisdiction.

Y. For sizes of all domestic water piping see plumbing fixture schedule and domestic water riser diagrams.

Z. For sizes of all sanitary and vent piping see plumbing fixture schedule and sanitary/vent riser diagrams.

3.2 DOMESTIC WATER HEATER INSTALLATION REQUIREMENTS

A. Install units on concrete bases, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Anchor units to substrate.

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 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.

E. 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.

F. Install vacuum relief valves in cold water inlet piping.

G. 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.

H. 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.

I. Fill unit with water. Install domestic water expansion tank and charge with air. Install piping adjacent to units to allow service and maintenance.

J. Connect hot and cold water piping with shutoff valves and unions. Connect hot water circulating piping with shutoff valve, check valve, and union.

K. Make connections with dielectric fittings where piping is made of dissimilar metal.

L. Electrical Connections: Power wiring is specified in Division 26 Sections. Arrange wiring to allow unit servicing.

M. 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.

N. 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 120 deg F 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. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.

E. Install strainers on supply side of each control valve, pressure regulator, and where indicated.

F. Install hose bibbs with integral or field installed vacuum breaker.

G. Install wall hydrants with integral or field installed vacuum breaker.

H. All hose bibs shall be mounted 18" above finished floor, unless otherwise specified.

I. All wall hydrants shall be mounted 24" above finished grade unless otherwise specified.

J. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of one percent and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow. Install trap priming stations plumb and level with adequate access for servicing and maintenance.

K. For all trap primer pipes label the same as to the location of the floor drain served.

L. For floor drains located in toilet rooms and similar spaces where flush valves are utilized. Contractor may utilize trap primer line from flush valve tail piece.

M. Install backwater valves in building drain piping as indicated. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing. Fasten wall hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated. For exterior installation provide handhole with hinged cover and top mounted to be flush with grade.

N. Fasten recessed, wall mounting plumbing specialties to reinforcement built into walls.

O. Secure supplies to supports or substrate.

P. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve as appropriate is not indicated.

Q. Install water supply stop valves in accessible locations.

R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons if required to conceal protruding pipe fittings.

S. Include wood blocking reinforcement for recessed and wall mounting plumbing specialties.

T. Install ball valves at all shock absorbers to allow removal for service/replacement.

3.4 WATER METER INSTALLATION REQUIREMENTS

A. Install water meters, piping, and specialties according to AWWA M6 and Manufacturer's requirements.

1. Install displacement type water meters with shutoff valve on water meter inlet. Install valve on water meter outlet and valved bypass around meter, unless prohibited by authorities having jurisdiction.
2. Install compound type water meters with shutoff valves on water meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.
3. Install detector type water meters with shutoff valves on water meter inlet and outlet and on full size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers. Install roughing in piping and specialties for water meter installation according to utility's instructions and requirements.

B. Install power and control wiring from water meter to ATC system.

C. Field insulate and jacket water meter to prevent condensation.

D. Install power wiring to water meter and encoder/reader.

3.5 FITTINGS FOR FIXTURES SUPPLIED BY OTHERS

A. Fixtures such as built in sink in counters equipment are provided under other divisions of the specifications and are complete with strainer and tailpiece. Fittings, accessories and connection of these fixtures to the plumbing system are provided under this section.

B. Rough-in and final connection includes but is not limited to all domestic water, waste, and vent, and gas systems. Furnish stops, strainers, vacuum breakers, and under counter

insulation where not furnished under another Division of these specifications.

3.6 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.

3.7 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.

3.8 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.

3.9 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.

3.10 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.11 CLEANING

A. At completion, clean plumbing equipment.

3.12 ELEVATOR PIT SUMP PUMP INSTALLATION REQUIREMENTS

A. Provide access space around pump for service and motor replacement.

B. Install all float wiring and water level controls.

C. Install all interlock wiring from pump to oil minder control panel and automatic temperature control system.

D. Furnish and install removable galvanized steel grate to match pit sump opening size.

E. Provide factory start-up and training.

F. Test/Balance Engineer to test pump and all controls and submit results in the TAB report.

END OF SECTION

DIVISION 23 SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC
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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.	ABMA	-	American Boiler Manufacturers Association
D.	ACCA	-	Air Conditioning Contractors of America
E.	ADC		Air Diffusion Council
F.	AGA		American Gas Association
G.	AMCA		Air Movement and Control Association
H.	ANSI	-	American National Standards Institute
I.	ARI	-	Air Conditioning and Refrigeration Institute
J.	ASHRAE	-	American Society of Heating, Refrigerating and Air Conditioning Engineers
K.	ASME	-	American Society of Mechanical Engineers
L.	ASPE	-	American Society of Plumbing Engineers
M.	ASTM	-	American Society for Testing and Materials
N.	ASME CSD-1	-	American Society of Mechanical Engineers Controls and Safety Devices for Automatically Fired Boilers
O.	CS	-	Commercial Standard
P.	CSD		Control and Safety Devices

Q.	DNREC	-	Delaware Department of Natural Resources
R.	FM	-	Factory Mutual
S.	IBC	-	International Building Code
T.	IBR	-	Institute of Boiler and Radiator Manufacturers
U.	IEEE	-	Institute of Electrical and Electronics Engineers
V.	MSSP Industry	-	Manufacturers Standards Society of the Valve and Fittings
W.	NEC	-	National Electrical Code
X.	NEMA	-	National Electrical Manufacturers Association
Y.	NFPA	-	National Fire Protection Association
Z.	NSF	-	National Sanitation Foundation
AA.	SMACNA	-	Sheet Metal and Air Conditioning Contractors National Association
BB.	UL	-	Underwriters' Laboratories

CC. State of Delaware Fire Protection Regulations.

DD. 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 six (6) copies or more as required under General Conditions of complete descriptive data for all items. Data shall consist of specifications, data sheets, samples, capacity ratings, performance curves, operating characteristics, catalog cuts, dimensional drawings, wiring diagrams, installation instructions, and any other information necessary to indicate complete compliance with Contract Documents. Edit submittal data specifically for application to this project.

C. Thoroughly review and stamp all submittals to indicate compliance with contract requirements prior to submission. Coordinate installation requirements and any electrical requirements for equipment submitted. Contractor shall be responsible for correctness of

all submittals.

D. Submittals will be reviewed for general compliance with design concept in accordance with contract documents, but dimensions, quantities, or other details will not be verified.

E. Identify submittals, indicating intended application, location and service of submitted items. Refer to specification sections or paragraphs and drawings where applicable. Clearly indicate exact type, model number, style, size and special features of proposed item. Submittals of a general nature will not be acceptable. For substituted items, clearly list on the first page of the submittal all differences between the specified item and the proposed item. The contractor shall be responsible for corrective action and maintaining the specification requirements if differences have not been clearly indicated in the submittal.

F. Submit actual operating conditions or characteristics for all equipment where required capacities are indicated. Factory order forms showing only required capacities will not be acceptable. Call attention, in writing, to deviation from contract requirements.

G. Acceptance will not constitute waiver of contract requirements unless deviations are specifically indicated and clearly noted. Use only final or corrected submittals and data prior to fabrication and/or installation.

H. For any submittal requiring more than two (2) reviews by the Engineer (including those caused by a change in subcontractor or supplier) the Owner will withhold contractor's funds by a change order to the contract to cover the cost of additional reviews. One review is counted for each action including rejection or return of any reason.

I. For resubmissions, the Contractor must address in writing all of the Engineer’s comments on the original submission to verify compliance.

1.9 SHOP DRAWINGS

A. Prepare and submit shop drawings for all mechanical equipment, specially fabricated items, modifications to standard items, specially designed systems where detailed design is not shown on the contract drawings, or where the proposed installation differs from that shown on contract drawings.

B. Submit data and shop drawings including but not limited to the list below, in addition to provisions of the paragraph above. Identify all shop drawings by the name of the item and system and the applicable specification paragraph number and drawing number.

C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

D. Items and Systems

1. Access Doors/Panels including layouts and locations
2. Airflow Monitoring Stations

3. Air Distribution Systems
4. Air Separators
5. Automatic Air Vents
6. Automatic Temperature Control Systems and Equipment
7. Backwater Valves
8. Bare Finned Tube Radiation – Hot Water
9. Baseboard Radiation Pedestal Radiation - Hot Water
10. Boiler Accessories, Trim, Flow Switches
11. Boiler Breaching, Stacks, and Combustion Air Ducts
12. Boiler Burners
13. Boilers and Accessories
14. Carbon Dioxide Sensors
15. Central Control and Monitoring Systems (CCMS) and Equipment
16. Chemical Feed Tank
17. Condensate Neutralizers
18. Coordinated Drawings
19. Dewpoint Temperature Sensors
20. Differential Bypass Valves, Transmitters
21. Ductless Fan Coil Units
22. Drip Pans
23. Ducted ECM Blower Coil Fan Coil Units
24. Duct Materials
25. Electric Unit Heaters
26. Electric Radiant Heat Panels
27. Energy Recovery Ventilators
28. Equipment Rails
29. Expansion Loops
30. Expansion Tanks and Accessories
31. Exterior Equipment/Duct Supports
32. Exterior Pipe Supports
33. Fans
34. Freeze Protection Pumps
35. Filters
36. Filter Housings
37. Fire Stopping - Methods and Materials
38. Fire Dampers
39. Flow Measuring Stations
40. Flowmeter Fittings
41. Fluid Filter Housings/Filters
42. Grilles, Registers, Diffusers
43. Heat Pipes
44. Horizontal Electric Unit Heaters
45. Horizontal Hot Water Unit Heaters
46. Hydraulic Separator/Buffer Tank
47. Identification Systems
48. In-Line Circulators
49. Intake Hoods
50. Louvers and Insulated Blank-Off Panels
51. Make-Up Water Meters
52. Material and Equipment Lists

53. Operations and Maintenance Manuals
54. Pete's Plugs
55. Pipe Enclosures
56. Pipe Guides and Anchors
57. Pipe Materials Including Itemized Schedules
58. Preliminary Testing and Balancing Reports
59. Pressure Relief Valves
60. Pressure Regulating Valves
61. Pressure Independent Control Valves
62. Pumps
63. Refrigerant Mitigation Controls
64. Roof Curbs
65. Screen shots of ATC System Graphics
66. Sloped Top Cabinet Unit Heaters
67. Split System Heat Pumps, Ductless
68. Strainers
69. Test Certificates
70. Thermal Insulation Materials Include Table Summaries
71. Thermometers and Gauges
72. Unit Heaters
73. Variable Frequency Drive Motor Bearing Protective Rings
74. Variable Speed Drives
75. Venturi Flow Meters
76. Vertical In-Line Pumps
77. Vibration Isolation Materials
78. Water Treatment Services
79. Weatherproof Assembly Components
80. 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 20 year 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. Where any abandoned pipes in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned pipes as necessary to accommodate new work.

F. The location of all existing equipment, piping, ductwork, etc., indicated is approximate only and shall be checked and verified. Install all new mechanical/plumbing/fire protection work to connect to or clear existing work as applicable.

G. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the authorities having jurisdiction.

H. Make provisions and include in bid all costs associated with confined entry/space requirements and all other applicable and OSHA regulations.

I. Where required to maintain the existing systems in operation, temporarily backfeed existing systems from new equipment. Contractor shall temporarily extend existing piping systems to new piping systems with the appropriate shut-off valves.

J. At completion of project all temporary piping, valves, controls, etc., shall be removed in their entirely.

K. Existing piping, equipment, ductwork, materials, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

L. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.

M. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing refrigerants. Contractor shall include in his bid all cost associated with the evacuation, removal and disposal of all existing equipment containing refrigerants in accordance with EPA and Health Department requirements.

N. Where piping and/or ductwork is removed, remove all pipe or ductwork hangers which were supporting the removed piping or ductwork. Patch the remaining penetration voids with like materials and paint to match existing construction.

O. 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 underground pipe 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.

W. Where hydronic system piping and equipment is removed, Contractor shall be responsible for proper disposal of all contained fluids containing glycol (ethylene or propylene), hazardous waste and water treatment chemicals. Contractor shall include in his bid all associated costs with the removal, testing, and disposal of hydronic system fluid in accordance with EPA, Health Department, and the Local Authority Having Jurisdiction.

1.16 EXCAVATION AND BACKFILLING

A. General

1. Perform all necessary excavation, or installation of work under Division 23, in whatever materials or conditions encountered, using suitable methods and equipment.
2. Accurately establish required lines and grades and properly locate the work.
3. Determine the locations of all existing utilities before commencing the work.

B. Excavation: (Refer also to other portions of the specifications)

1. Excavate only the required elevations. If excavation is carried below the foundation lines or other required limits, backfill the excess with concrete.
2. Keep banks of trenches as nearly vertical as possible, and provide sheeting and/or shoring as required for protection of work and safety of personnel. Follow local, State, and OSHA Guidelines.
3. Keep excavations dry. Protect excavations from freezing.

C. Backfilling: (Refer also to other portions of the specifications)

1. Backfill excavations to the required elevations and restore surfaces to their original or required conditions.
2. Backfill shall be similar material, free from objectionable matter such as rubbish, roots, stumps, brush, rocks and other sharp objects. Unless otherwise indicated, suitable material from the excavation may be used for backfill.
3. Carefully place and mechanically tamp backfill in layers not exceeding 12 inches loose thickness. Compact to 95 percent minimum.
4. Do not backfill against frozen material. Do not use frozen material for backfill.

1.17 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, piping or ductwork to building structure. See Division 23 Section, “Vibration Control for HVAC, Plumbing and Fire Protection Equipment”.

1.19 ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

1.20 REFRIGERANT SYSTEM CAPS

A. For all exterior 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.

1.21 DEFINITIONS

A. Approve - to permit use of material, equipment or methods conditional upon compliance with contract documents requirements.

B. Furnish and install or provide means to supply, erect, install, and connect to complete for readiness for regular operation, the particular work referred to.

C. Contractor means the mechanical contractor and any of his subcontractors, vendors, suppliers, or fabricators.

D. Piping includes pipe, all fittings, valves, hangers, insulation, identification, and other accessories relative to such piping.

E. Ductwork includes duct material, fittings, hangers, insulation, sealant, identification and other accessories

F. Concealed means hidden from sight in chases, formed spaces, shafts, hung ceilings, or embedded in construction.

G. Exposed means not installed underground or concealed as defined above.

H. Invert Elevation means the elevation of the inside bottom of pipe.

I. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceiling, and unexcavated spaces.

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. ECM: Electronically Commutating Motor.

L. Building Line: Exterior wall of building.

1.22 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. Department of Energy (DOE) compliance: Pump manufacturers shall comply with US Department of Energy (DOE) energy conservation standard for "clean water pumps" 1-200 horse power, less than 459 feet of head and greater than 25 gpm. These pumps shall be evaluated using the Pump Energy Index (PEI) of equal to or lesser than 1.0. the PEI number shall appear on the pump name plate and shall be available for the record at http://er.pumps.org.

E. Where Energy Star certification exists for equipment utilized on this project, the equipment must be Energy Star certified. Provide Energy Star certification with submittals.

1.23 SYSTEM INTEGRATION

A. For all HVAC equipment specified to be provided with packaged controls and interfaced with the automatic temperature control system, provide system integration between the equipment manufacturer and the automatic temperature control subcontractor.

B. HVAC equipment submittals requiring system integration as defined above must identify all required system integration points.

C. HVAC equipment manufacturers must coordinate with ATC subcontractor regarding system integration prior to submitting on the equipment.

D. A system integration meeting must be arranged by the Mechanical Contractor and include, but not be limited to the systems integrator for the HVAC equipment manufacturer and the ATC Subcontractor. This portion of systems integration must occur prior to HVAC equipment being delivered to the project.

E. Once the HVAC equipment is on site, a second systems integration meeting must be arranged by the Mechanical Contractor to coordinate the packaged controls with the ATC system. The HVAC equipment manufacturer's representative familiar with system integration and the ATC subcontractor familiar with programming must be present.

F. A final system integrations meeting shall occur once all equipment is in place and ready for operation. The Mechanical Contractor, the HVAC equipment systems' integrator, and the ATC Subcontractor shall meet on site to jointly program, schedule, verify points, interlock devices, and fully set up all systems integration components.

G. All systems integration coordination, programming, and graphics must be completed prior to requesting commissioning and/or inspections by the Engineer of Record.

1.24 FUTURE ADDITIONS

A. Where future additions are indicated, size and install all piping to account for future additions. Furnish and install shut-off valves, flow meters, and balance valves in ceiling adjacent to future additions. Provide cap at the end of the piping. Arrange so that in the future the cap can be removed and shut-off valve opened to serve future addition without

draining system.

1.25 COORDINATION WITH DELAWARE TECHNICAL AND COMMUNITY COLLEGE I.T. DEPARTMENT

A. All equipment that interfaces with the internet shall be coordinated with the Delaware Technical and Community College I.T. Department to verify that the same is suitable for use on the Delaware Technical and Community College IT infrastructure. Coordinate with the Delaware Technical and Community College I.T. Department regarding the allowable frequency bands to avoid interference with the Delaware Technical and Community College I.T. infrastructure.

1.26 VFD BYPASSES

A. When VFD's are specified with integral bypasses and the equipment manufacturer is not able to provide bypasses due to equipment space constraints, then the manufacturer must provide spare VFD's for each fan/pump.

1.27 A2L REFRIGERANT REQUIREMENTS

A. All refrigerants utilized on this project shall be lower flammability and lower toxicity refrigerants as defined by ASHRAE Standard 34-Designation and Safety Classification of refrigerants. Per ASHRAE 34-2019, this project shall only utilize A2L refrigerants in HVAC equipment such as R-32 and R-454B.

B. Refrigerants classified as B-1, B2i, A2, B2, A3, and B3 shall not be utilized.

C. All scroll compressor products shall be manufactured in compliance with UL-60335-2-40.

D. All equipment including installations shall comply with ASHRAE 15-2022 requirements and International Mechanical Code requirements whichever is more stringent.

E. The installing contractor shall submit a declaration to the authority having jurisdiction that the refrigerant systems have been installed and tested per ASHRAE 15-2022.

F. Provide equipment with U.L listed refrigerant mitigation controls per ASHRAE 15-2022 requirements.

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, humidifiers air streams, and outdoors shall be totally enclosed weatherproof epoxy-treated type.

H. Nominal efficiency and power factor shall be as scheduled at full load and rated voltage when tested in accordance with IEEE 112.

I. Brake horsepower load requirement at specified duty shall not exceed 85 percent of nameplate horsepower times NEMA service factor for motors with 1.0 and 1.15 service factors.

J. All single phase motors shall be provided with thermal protection: Internal protection shall automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature ratings of motor insulation. Thermal protection device shall automatically reset when motor temperature returns to normal range, unless otherwise indicated.

K. Where a motor disconnect is indicated downstream of a variable frequency drive (VFD) provide interlock wiring from the auxiliary contacts on the disconnect to the VFD to de-energize when the disconnect is turned "off".

L. Where equipment under this Division is specified with integral disconnecting means, the same shall be a single disconnecting means for disconnecting all ungrounded main power supply conductors that is capable of being locked in the open ("off") position in accordance with the National Electrical Code and the local electrical inspector.

2.2 MOTORS AND CONTROLS

A. Motors and controls shall conform to the latest requirements of IEEE, NEMA, NFPA-70 and shall be UL listed. Motor sizes are specified with the driven equipment. Motor starting and control equipment is specified either with the motor which is controlled or in an electrical specification section. The Contractor is advised to consult all specification sections to determine responsibility for motors and controls.

B. Motors shall be designed, built and tested in accordance with the latest revision of NEMA Standard MG l.

C. Motors 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	89.5 percent	87 percent
7½ HP	91 percent	86 percent
10HP	91.7 percent	85 percent
15HP	93.0 percent	85 percent

MOTOR NAMEPLATE	MINIMUM PERCENT EFFICIENCY AT NOMINAL SPEED AND RATED LOAD	MINIMUM PERCENT POWER FACTOR
20HP	93.0 percent	86 percent
25HP	93.6 percent	85 percent
50HP and above	94.5 percent	88 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. For motors serving equipment being controlled by a variable speed drive, motor shall be premium efficiency inverter duty rated.

J. Motor frames shall be NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast-iron or aluminum with steel inserts.

K. Control of each motor shall be manual or automatic as specified for each in the various mechanical sections. In general, and unless otherwise specified for a particular item in the various mechanical sections of the specifications, motor starters and controls shall be specified and provided under the various electrical sections of these specifications.

L. Provide manufacturer's warranty for all motors for minimum of 5 years including all labor and materials.

2.3 MOTOR INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors to support shaft regardless of shaft position.

C. Check line voltage and phase and ensure agreement with nameplate. Check that proper thermal overloads have been installed prior to operating motors.

D. Use adjustable motor mounting bases for belt-driven motors.

E. Align pulleys and install belts.

F. Tension belts according to manufacturer's written instructions.

2.4 WIRING DIAGRAMS

A. The Contractor is responsible for obtaining and submitting wiring diagrams for all major items of equipment.

B. Wiring diagrams shall be provided with shop drawings for all equipment requiring electric power.

C. Provide wiring diagrams for all major mechanical items of equipment to electrical contractor and ATC subcontractor for coordination.

2.5 VARIABLE FREQUENCY DRIVE MOTOR BEARING PROTECTIVE RINGS

A. For all motors driven by a variable frequency PWM drive include a maintenance free, circumferential, conductive micro fiber shaft grounding ring to discharge shaft currents. Grounding rings shall be manufactured by AEGIS SGR or approved equal.

B. Furnish units with two (2) year warranty.

C. Size and select Bearing Protective Rings per the manufacturer requirements based on the motor size, shaft diameter, and shaft shoulder length. For motors with slingers furnish and install NEMA /IEC kit as required.

D. Furnish and apply Colloidal silver shaft coating to all shafts with Bearing Protective Rings to improve shaft voltage discharge capability.

2.6 ENCLOSURES

A. Electrical enclosures including factory provided enclosures, field provided and installed enclosures, and automatic temperature control system enclosures shall be as follows:

1. Dry Interior Locations: NEMA 1.
2. Damp/Wet Locations, Including Exterior Locations: NEMA 3R.
3. Corrosive Locations, Including Janitor’s Closets 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. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

G. Do not install equipment, ductwork, or piping over electrical gear, electrical panels, motor controllers, and similar electrical equipment. Install equipment, ductwork, and piping to maintain clear space above and in front of all electrical components per the National Electric Code.

3.2 SUPPORTS, HANGERS AND FOUNDATIONS

A. Provide supports, hangers, braces, attachments and foundations required for the work. Support and set the work in a thoroughly substantial and workman-like manner without placing strains on materials, equipment, or building structure, submit shop drawings for approval. Coordinate all work with the requirements of the structural division.

B. Supports, hangers, braces, and attachments shall be standard manufactured items or fabricated structural steel shapes. All interior hangers shall be galvanized or steel with rust inhibiting paint. For un-insulated copper piping provide copper hanger to prevent contact of dissimilar metals. All exterior hangers shall be constructed of stainless steel utilizing stainless steel rods, nuts, washers, bolts, etc.

C. Concrete housekeeping pads and foundations shall be not less than 4 inches high (6 inches high for boilers) 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, 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, Boiler Rooms, Penthouses, 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.

H. All HVAC piping/equipment strainers must be pulled and cleaned prior to substantial completion. In addition six (6) months after substantial completion all HVAC piping/equipment strainers must be pulled and cleaned a second time. Document and submit verification of strainer cleaning to Engineer, Owner, and Construction Manager.

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 six (6) copies of operating and maintenance instructions for all principal items of equipment furnished. This material shall be bound as a volume of the Record and Information Booklet as hereinafter specified.

E. All lines piping and ductwork installed under this contract shall be stenciled with direction of flow arrows and with stenciled letters naming each pipe and ductwork and service. Refer to Division 23 Section, “HVAC Piping, Fittings, Valves, Etc.” and Division 23 Section, “HVAC Air Distribution”. Color-code all direction of flow arrows and labels. In finished spaces omit labeling and direction of flow arrows. Paint in color as selected by Architect.

F. Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit samples of equipment identification cards, piping labels, ductwork labels, and valve tags to Engineer for review prior to installation.

G. Provide at least 8 hours of straight time instruction to the operating personnel. Time of instruction shall be designated by the Owner. Additional instruction time for the automatic temperature control (ATC) system is specified in Division 23 Section, "Instrumentation & Controls of HVAC & Plumbing Systems".

H. Contractor shall demonstrate Sequences of Operation of all equipment in presence of Owner's representative, Engineer, and ATC subcontractor.

3.11 WALL AND FLOOR PENETRATION

A. All penetrations of partitions, ceilings, roofs and floors by ducts, piping or conduit under Division 23 shall be sleeved, sealed, and caulked airtight for sound and air transfer control. Penetrations of mechanical room partitions, ceilings, and floors shall be as specified in Division 23 Section, "Vibration Control for HVAC, Plumbing and Fire Protection Equipment".

B. All penetration of fire rated assemblies shall be sleeved, sealed, caulked and protected to maintain the rating of the wall, roof, or floor. Fire Marshal approved U.L. assemblies shall be utilized. See Division 07 Section, "Fire Protection, HVAC & Plumbing Penetration Firestopping".

C. Where piping extends through exterior walls or below grade, provide waterproof pipe penetration seals, as specified in another division of these specifications.

D. Provide pipe escutcheons and duct flanges for sleeved pipes and ducts in finished areas.

E. Piping sleeves:

1. Galvanized steel pipe, standard weight where pipes are exposed and roofs and concrete and masonry walls. On exterior walls provide anchor flange welded to perimeter.
2. Twenty-two (22) gauge galvanized steel elsewhere.

F. Ductwork sleeves: 20 gauge galvanized steel.

G. Extend all floor sleeves through floor at least 3/4-inches above finished floor, caulk sleeve the entire depth and furnish and install floor plate.

H. 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 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.

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 six (6) hardcopies and one (1) electronic copy of the Operations and Maintenance Manuals and deliver these copies of the booklet to the Owner. The booklet shall be as specified herein. The booklet must be approved and will not be accepted as final until so stamped.

B. The booklet shall be bound in a three ring loose-leaf binder similar to National No. 3881 with the following title lettered on the front: Operations and Maintenance Manuals – Delaware Technical Community College – Owens Campus – Betze Library Renovations - 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 boiler breeching, variable frequency drives, air conditioning compressors, storage tanks, heat pumps.
5. Chart form indicating frequency and type of routine maintenance for all mechanical equipment. The chart shall also indicate model number of equipment, location and service.
6. Provide sales and authorized service representatives names, address, and phone numbers of all equipment and subcontractors.
7. Provide supplier and subcontractor’s names, address, and phone number.
8. Catalog data of all equipment, valves, etc. shall include wiring diagrams, parts list and assembly drawing.
9. Provide and install in locations as directed by the Owner, valve charts including valve tag number, valve type, valve model number, valve manufacturer, style, service and location. Each valve chart shall be enclosed in a durable polymer based frame with a cover safety glass.
10. Copy of the approved balancing report including duct leakage data.
11. ATC systems including as-built ATC drawings of systems including internal of all panels.
12. Access panel charts with index illustrating the location and purpose of access panels.
13. Approved HVAC Inspector, Boiler Inspector, and Electrical Inspector Certificates.
14. Start-up reports for equipment.
15. Water treatment test reports.

16. Provide and install in locations as directed by Owner, filter charts, including filter type, size, model number, manufacturer, quantity and size for each filter utilized on the project. Filter charts shall be enclosed in a durable polymer based frame with a cover safety glass.
17. Insert color graphic with embedded parameters for ATC system into record and information booklet.
18. Filter charts indicating equipment served, size, and type of filter required.
19. Documentation of strainer pulling and cleaning.
20. Base mounted pump shaft alignment test results.
21. Pipe Pressure 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 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
Heating and Chilled Water Supply & Return Piping, Including Chemical Treatment Piping	100 psig
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.

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 STRAINER CLEANING

A. All equipment strainers must be pulled and cleaned at substantial completion. Document in writing and via digital photographs that all strainers have been pulled and cleaned.

B. One year after project substantial completion all strainers shall be pulled again and cleaned. Document in writing and via digital photographs that all strainers were pulled and clean at

the one year after project substantial completion data.

C. Insert documentation that the strainers have been pulled and cleaned in the Record and Information Books.

D. Re-purge hydronic systems of all air after strainers are pulled and cleaned.

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 SECTION

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE: _____

END OUTAGE -- TIME: _____ DATE: _____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____

(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ NO ___ BY: _____ DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER : _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ NO: ____ NAME: _____

POINT OF CONTACT: _____ PHONE: _____

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.

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.

1. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.

E. 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.

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. Heating & Chilled Water Supply & Return Piping, Chemical Treatment Piping, (Inside of Building):
   a. Manufactures: Victaulic, Grinnell, or Sure-Joint.
   b. Pipe: Schedule 40 Black steel pipe, ASTM A53
      1-1/2 inch and smaller - Type F, ASTM A53 steel (CW) with threaded joints
      2 inch and larger - Grade B, Type E, ASTM A53 steel (ERW) with welded, flanged or grooved joints.
   c. Fittings & Joints: 2-1/2 inches & larger, schedule 40 wrought steel ASTM A234 Grade WPB or Std. B16.9 long radius welding; factory-fabricated from ASTM A53 pipe; or ASTM A536 ductile iron; 2 inches & smaller 125 lb. std. cast iron screwed, ASTM Standard B16.4; or Vic-Press precision, cold drawn, stainless steel with elastomer O-ring seals. Joints shall be threaded or AWS D1.1 welded. Victaulic, Appollo/Shurjoint, or approved equal grooved joints shall be acceptable.
   d. Flanges: Wrought steel Class 150 welding neck. ASTM Standard B16.5.
   e. Grooved Joint Couplings: Two ductile iron housings, pressure responsive elastomer gasket, and ASTM A449 zinc electroplated steel bolts and nuts. Couplings shall comply with ASTM F1476 Standard Specification for the Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
      i. Rigid Type: Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ASNI B31.1 and B31.9.
         1) Victaulic Style 107H, Apollo/Shurjoint Z-07, Installation-Ready or approved equal, for direct stab installation without field disassembly, with grade EHP gasket, suitable for water service to +250 degrees F.
      ii. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for the elimination of flexible connectors. Victaulic Installation-Ready Style 177 or Style 77, or approved equal.
      iii. 14” and Larger: AGS Series, two segment coupling with lead-in chamfer on housing key and wide width FlushSeal gasket. Victaulic Style W07 (rigid) and Style W77 (flexible), Apollo/Shurjoint 7707/7707N, or approved equal.
      iv. Flange adapters shall be suitable for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741/W741, Apollo/Shurjoint 7041, or approved equal.
      v. Rolled form grooves only. Cut grooves are prohibited.
      vi. Verify gasket compatibility on Chemical Treatment piping.

f. Gate Valves: 2-1/2 inches & larger - IBBM, 150 lb. OS&Y grooved end or flanged; 2 inches & smaller - 150 lb. Bronze body bronze trim. Basis of Design: Victaulic Series 771V or approved equal.
For valves 4 inch and larger located in mechanical equipment spaces 10 feet-0 inch or greater above finished floor, valve shall have chain wheel operators with chains extending to within 6 feet-0 inch above finished floor. Chain wheels and guides shall be galvanized.

g. Ball Valves: Shut-off valves 2 inches and smaller shall be ball valves. Ball valves shall be 600cwp, 150swp full port, with RPTFE seats, chrome plated ball and stem 2 ½ and larger, class 125 cast iron OS&Y IBBM gate valve, brass or bronze body, standard port, 2 piece body. Ball valves shall be VicPress end, threaded end or solder end as required to accommodate piping. Ball valves shall be as manufactured by Victaulic, Crane, Apollo, Nibco, Watts or engineer approved equal.

h. Globe Valves: 2-1/2 inches & larger – IBBM 125 lb.std. flanged, with No. 1 disc; 2 inches & smaller - bronze 150 lb. std. screw ends, with #1 disc.

i. Check Valves: 2-1/2 inches & larger – IBBM or stainless steel trim, 125 lb.std. grooved end or flanged spring-assisted swing check suitable for vertical or horizontal installation, with metal disc; 2 inch & smaller - 125 lb. std. screwed. Provide "silent" spring loaded check valves at all pump discharges. Victaulic Series 716/W715 or approved equal.

j. Balancing Valves: Victaulic Series 377/365, DeZurik Series 100, Fig. 118 or approved equal, ductile iron or cast iron construction, stainless steel bearings, nickel seats (3 inches and larger) non-lubricated, eccentric plug with EPDM, chlorobutyl rubber or Bunz-N resilient faced plugs suitable for 230 degrees F, semi-steel screwed with fig. 159, removable lever and open. nut for valves 3 inches and smaller. For valves 4-inch and larger, provide gear operators and grooved ends or flanged connections. Provide chain operated valves for sizes 4-inches and larger located 10 feet-0 inches or more above finished floor. Chains shall extend to within 6 inch-0 inches above finished floor. All valves shall have adjustable memory stop. Chain wheel and guide shall be galvanized.

k. Butterfly Valves: Victaulic Vic300 MasterSeal/ AGS-Vic300, DeZurik, Apollo 215L series, high performance, Milwaukee High Performance Valve, or Keystone K-Loc, type with infinite position lever (for 3-inches and smaller) and pressure-responsive seat or double seat type and memory stop. Provide gear operator on valves 4-inches and larger.
    i. Valve stem shall be stainless steel, and shall be offset from the disc centerline to provide complete 360 degree circumferential seating.
    ii. Valve shall be rated to +250 deg F in sizes through 12-inches.
    iii. Seat shall be elastomer, of a grade suitable for the intended service. The seat shall be pressure responsive in sizes through 12 inches.
    iv. For valves 4 inches and larger located 10 feet-0 inches or more above finished floor shall be provided with chain operators with chains extending to within 6 feet-0 inches above finished floor. Chain wheel and guide shall be galvanized.

l. Combination Shut-off/Balancing Valves:

Victaulic/ TA Hydronics, Taco Circuit Setter, Bell & Gossett Circuit Setter Plus, Flowset Accuset, Gerand, or as approved equal, 2-inch-3-inch 300 lb. rated Ametal (copper-alloy) body globe type or ball valve with 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.

m. 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.

n. Alternate:

i. At contractors option all HVAC water supply and return lines may be copper type L (ASTM Std. B88) with wrought copper fittings (ASTM Std. B 16.22) with brazed or 95-5 silver solder joints lead and antimony based solders are prohibited and all bronze valves may be used on piping 2 inches and less in size.

ii. At Contractors option, copper press fittings may be utilized as manufactured by Viega Pro Press/ Mega Press, Apollo Press/Apollo Power Press, or Mueller Streamline Co. Viega, ProPress, and Mueller Streamline Co. Pressure Seal Fittings: Bronze or copper shall conform to ASME B16.51, ICC LC 1002, and IAPMO PS 117. ProPress 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. ProPress fittings shall have an EPDM sealing element and Smart Connect (SC) feature. 2-1/2-inch thru 4-inch shall have a 420 stainless steel grip ring, PBT separator ring, EPDM sealing element and leak detection feature.

2. Refrigeration Piping:

a. Concealed: Tube Size ¾ -inch & Smaller:
ASTM B280, copper tube; Type ACR, soft annealed temper fittings; cast copper-alloy fittings for flared copper tubes; flared joints. Fittings shall be ASME B16.22, wrought copper. Joints shall be brazed, AWS A5.8, BCUP silver/phosphorous/copper alloy with melting range 1190 to 1480 degrees F.

b. Concealed: Tube Size 7/8 inch through 4-1/8inches:
Copper tube, Type ACR, soft annealed temper; wrought-copper, brazed-joint fittings; brazed joints.

c. Exposed: Tube Size ¾ Inch and Smaller:
Copper pipe, Type ASTM B88, Type K with brazed wrought-copper fittings conforming to ASME B16.22. Filler metal shall be brazing type conform to AWS A5.8.

d. Exposed: Tube Sizes 7/8 Inch and Larger:
Copper pipe, Type ASTM B88, Type K with brazed wrought-copper fittings conforming to ASME B16-22. Filler metal shall be brazing type conforming to AWS A5.8.

e. Brazed Joints: Braze joints using American Welding Society (AWS) classification BCuP-4 for brazing filler metal.

f. Flexible connectors: 500-psig (3450-kPa) minimum operating pressure; stainless-steel core and high-tensile stainless-steel-braid covering; dehydrated, pressure tested, minimum 7 inches (180 mm) long.

g. Diaphragm Packless Valves:
500-psig (3450-kPa) working pressure and 275 degrees Fahrenheit (135 degrees C) working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.

h. Packed-Angle Valves: 500-psig (3450-kPa) working pressure and 275 degrees Fahrenheit (135 degrees C) working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.

i. Check Valves: Smaller than NPS 1 (DN 25): 400-psig (2760-kPa) operating pressure and 285 degrees Fahrenheit (141 deg Celsius) operating temperature; cast-brass body, with removable piston, polytetrafluoroethylene seat, and stainless-steel spring; globe design. Valve shall be straight-through pattern, with brazed-end connections.

j. Check Valves: NPS 1 (DN 25) and Larger: 400-psig (2760-kPa) operating pressure and 285 degrees Fahrenheit (141 deg Celsius) operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained polytetrafluoroethylene seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.

k. Service Valves: 500-psig (3450-kPa) pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with brazed-end connections.

3. Cooling Coil A/C Condensate Drain and Floor Drain Piping that is Collecting A/C Condensate Piping:

a. Pipe & Fittings: All A/C condensate drain piping, including floor drain piping that is collecting A/C condensate, shall be constructed of Type L copper tubing, with sweat fittings made with 95-5 solder. Washout plugs (cleanouts) shall be strategically located to allow periodic flush out of system. At a minimum, provide washout plugs at equipment connections and at direction changes of 90 degrees F or greater. Also install cleanout at all equipment traps for cleaning and service.

b. Provide backwater valve (ball float type) at connections of condensate piping to stormwater piping and air gap fitting. Backwater valve shall be Model Z1099 as manufactured by Zurn or approved equal. Backwater valve shall have drain coated cast iron body, plastic ball float, bronze backwater bushing and replaceable neoprene seat.

c. Exterior condensate pipe penetrations must exit exterior wall above

flashing. Extend discharge away from exterior walls as detailed.

4. Gas Fired Condensing Boiler Condensate Piping
   a. Piping shall be PVC pipe, ASTM D1785 schedule 40 with ASTM D2466 socket fittings for schedule 40. Join PVC pipe/fittings utilizing solvent cement ASTM D2564 with ASTM F656 primer.

B. 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, 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	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

NOMINAL PIPE SIZE IN	STD. STEEL PIPE	MAXIMUM SPAN FT. COPPER TUBE	MINIMUM ROD DIAMETER INCHES OF ASTM A36 STEEL THREADED RODS
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.

D. Hangers for cold pipe sizes 2 inches (50 mm) and over: Carbon steel, adjustable, clevis.

E. Hangers for cold pipe sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.

F. Hangers for cold pipe sizes 6 inches (150 mm) and over: adjustable steel yoke, cast iron roll, double hanger.

G. Multiple or Trapeze hangers: Steel channels with welded spacers and hanger rods.

H. Multiple or Trapeze hangers for hot pipe sizes 6 inches (150 mm) and over: Steel channels with welded spacers and hanger rod, cast iron roll.

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 exterior pipe supports provide stainless steel, supports, brackets, hardware and anchors.

R. 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 base mounted pump discharges shall be of the vertical type and shall be Victaulic Series 716/ W715, Miller "non-slam" check valves, Apollo, Shurjoint SJ-900, Grinnell, or approved equal suitable for service intended. Check valves in circulator discharges shall be “non-slam” horizontal type.

C. Provide at each base mounted pump a suction diffuser of size and type shown on drawings. Units shall consist of a ductile cast iron angle type body with inlet vanes, magnetic insert, and blowdown connection tapped gauge post, 125 psi ANSI flange and a combination stainless steel diffuser strainer with 5/32 or 3/16-inch diameter opening for pump protection. Unit shall be equipped with a disposable fine 20-mesh stainless steel start up strainer which shall be removable after 30 days. Flow direction shall be from inside the strainer to outside for ease of service and cleaning. The body shall fit the pump and connecting pipe size. The unit shall be provided with a base support boss or an adjustable support foot to relieve piping strains from the pump suction. Suction diffuser shall be Victaulic 731 Series, Taco "SD" Series Catalog 300-4.1, Bell and Gossett Model FLG, Armstrong, Patterson, Apollo/Shurjoint 725F, or engineer approved equal.

D. Multi-purpose valve (non-slam check valve, throttling valve, shut-off valves and calibrated balancing valve) shall be provided at discharge side of constant speed pumps. 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, Patterson, 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.

E. Triple Duty Valve Assembly: Assembly shall consist of a Victaulic Master Seal, Apollo/Shurjoint SJ-900, Grinnell, or approved equal butterfly valve with memory stop and a Series 779 Venturi-Check, rated for water service to 230 degrees Fahrenheit (110 degrees Celsius) and pressures to 300 psig (2065-kPa).

F. Do not install multipurpose valves or balance valves on the discharge of variable speed pumps.

2.4 AUTOMATIC FLOW CONTROL VALVES

A. Automatic flow control valves shall be provided and installed where indicated. Units shall be factory set to maintain constant flow with plus or minus 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain and

be factory marked with the zone identification, valve number and flow rate. Valves shall be line size and shall be Model AC or WU as manufactured by Flow Design, Inc., Victaulic Series 76, Griswald Controls, Bell & Gossett, or approved equal.

B. Valves shall be selected for 2 - 32 psig flow range. Furnish valves with extended valve handle, stem extender, ball valve, flow regulator and unions. Where velocities are below 2 feet per second utilize 5-60 psig auto flow valves to avoid noise issues. 5-60 psig autoflow valves must be utilized where gpm is less than 2.0 gpm for ½ inch or ¾" autoflow valves.

C. Design:

1. The GPM for the automatic flow control valves shall be factory set and shall automatically limit the rate of flow to within 5% of the specified GPM over at least 95 percent of the control range.
2. For ½ -inch – 2-inches, the flow cartridge shall be removable from the Y-body housing without the use of special tools to provide access for regulator change-out, inspection and cleaning without breaking the main piping. (Access shall be similar to that provided for removal of a Y-strainer screen).
3. Pump Head Requirements: the permanent pressure loss added to the pump head shall not exceed seven feet.
4. Each valve shall have two P/T ports.
5. All automatic flow control devices shall be supplied by a single source and certified flow tests, witnessed by a professional engineer, shall be available.
6. Five-year product warranty and free first-year cartridge exchange, up to 10 percent.

D. Construction:

1. The internal wear surfaces of the valve cartridge shall be stainless steel.
2. The internal flow cartridge body shall have machined threads so the spring free height may be compensated for without the use of fixed shims. A crimped sheet metal design is not acceptable.
3. The internal flow cartridge shall be permanently marked with the GPM and spring range.
4. For ½-inch through 2-inch pipe sizes: An assembly shall consist of a brass Y-type body, integral brass-body ball valve and "O" ring type union; Flow Design Model AC or approved equal.
5. For 2½-inches and larger flanged connections: Ductile-iron body suitable for mounting wafer style between standard 150# or 300# flanges. The long flange bolts and nuts shall be provided with each control valve. Flow Design Model WS or approved equal.
6. All valves shall be factory leak tested at 100 psig air under water.

E. Minimum ratings:

1. ½-inch through 2-inch pipe size: 400 PSIG at 250 degrees Fahrenheit.
2. 2 ½ -inch through 14-inch pipe size: 600 PSIG at 250 degrees Fahrenheit.
3. 16-inch through 30 -inch pipe size: 250 PSIG at 250 degrees Fahrenheit.

F. Flow Verification

1. The differential pressure across the Automatic Flow Control Valve shall be measured for flow verification and to determine the amount of system over heading or under pumping.

2.5 STRAINERS

A. Strainers shall be of the basket or "Y" type and shall be heavy and durable, constructed of ductile iron to ASTM A536 or the 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 stainless steel or 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 Apollo 78-100/200 series or as approved equal.

D. Strainers shall be manufactured by Victaulic Style 732/W732, Watts, Mueller, Armstrong, Yarway, Spirax/Sarco, Apollo/Shurjoint 726, or as approved equal.

2.6 UNIONS, FLANGES, AND COUPLINGS

A. Unions in steel pipe 2-inches and smaller shall be malleable iron with brass inserted seats designed for a working pressure of 150 psig.

B. Unions in copper pipe 2-inches and smaller shall be sweat fittings with bronze seats designed for a working pressure of 125 psig.

C. 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.

2.7 MANUAL AIR VENTS

A. Manual air vents shall be similar to the hereinafter specified gauge valves. Provide 1/4-inch size on ¾-inch pipe and smaller, ½ -inch size on 1-inch pipe and larger. Install at all

high points of piping. Valves shall be Crane No. 88, or as approved equal, with threaded ends, bronze body, bronze or brass bonnet and bronze stem.

2.8 AUTOMATIC AIR VENTS

A. Provide at air separators, expansion tanks, hydraulic separator/buffer tanks and where shown on the drawings, float actuated non-modulating high capacity air vent to purge free air from the system and provide a positive shut-off at pressures up to 150 psig at a maximum temperature of 250 degrees Fahrenheit. The high capacity air vent shall prevent air from entering the system if the system pressure drops below atmospheric pressure. The air vent shall be pilot operated for intermittent purging of free air up to pressures of 2 psig during normal system operation and diaphragm operated for full capacity purging of free air at pressures between 2 and 150 psig. The high capacity air vent shall be constructed of cast iron and fitted with components of type 313 stainless steel, brass, EPDM and silicone rubber. Pipe discharge to closest floor drains with Type K copper tubing. The high capacity vent shall be Model 107 by Bell and Gossett, Model 13w by Spirax Sarco, Taco, Spirotherm Spirotop, or as approved equal.

2.9 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. Chilled water systems: 0 degrees F to 100 degrees Fahrenheit, 1 degrees Fahrenheit Division
2. Heating Water: 30 degrees Fahrenheit to 240 degrees Fahrenheit, 2 degrees Fahrenheit Division.

C. Provide heat conducting compound in wells.

2.10 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.

2.11 FLOW METER FITTINGS

A. Griswold or Bell & Gossett Venturi disturbed flow measurement quickset flow meter fittings shall be utilized for hydronic flow measurement. Units shall consist of a spun steel venturi welded into the pipe. Disturbed fluid shall be channeled through the throat of the venturi with a multi-point Piezo Ring. Accuracy shall be ± 1% PSID with no straight pipe run required.

2.12 PIPING SPECIALTIES

A. Furnish and install flexible pipe connections, as specified and/or shown on the drawings, at suction and discharge connections of all pumps, all vibrating equipment, and elsewhere as shown. Refer to Division 23 Section, Vibration Controls 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.

2.13 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.

2.14 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 hydraulic decoupler, 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.

2.15 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.

2.16 WATER PROOF PIPE PENETRATION SEALS

A. Provide and install waterproof pipe penetration seals at all pipes that enter the building below grade or through exterior wall.

B. Link seals are to be Metraflex Metraseals, Model MS, Linkseal, or approved equal, black

EPDM seal material, glass reinforced plastic pressure plates, zinc plated nuts and bolts, seals are to be resistant to sunlight and ozone, pressure rated to make a hydrostatic seal of up to 20 psig and up to 40 feet of head, temperature rated from –40 degrees F to 250 degrees Fahrenheit.

2.17 TEST PLUGS

A. Where indicated, furnish and install P/T plugs or Pete's Plugs as manufactured by IMAC Systems or approved equal.

B. Description: Nickel-plated, brass-body test plug in NPS 2 (DN15) fitting. Test plugs shall be as manufactured by Trerice, Watts, Natural Meter, Apollo Brass Test Plugs, or approved equal. Test-station fitting made for insertion in piping tee fitting.

C. Body: Length as required to extend beyond insulation. Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS ¼ (DN 8) or NPS ½ (DN15) as required, ASME B1.20.1 pipe thread.

E. Pressure Rating: 500 psig minimum.

F. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

G. Core Inserts: One or two self-sealing valves, suitable for inserting 1/8 inch OD probe from dial-type thermometer or pressure gage. Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

H. Core Insert: Self-sealing valve, suitable for inserting 1/8 inch OD probe from dial-type thermometer or pressure gage.

I. Core Material for Air, Water, Oil, and Gas: 20 to 300 degrees F chlorosulfonated polyethylene synthetic rubber.

J. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.

K. Pressure Gage and Thermometer Ranges: approximately two times the system's operating conditions.

L. Self-closing valves with caps and retaining straps.

2.18 FLO-CONTROL VALVES

A. Furnish and install flo-control valves as shown on contract drawings to prevent gravity circulation in forced hot water systems. Flo-control valves shall be Bell & Gossett flo-control valves, TACO flo checks, or approved equal.

B. Flo-control valves shall be suitable for installation in vertical or horizontal piping. Disc

shall be precision machined bronze. Valve seats shall be heavy wall brass. Flo-control valves shall be suitable for a maximum operating temperature of 275 degrees F and a maximum working pressure of 125 psig. Flow-control valves shall not be selected based on line size. Select flow-control valves at design flow rate to limit pressure drop to 6 Ft head.

C. Flo-control valves shall be constructed to allow cleaning without breaking pipe connections. Flo-control valves shall be installed with clearances from center line of valves to ceiling as required by manufacturer. Flo-control valves shall feature a manual open position for gravity circulation.

2.19 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. Harvel Plastics, Inc.
c. Spears Manufacturing Company.

2. Description: PVC or CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket end.

D. Plastic-to-Metal Transition Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Colonial Engineering, Inc.
b. NIBCO INC.
c. Spears Manufacturing Company.

2. Description: PVC or CPVC four-part union. Include brass threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

PART 3 - EXECUTION

3.1 GENERAL PIPING INSTALLATION REQUIREMENTS

A. All pipes shall be cut accurately to measurements established at the building, and shall be worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted. All pipes shall be so installed as to permit free expansion and contraction without causing damage. All horizontal mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. All open ends of pipe lines, equipment, etc., shall be properly capped or plugged during installation to keep dirt or other foreign material out of the system. All pipes shall be run parallel with the lines of the building and as close to walls, columns and ceilings as may be practical, with proper pitch. All piping shall be arranged so as not to interfere with removal of other equipment on devices not to block access to doors, windows, manholes, or other access openings. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment, coils, etc., and installed so that there will be no interference with the installation of the equipment, ducts, etc. All valves and specialties shall be placed to permit easy operation and access and all valves shall be regulated, packed and glands adjusted at the completion of the work before final acceptance. All piping shall be installed so as to avoid air or liquid pockets throughout the work. Ends of pipe shall be reamed so as to remove all burrs.

B. All piping shall be graded to convey entrained air to high points where automatic air vents shall be provided. The size of supply and return pipes for each piece of equipment shall in no case be smaller than the outlets in the equipment.

C. All piping shall be run to provide a minimum clearance of 2-inches between finished covering on such piping and all adjacent work. Group piping wherever practical at common elevations.

D. All valves, strainers, caps, and other fittings shall be readily accessible.

E. 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.

F. 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.

G. 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.

H. Cutoff valves shall be provided on each branch line from the mains on all heating/air conditioning lines.

I. Shut-off valves shall be installed at the inlet and outlet of each coil and piece of equipment to permit isolation for maintenance and repair. Units having multiple coils shall have separate valves for each coil.

J. Balancing valves shall be installed in all heating/air conditioning water branches and at all pumps, and where indicated on the drawings.

K. 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.

L. 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.

M. 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.

N. Approved expansion loops shall be provided to permit free expansion and contraction of all piping systems.

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. Due to the fact that we are connecting to the existing central chilled water plant piping systems all new and existing piping shall be cleaned, flushed, and purged of air. All new and existing strainers shall be pulled and cleaned. Document strainer cleaning with digital photographs and include in the Operation and Maintenance Manuals.

3.2 THERMOMETER AND PRESSURE GAGE INSTALLATION REQUIREMENTS.

A. Install thermometers 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 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 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

I. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.

J. Locate valves for easy access and provide separate support where necessary.

K. Install valves in horizontal piping with stem at or above the center of the pipe.

L. Install valves in a position to allow full stem movement.

M. For chain wheel operators, extend chains to 60 inches above finished floor elevation.

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.

O. Install flow control valves with clearances from center line of valve to ceiling to allow servicing as required by manufacturer.

3.4 AUTOFLOW CONTROL VALVE INSTALLATION

A. Install automatic flow control valves on the return lines of coils as indicated on the contract drawings. A balancing valve on supply side is not acceptable.

B. The standard ports and handles shall clear 1-inch thick insulation. Provide handle and port extensions for all insulation over 1-inch thick. Do not insulate flow control valves used on heating coils.

C. Install, on the supply side of coils, a Y-strainer (40 mesh, 2 GPM or less; 20 mesh, above 2 GPM) with brass blow down valve with ¾-inch hose-end connection with cap. Inline (basket) strainer is not acceptable.

D. Where installed in piping with a vapor barrier, field insulate valve body to prevent surface condensation.

3.5 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. 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. Install liquid indicators in liquid line leaving condenser, in liquid line leaving **[receiver]**, and on leaving side of liquid solenoid valves.

MM. Install strainers immediately upstream from each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.

NN. Install strainers in main liquid line where multiple expansion valves with integral strainers are used.

OO. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic

expansion valves and in liquid line to receiver.

PP. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

QQ. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.

1. Test refrigerant piping, specialties and receivers. 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.

RR. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

SS. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

TT. Adjust set-point temperature of the conditioned air or chilled-water controllers to the system design temperature.

UU. 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.

VV. Before installing copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

WW. Replace core of filter-dryer after system has been adjusted and design flow rates and pressures are established.

XX. 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.

3.6 PIPE JOINTS INSTALLATION REQUIREMENTS

A. Grooved Joints: Grooved joint shall be installed in accordance with the manufacturer's written recommendations. Grooved ends shall be clean and free from indentations, projections, or roll marks. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. (A distributor's representative is not considered qualified to conduct the training.)

B. 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.

C. 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.

D. Where copper piping joins steel piping, approved bronze adapters shall be used.

E. 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.

3.7 HANGERS, SUPPORTS, ANCHORS, GUIDES INSTALLATION REQUIREMENTS

A. General: All hangers shall be of an approved type arranged to maintain the required grading and pitching of lines to prevent vibration and to provide for expansion and contraction. Provide protection saddles between hangers and insulation on heating water insulated pipe. Saddles shall be Grinnells Figure 173/273 or approved equal. Provide approved spacers between saddles and pipe where flexible insulation is specified. Provide insulation protection shields for insulated piping without saddles. Shield shall be Grinnell Figure 167 or as approved equal.

B. Spacing: Regardless of spacing, hangers shall be provided at or near all changes in direction, both vertical and horizontal, for all piping.

C. Vertical Lines: Shall be supported at their bases, using either a suitable hanger placed in a horizontal line near the riser, or a base type fitting set on a pedestal, foundation or support. All vertical lines extending through more than one floor level shall be supported at each floor with a riser clamp. Riser clamp shall be Grinnell Co.'s Figure 261, or approved equal. All vertical drops to pump suction elbows shall be supported by floor posts.

D. Racks and Brackets: All horizontal piping on vertical walls shall be properly supported by suitable racks securely anchored into the wall construction. Where not practical to obtain ceiling anchorage, all piping near walls shall be supported by approved brackets securely anchored into the wall construction. Washer plates (Fib. 60, 60L) and other miscellaneous attachments, fasteners, etc., shall be Grinnell or as approved equal. All exterior hanger and bracket systems in their entirety shall be galvanized.

E. Pipe Hangers and supports shall be attached to the panel point at the top chord of bar joist or at a location approved by the structural engineer.

F. Select hangers and components for loads imposed. Secure rods with double nuts.

G. Support of horizontal piping shall allow for vertical adjustment after installation of piping.

H. Support overhead piping with clevis hangers.

I. Do not support all parallel piping from the same joist. Stagger all supports in accordance with the structural engineer's recommendations.

J. Install guides on piping adjoining expansion fittings and loops.

K. Attach guides to pipe and secure to building structure.

L. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

M. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

N. Construct concrete anchors of poured in place concrete of dimensions indicated and include embedded fasteners.

O. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.

P. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

Q. Refer to structural documents for appropriate connection/attachment materials to building.

3.8 AIR VENTING INSTALLATION REQUIREMENTS

A. The top of each hydronic water supply and return piping 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.

3.9 SWING CONNECTION INSTALLATION REQUIREMENTS

A. 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.

B. 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.

C. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

D. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

E. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.10 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

3.11 VALVE IDENTIFICATION REQUIREMENTS

A. All valves shall be tagged with a numbered tag.

B. The tags shall be made of 1-inch diameter brass tags fastened to the valve by means of brass chains. Numbers shall agree with valve numbers on diagrammatic herein before specified.

C. Provide a minimum of six (6) valve charts with valve numbers indicating valve type, size, manufacturer and service.

D. Additional valve charts shall be mounted behind glazed wooden frames and be hung in

each mechanical equipment room including each air handling unit mechanical equipment room. Additional copies shall be provided in each copy of the O&M manuals.

3.12 CLEANING PIPING AND EQUIPMENT

A. All chilled water, glycol, condensate, heating water, and HVAC systems shall be cleaned by filling with a solution of one (1) pound of trisodium phosphate to each 50 gallons of water and circulating this solution for a period of six (6) hours during which time the system shall reach operating temperature. The systems shall then be flushed with fresh water and refilled with fresh water and/or where indicated antifreeze solution and purged of all air.

B. New and existing piping systems shall be cleaned, flushed, and purged.

C. All glycol, condensate, chilled water, heating water, HVAC, piping system shall be flushed clean with fresh water. See Division 22 Sections, Plumbing Fixtures and Plumbing Equipment for domestic potable water cleaning and sterilization.

D. Any equipment, such as coils that have small tubing, shall be bypassed to prevent deposition of debris from the piping. Water balancing shall not be scheduled until the completion of the cleaning and treatment process.

E. All new and existing strainers shall be inspected and cleaned prior to testing and balancing. In addition, prior to substantial completion, contractor must inspect and clean all new and existing strainers.

F. Where new equipment is connected to existing piping systems, install temporary bypasses as required for flushing new equipment piping.

3.13 PRESSURE SEAL FITTING INSTALLATION REQUIREMENTS

A. Viega, ProPress Pressure Seal bronze 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 ½-inch thru 4-inch shall be installed according to the most current edition of the Viega installation guidelines, using appropriate sized rigid ProPress tools. Installers shall attend a Viega ProPress installation training class.

B. After ProPress 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 specification requirements, not to exceed 600 psi with water.

3.14 CLEANING/FLUSHING/PURGING PIPING AND EQUIPMENT

A. The Contractor shall submit a detailed written flushing plan including shop drawings depicting locations of temporary bypasses, strainers, vents, drains, isolation valves and temporary spool pieces for review and approval by the Engineer of Record.

B. All hot water and chilled water systems shall be cleaned by filling with a solution of one (1) pound of trisodium phosphate to each 50 gallons of water and circulating this solution for a period of five (5) days during which time the system shall reach operating temperature. The systems shall then be flushed with fresh water and refilled with fresh water and purged of all air.

C. Any equipment, such as coils that have small tubing, shall be bypassed to prevent deposition of debris from the piping. Water balancing shall not be scheduled until the completion of the cleaning and treatment process.

D. All strainers shall be inspected and cleaned prior to testing and balancing. In addition, prior to substantial completion, contractor must inspect and clean all strainers.

E. Flushing & Treatment:

1. The hot water and chilled water systems shall be thoroughly flushed and treated.
2. Flushing and Treatment shall be witnessed by representatives of the Mechanical Contractor, Chemical Treatment Contractor, Engineer of Record, and Owner.
3. The phasing layout and complexity of the piping system may require the system to be separately flushed in sections.

F. Chemical Water Treatment Contractor:

1. The Contractor shall submit to the Engineer of Record the Proposed Chemical Treatment Contractor Company information and Qualifications along with the proposed chemical cleaning, dispersant, & inhibitor brands and concentrations of the chemicals for review and approval.

G. Pumps:

1. Temporary Pump System:

a. The incorporation and use of temporary pump systems is recommended for the flushing & cleaning process. The Contractor shall size the temporary pump system to ensure a fluid velocity of 6 FPS through the largest pipe diameter in the system.
b. The Contractor shall submit documentation to the Engineer of Record for approval of the proposed temporary pump system. This shall include pump curves, flow meters to prove the required velocity, pressure gauges, connection details and temporary power requirements along with a written description and photos of the proposed temporary pump system.

2. Permanent Facility Pump Systems:

   a. In the event temporary pumps cannot be utilized for the flushing and cleaning process, the existing permanent facility pump systems may be used only with prior approval of the Engineer of Record. The Contractor shall submit documentation to the Engineer of Record for approval of the proposed use of the Permanent Facility pump system. This shall include verification that the permanent facility pump system is capable of achieving the required fluid velocity of 6 FPS through the largest pipe diameter in the system, pump curves, flow meters to prove the required velocity, pressure gauges, connection details and power requirements along with a written description and photos of the proposed Permanent Facility pump system.
   b. In exchange for the use of the permanent facility pump system, The Contractor shall engage the Pump Manufacturer at the end of the cleaning/flushing process to disassemble the pump bodies and fully inspect the condition of the impellers, seals, bearings, wear rings, and motors for any damage caused by the flushing process. The Pump Manufacturer shall provide a written report with documenting photos of the condition of the pump system to the Engineer of Record. The permanent facility pumps must be in new condition and unconditionally warranted for a period of 2 years from the date of Project Substantial Completion. In the event a pump or pumps fail and is proven to be a result of the cleaning/flushing process during the 2 year warranty period the Contractor shall provide an additional 2 year extended warranty from the date of repair/replacement on the failed pump system.

H. Bypasses, Vents, Drains, Strainers, Isolation Valves, Temporary Spool Pieces & Hoses:

The Contractor shall prepare the piping system to ensure equipment and fragile devices are protected from damage caused by the flushing process.

1. The Contractor shall isolate & bypass all major equipment, heat pumps, ERV units, make-up air units, coils, ancillary equipment, control valves, check valves, insertion type & inline flow meters and any other fragile device that may be damaged as a result of the cleaning/flushing process. The Contractor shall incorporate the use of Line Size temporary flanged / union spool pieces in locations where fragile devices were removed.
2. The Contractor shall install high point air vents and low point drains where required. The layout of the piping system may require additional secondary high point vents and low point drains to ensure the system can be fully vented and drained during the cleaning/flushing process. The Contractor shall depict on the Flushing procedure shop drawings all required and secondary vents & drains. Secondary vents and drains shall be at No additional costs to the Owner.
3. The Contractor shall provide and install strainers where required.

I. Flushing Operation:

1. Pre Flush - Bypass loops should be installed at all equipment components.

Strainers can be removed when a self-contained purge unit is used in conjunction with on board filtration. Flush ports should be identified along with the type of high pressure hose or piping that will be used to connect to the system. The water source should be identified and must be adequate to fill and make up water in a timely manner to the system during the flush process.

2. Clear Water Flush – Fill the piping system with clean potable water. The first flush is a clear- water flush intended to circulate water through the system and force loose debris to low point drains and the flush cart filtration system. This flush should be at minimum velocity throughout the system of 5 to 7 ft/sec. Filtration size shall be 25 micron.
3. Cleaning & Passivation - The second flush cycle is a combined flushing cycle where cleaning and passivation chemicals are introduced into the system to clean the oils and treat the inside wall of the piping system. This process will be monitored by the chemical treatment company to meet the chemical specifications of the water. The cleaning velocity should be between 3 to 5 ft/sec and the circulation time will be based on the chemical testing but will typically be up to 48 hours.
4. A circulation pump shall be sized to meet a fluid velocity of 6 FPS in the largest pipe main. Add by-pass piping for continuous circulation at each end where required.
5. The system shall be filled from the lowest available point; all vents and high point connections shall be open during this operation to allow the air in the system to vent off. Fill system with fresh water and circulate for 12-24 hours and flush to remove large sediment first.
6. Drain system from all lowest possible points and refill with fresh water.
7. Add a System Cleaner/Dispersant: Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products, similar to Bond - 8050 Closed System Cleaner, at a dosage of 15 gallons per 1000 gallons of system volume, and circulate for 24 hours.
8. All new installed equipment (such as water source heat pumps, HX's, expansion tanks, etc.) which are not to be subjected to chemical cleaning and flushing, shall be disconnected from the piping. Add by-pass loops at each branch pipe to ensure continuous circulation of flushing fluids. Circulating pump must run continuously during the entire cleaning and flushing procedure to assure proper cleaning.
9. Drain system from all of the lowest points until the pH is equal to fresh potable water make-up (< 8.0).
10. Circulate the system water again after flushing for 12 hours, then drain system again if water is still turbid.
11. If system water is clean at test valves on lower section of system proceed to step 13. If the system is still turbid fill circulate for another 12 hours and flush until it is clear.
12. Refill system with fresh water and add corrosion inhibitor, similar to Bond-5010 Molybdum, to system water to achieve the desired residual (50-150ppm).
13. The system must be tested after 2-3 weeks of operation to ensure the chemical residual is adequate and maintained.
14. Submit Piping System Flushing report of cleaning and flushing. Report is to include largest main, circulation pump sizing (flow and head), system volume (in gal), amount of cleaning agent added (in gal), flush start date and time and end date and time, amount of chemical added, water quality parameters and chemical residual after 2 week operation period.

15. Treatment – After cleaning and before adding chemical initial charge, system must be flushed to meet these minimum requirements:

    a. Conductivity no higher than 20 micromhos above domestic water level
    b. No foam
    c. Copper level less than 0.5 ppm
    d. Iron level less than 1.0 ppm
    e. pH 9.4 or less
    f. Less than 1 ppm phosphates (ortho-phosphate PO4)

16. Final Clear Water Flush – The system will be continuously flushed while discharging chemicals into the sanitary system as approved locally. As the existing or new treated water is being discharged a fresh water make-up source will be utilized to ensure air is not introduced into the system. Continue to drain the system while adding domestic water to dilute the treated water. The chemical treatment company will monitor the outgoing water composition and compare the composition with the incoming water. Flush with fresh water until the conductivity is reduced to that of the make-up water and iron level is 1.0 ppm or less the final system water should be approved by the chemical treatment company. Filtration should be 5 micron.
17. Final Chemical Fill – Once the chemical treatment company has determined the system has been brought back to the correct composition, the chemical treatment company will inject the final chemicals into the system. Once the system is filled with the final chemicals it is important that the water is not to be left stagnant.
18. Verify satisfactory completion of clean pipe and a final flushing and chemical treatment report should be signed by field personnel and submitted.
19. Treat and test hot water, chilled water, systems monthly for the entire 24 month warranty period.

END OF SECTION

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 THRUST RESTRAINTS

A. Adjustable spring thrust restraints, able to resist the thrust force with at least 25 percent unused capacity. The operating spring deflection shall be not less than 50 percent of the static deflection of the isolation supporting the machinery. The spring element shall be contained within a steel frame and designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of ¼" movement at start and stop. The assembly shall be furnished with one rod and angle bracket for attachment to both the equipment and ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on either side of the unit. Horizontal thrust restraints shall be type WB.

2.10 INERTIA BASES

A. Structural Bases: Vibration isolator manufacturer shall furnish integral structural steel bases. Bases shall be rectangular in shape for all equipment other than centrifugal refrigeration machines and pump bases which may be "T" or "L" shaped. Pump bases for split case pumps shall include supports for suction and discharge base ells. All perimeter members shall be beams with a minimum depth equal to 1/10th of the longest dimension of the base. Beam depth need not exceed 14" provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of one inch- bases shall be type WF.

B. Structural Rails: Vibration isolator manufacturer shall provide steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment. Inverted saddles shall be type ICS.

C. Concrete Bases: Vibration isolator manufacturer shall furnish rectangular structural beam or channel concrete forms for floating foundations. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth need

not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. In general, bases shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6". Forms shall include minimum concrete reinforcement consisting of half inch bars or angles welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom, or additional steel as is required by the structural conditions. Forms shall be furnished with steel members to hold anchor-bolt sleeves when the anchor bolts fall in concrete locations. Height saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Concrete shall be 3,000 psi concrete. Mass of concrete inertia bases shall be minimum of 2 times weight of isolated equipment. Bases shall be type K.

2.11 FLEXIBLE CONNECTORS FOR PIPING

A. General: Straight or elbow flexible connectors rated for temperatures, pressures, and fluids to be conveyed. Provide flexible connectors with the strength 4 times operating pressure at highest system operating temperature. Provide elbow flexible connectors with a permanently set angle.

B. Elastomeric Flexible Connectors: Flexible neoprene connectors shall be manufactured of multiple plys of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Connectors up to and including 1 ½ " diameter may have threaded ends. Connectors 2" and larger shall be manufactured with floating galvanized flanges recessed to lock the connector's raised face neoprene flanges. Hoses shall be installed on the equipment side of the shut-off valves. Connectors shall be rated a minimum of 150 psi at 220°F. Flanged equipment shall be directly connected to neoprene elbows in the size range 2 ½ " through 12" if the piping makes a 90o turn at the equipment. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. 12" and larger sizes operating above 100 psi shall employ control cables with end fittings isolated by means of ½ " thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.

C. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies.

D. Elbows shall be Mason-Flex type MFNEC, straight connectors Mason-Flex type MFTFU or MFTNC, and control cable assemblies type ACC.

E. Metal Flexible Connectors: Fabricated of Grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover. Sizes 3" and larger shall be flanged. Sizes 2 ½ " and smaller shall have male nipples. Lengths shall be as indicated:

Nominal Diameter (Inches)	Length (Inches)

½ "	12"
3/4"	12"
1 ½ "	12"
1 ½ "	12"
2"	12"
2 ½ "	12"
3"	18"
4"	18"
5"	24"
6"	24"
8"	24"
10"	24"
12"	36"
14"	36"
16"	36"

2.12 ACOUSTICAL FLOOR, CEILING AND WALL SEALS

A. Provide acoustical floor, ceiling and wall seals where piping passes through mechanical equipment room/fan room walls, floors or ceilings and any noise sensitive areas. The vibration isolator manufacturer shall provide a split seal consisting of two bolted pipe halves with 3/4" or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240oF, 10# density fiberglass shall be used in lieu of the sponge. Seals shall be type SAWS.

2.13 RISER SUPPORTS, ANCHORS AND GUIDES (ACOUSTICAL PIPE ANCHOR)

A. Vibration isolator manufacturer shall provide an all directional acoustical pipe anchor, consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material.

Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA.

2.14 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.

2.15 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. A minimum of 6" thick reinforced concrete housekeeping pads shall be provided under all boilers and where indicated. Rest subbases on structural floor and reinforce with steel rods interconnected with floor reinforcing bars by tie bars hooked at both ends. Provide at least one (1) inch clearance between subbases and inertia bases, steel bases, and steel saddles with machinery in operation.

D. All vibration isolators exposed to weather or humid environment shall be hot dipped galvanized with springs coated with neoprene in accordance with paragraph hereinbefore described.

E. Concrete inertia bases shall be a minimum of two (2) times the weight supported. Clearance between the underside of the inertia base and the housekeeping pad below shall not be less than 1 inch. Concrete shall be 3000 psi. Install inertia bases in accordance with the recommendations of the machinery manufacturer and the inertia base manufacturer.

F. Anchor Bolts and Grout: Secure machinery to foundations and inertia bases with anchor bolts. Grout equipment with baseplates, the full area under baseplates with premixed non-shrinking grout. After grout has set, remove wedges, shims, and jack bolts and fill spaces with grout.

G. Common Machinery Foundations: Mount electrical motors on the same foundations as driven machinery. Support piping connections, strainers, valves, and risers on the same foundation as the pumps.

H. Thrust Restraints: Where required, provide pairs of thrust restraints, symmetrically installed on both sides of the steady state line of thrust.

I. 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.

J. 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.

K. 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.

L. 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.

M. 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.

N. Roof and Upper Floor Mounted Machinery: On the roof or upper floors, mount machinery on isolators with vertical stops. Rest isolators on beams or structures designed and installed in accordance with the SMACNA ASMM Plate 61.

O. 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.

P. 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.

Q. 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.

R. Install in accordance with manufacturer's instructions.

S. Install isolation for motor driven equipment.

T. Bases:

1. Set steel bases for one inch (25mm) clearance between housekeeping pad and base.
2. Set concrete inertia bases for 2 inch (50mm) clearance between housekeeping pad and base.
3. Adjust equipment level.

U. Install spring hangers without binding.

V. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

W. 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.

X. Connect wiring to isolated equipment with flexible hanging loop.

3.2 PIPE ISOLATION

A. Horizontal Pipe Isolation:

1. Precompressed Suspension Spring Isolators:

a. For the first three pipe hangers in the main lines near the mechanical equipment provide precompressed suspension spring isolators. Floor supported piping shall rest on trained spring isolators. All precompressed suspension spring isolators hangers or the first three trained spring isolators mounts as noted above, will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1.5" deflection for pipe sizes up to and including 6" and 2.5" deflection thereafter. All other hangers and mounts will have a minimum steel spring deflection of 0.75". Hangers shall be located as close to the overhead supports as practical.

2. Combination Spring and Neoprene Suspension Hanger:

a. For horizontal runs in other than those hereinbefore specified provide suspension spring hangers (combination spring and neoprene) with .75" minimum steel spring deflection.
b. Chilled Water and Hot Water Piping:

i. For the first 20 feet of the branch connection of the main supply and return piping at each floor.
ii. For all piping over 2" diameter.

B. Floor-Supported Piping:

1. Floor supports for piping in equipment rooms and adjacent to isolated equipment shall use vibration isolators as described hereinbefore and selected to the guidelines of hangers.
2. The first three adjacent floor supports shall be the restrained spring type with a blocking feature that prevents load transfer to equipment flanges as the piping is filled and drained.
3. Where piping is subject to larger thermal movement a slide plate shall be installed on the top of the isolator. Slide plate shall be teflon, graphite or steel.
4. Provide a thermal barrier where neoprene products are installed directly beneath steam or hot water lines.

C. Pipe Risers: Provide pipe riser supports with bearing plates and two layers of ¼ " thick ribbed or waffled neoprene pad loaded to not more than 50 psi. Separate isolation pads with ¼ " steel plate. Weld pipe riser clamps at anchor points to the pipe and to pairs of vertical acoustical pipe anchor mountings which shall be rigidly fastened to the steel framing.

D. Supports at Base of Pipe Risers: Piping isolation supports at the base of risers shall be two layers of ½" thick heavy-duty neoprene pad separated by ¼ " thick steel plate. Use bearing plates sized to provide a pad loading of not more than 500 psi. Weld the stanchion between the pipe and isolation support to the pipe and weld or bolt to the isolation support. Bolt isolation support to the floor slab with resilient sleeves and washers. Where supplementary steel is required to support piping, provide a maximum deflection of 0.08 inches at the mid-span of this steel under the load. Rigidly support piping from the supplementary steel with the supplementary steel isolated from the building structure with isolators.

E. Pipe Anchors: Attach each end of the pipe anchor to an omni-directional pipe isolator which in turn shall be rigidly fastened to the steel framing or structural concrete. Provide a telescoping pipe isolator of two sizes of steel tubing separated by a minimum ½ " thick pad of heavy-duty neoprene or heavy-duty neoprene and canvas. Provide vertical restraints by similar material to prevent vertical travel in either direction. The load on the isolation material shall not exceed 500 psi.

3.3 BOILER, MECHANICAL, FAN AND EQUIPMENT ROOM SOUND ISOLATION

A. Do not allow direct contact between pipes or ducts and walls, floor slabs, roofs, ceilings or partitions of equipment rooms.

B. Pipe Penetrations: All piping passing through mechanical equipment room and fan room walls, floors and ceilings shall be protected against sound leakage by means of an acoustical wall seal as described hereinbefore and fire stopping.

C. Duct Penetrations: Provide with sound insulation equal to the sound attenuation value of

the wall, floor, or ceiling penetrated.

3.4 FLEXIBLE PIPE CONNECTORS

A. Provide flexible connectors in accordance with manufacturers instructions where piping systems serving vibration isolated equipment and as shown on the drawings. Flexible connectors shall be installed near the connection to the equipment. Where liquid pulsation dampening is required, flexible connectors with spherical configuration may be used. Provide restraints for pipe connectors at pumps to prevent connector failure upon pump start-up.

3.5 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. All base mounted pumps shall be mounted on concrete inertia bases supported on stable steel springs in series with ribbed neoprene pads selected for not less than 1.5 inch static deflection under full operating load. Mason Industries type SLF or as approved equal.
2. Floor support of the initial pipe elbows at the pump discharge and suction diffuser at the pump intake shall be made from the isolated inertia base, not from the equipment room floor. Mason Industries Type K or as approved equal.
3. 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.
4. Provide discharge and suction vibration isolaters at all in-line pumps.

C. Energy Recovery Ventilators:

1. All energy recovery ventilators shall be supported on stable steel springs in series with ribbed neoprene pads selected for not less than 2.0" deflection under full operating load. Mason Industries type SLF springs or as approved equal. Following the manufacturer's specific installation instructions for specific equipment is acceptable.

D. Fans:

1. Fans up to 22" wheel diameter shall be mounted stable steel springs in series with ribbed neoprene pads selected for not less than 1.0" static deflection (Mason Industries Type SLF or equivalent).
2. Fans with wheel diameters 24" and greater shall be mounted on unhoused stable steel springs in series with ribbed neoprene pads and structural rails selected for not less than 1.5" static deflection (Mason Industries Type SLF or equivalent and

structural rails Type ICS with thrust restraint provisions) and rails shall be Type ICS.

3. All fans suspended from the ceiling, joists or roof structure, including ventilation fans, and exhaust fans, shall be suspended using hangers incorporating steel springs in series with neoprene, selected for not less than 2.0" static deflection under full load (Mason Industries Type 30N or equivalent).

E. All horizontal, vertical, and recessed unit heaters and ducted/ductless fan coil units shall be suspended using hangers incorporating steel springs in series with neoprene selected for not less than 1" static deflection under full load (Mason Industries Type 30N or equivalent).

F. Conventional Ductless Units: Indoor ductless units shall be supported with rubber grommet type suspension isolators. Outdoor ductless units shall be supported on ribbed neoprene pads resting on roof curbs (roof application) as indicated on the contract drawings.

3.6 MANUFACTURER'S FIELD SERVICES

A. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

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 Flow Monitoring Stations
2. Coils (Air Temperatures, Fluid Temperatures, Fluid Pressure Drops, & Static Pressure Drops)
3. Diffusers, Registers and Grilles
4. Duct Smoke Detectors

5. Ductless Split System Units (Indoor and Outdoor units)
6. Energy Recovery Ventilator
7. Electric Radiant Heat Panels
8. Electric Unit Heaters
9. Exhaust Fans
10. Fans
11. Fan Coil Units
12. Fire Dampers
13. Finned Tube Radiator
14. Heat Recovery Systems
15. Heat Pipes
16. Intake Hoods
17. Pressure Independent Control Valves
18. Radiant Heat Panels
19. Refrigerant Mitigation Controls
20. Supply Fan AHU
21. Unit Heaters
22. Ventilation Fans
23. Zone Branch and Main Ducts

Hydronic Systems:

1. Autoflow Valves
2. Boilers
3. Chemical Feed Tank Flow Rates
4. Coils
5. Condensate Pumps
6. Condensate overflow safety switches
7. Differential Pressure Bypass Valves
8. Domestic Hot Water Heater Pumps
9. Domestic Re-circulating Systems and Water Heater
10. Elevator Pit Sump Pumps
11. Energy Recovery Ventilator
12. Existing Central Plant Secondary Chilled Water Pumps
13. Existing Equipment where indicated
14. Fan Coil Units
15. Flow Measuring Stations
16. Flow Meter Fittings
17. Flow Switches
18. Fluid Filter Housing Flow Rates
19. Freeze Protection Pumps
20. Hydronic Finned Tube Radiators
21. Hydraulic Separator/Buffer Tank
22. In-line Pumps
23. Minimum Flow Bypass Valves.
24. Pumps
25. System Mains and Branches
26. Thermostatic Mixing Valves
27. Unit Heaters

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 construction manager, mechanical contractor, temperature control contractor and suppliers of the HVAC equipment shall all cooperate with the balancing agency to provide all necessary data on the design and proper application of the system components.

D. For heat pumps, the manufacturer's start-up agency and Test and Balance Engineer shall assist each other with obtaining proper flow rates and refrigerant pressures.

1.11 INSTALLATION TOLERANCE

A. Unless otherwise indicated, all air devices shall be adjusted to within plus or minus 10 percent of design. All fans shall be adjusted to within plus or minus 5 percent of design. All pumps and Hydronic equipment shall be adjusted to within plus or minus 5 percent of design.

1.12 RESPONSIBILITIES OF THE TAB AGENCY

A. Liaison and Early Inspection. The following reviews, observations, and tests shall be performed by the TAB Agency:

1. Review the mechanical drawings and specifications for balanceability and provide commentary. Verify proper types and locations of all Test and Balance devices.
2. During construction, review all approved HVAC submittals such as control diagrams, air handling devices, hydronic devices, and other components that pertain to TAB work and balanceability. Assist the commissioning agent with all Functional Performance Testing.
3. Perform construction observations and submit a written report:

    a. On the ductwork prior to insulation and/or ceiling cover-up.
    b. On the piping prior to insulation and/or ceiling cover-up.

4. Witness duct pressure test as defined in the specifications, and submit a written report.
5. Perform a pre-balance site review, and submit a written report.
6. During the balancing process, abnormalities and malfunctions of equipment or components may be discovered by the TAB personnel. The Construction Inspector, Architect, Engineer, and Owner shall be advised in writing so that the condition(s) can be corrected by the Contractor. The written document need not be

formal, but shall be understandable and legible. The TAB Agency shall not instruct or direct the Contractor in any of the work, but will make reports to the appropriate parties.

B. Final Air Balance. When systems are complete and ready for operation, the TAB Agency will perform a final air balance for all air systems and record the results. The volume of air for the supply, return, exhaust, and outside air equipment and terminals will be tested and balanced within the tolerances of the AABC Standard, or as specified, whichever is more stringent. Air handling unit and fan volumes shall be adjusted by changing fan speed. Air distribution device volumes shall be adjusted using the duct dampers and not the grille face. Air distribution devices shall be balanced with air patterns as specified. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown. The general scope of balancing by the TAB Agency will include, but is not limited to, the following:

1. Filters: Check air filters and filter media. Balance systems with essentially clean filters and 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. In variable flow systems, adjust the air and water flow to design for all the above readings.
7. Zone Air Flow: Adjust each HVAC terminal unit and each air-handling unit for design CFM.
8. Outlet Air Flow: Adjust each supply diffuser, register and grille, and each exhaust inlet to within the tolerance per the AABC Standard.
9. Pitot Tube Traverses: For use in future troubleshooting by maintenance personnel, all main supply, return, outside air, and exhaust ducts shall have air velocity and volume measured and recorded by the Pitot tube traverse method shown in the AABC Standard. Locations of these traverse test stations shall be described on the sheet containing the data. All Pitot tube traverses shall be clearly identified on the outside of the duct insulation with the traverse identified and duct size. Submit half scale drawings showing the locations of all duct traverses.

C. Final Water Balance. When systems are complete and ready for operation, the TAB Agency will perform a final water balance for each hydronic HVAC system. The general scope of balancing by the TAB Agency will include, but not be limited to, the following:

1. Adjusted System Tests: Adjust balancing valves at each coil and heat exchanger

for design flow per the AABC Standard. Adjust balancing valves at pumps to obtain design water flow. Record pressure rise across pumps, and obtain GPM flow from the pump curve. Permanently mark the balanced position for each valve. If discharge valves on the pumps are used for balancing, record the head being restricted by the valves. Test and record autoflow valve differential pressures and adjust pump speed to optimize and minimize autflow differential pressure.

2. Temperature Readings: Read and record entering and leaving water temperature at each water coil, converter, heat rejection equipment and heat exchanger at design flow. Adjust as necessary to secure design operating conditions. Provide final readings at all thermometer well locations.
3. Pressure Readings: Water pressure shall be recorded at all gauge connections. Pressure readings at coils and pumps shall be related to coil and pump curves in terms of GPM flow and through flow measuring stations, where provided and installed, at each hydronic unit. The flow of water through all water coils shall be adjusted by balancing valves until the rated pressure drop across each coil is obtained and total water flow is verified by flow measuring station. For coils equipped with three-way valves, the rated pressure drop shall first be adjusted through the coils. The bypass valve shall then be adjusted on each coil until the pressure drop between supply and return connections is the same as with the flow through the coil.
4. Voltage and Amperage Readings: Read and record the final operating voltage and amperage for each pump motor.
5. Pump Speed: Measure and record RPM for each pump. Provide Controls Contractor with drive parameters for variable speed pumps.

D. Testing of Temperature Control Systems as applicable to the project.

1. Air Handling Units

a. Start each air handling unit; verify and document:
- Dampers modulate properly and in the correct sequence.
- Fan(s) VFD ramps to design speed or proper controlled speed.
- All coil valves operate in response to the controlled temperature.
- All interlocked fans and/or devices energize.
- All alarms and safeties are operational and will alarm or shut down the unit.
- All operating scenarios are tested; e.g.: economizer cycle, minimum/maximum airflows, outside airflows at unit minimum/maximum volume, and special sequences.
- All end switches and positioners are properly set.
- All pressure controllers respond to increases or decreases in system pressure.
- All temperature and pressure sensors are calibrated.
- Airflow monitors report the correct airflow and control devices respond correctly to a change in airflow; e.g.: outside air control.
- Reset control sequences operate in response to changes in system temperatures, flows, or pressures.
- Correct operation of fan sequences when multiple fans are installed.
- Emergency mode operation; e.g.: power outage, freeze protection.

b. Shut down each air handling unit; verify and document:
- Dampers respond properly (open, close, or modulate), and in the correct sequence.
- All fan systems ramp down and stop.
- Correct operation of fan sequences when multiple fans are installed.
- Emergency mode operation; e.g.: freeze protection.
- Interlocked devices turn off.
- System starts for setback temperature control.
- System starts on a temporary occupancy override.
- All coil valves go to their specified position.
- 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) VFD ramps to design speed or proper controlled speed.
- All alarms and safeties are operational and will alarm or shut down the fan.
- Dampers modulate properly and in the correct sequence.
- All interlocked fans and/or devices energize.
- All end switches and positioners are properly set.
- All pressure controllers respond to increases or decreases in system pressure.
- All temperature and pressure sensors are calibrated.
- Airflow monitors report the correct airflow and that control devices respond correctly to a change in airflow; e.g.: outside air control.
- Correct operation of fan sequences when multiple fans are installed.
- Emergency mode operation; e.g.: power outage, freeze protection.

b. Shut down each fan or fan system; verify and document:
- Dampers respond properly (open, close, or modulate) and in the correct sequence.
- All fan systems ramp down and stop.
- Correct operation of fan sequences when multiple fans are installed.
- 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:
- Valves modulate properly and in the correct sequence.
- Pump(s) VFD ramps to design speed or proper controlled speed.
- All isolation valves go to their “system on” position.
- All coil valves operate in response to the controlled temperature.
- All interlocked devices energize.
- All alarms and safeties are operational and will alarm or shut down the

system.

- All operating scenarios are tested; e.g.: minimum/maximum water flows, minimum/maximum pressure, and special sequences.
- All end switches and positioners are properly set.
- All pressure controllers respond to increases or decreases in system pressure.
- All temperature and pressure sensors are calibrated.
- Flow meters report the correct water flow and that control devices respond correctly to a change in water flow.
- Reset control sequences operate in response to changes in system temperatures, flows or pressures.
- Differential pressure across all autoflow valves, flow meters, PIC valves, coils, and equipment.
- Correct operation of pump and HVAC equipment sequences when multiples are installed.
- Emergency mode operation; e.g.: power outage, freeze protection.
- The controls have time delay strategy to avoid excessive cycling of pumps, and coils.
- Fluid filter housings and chemical feed tank pressure drops and flow rates.

b. Shut down hydronic systems; verify and document:

- Valves modulate properly and in the correct sequence.
- Pump(s) VFD ramps down to off position.
- All isolation valves go to their "system off" position.
- All coil valves go to their normal off position.
- All interlocked devices de-energize.
- All alarms and safeties remain operational.
- Correct shutdown of pump or HVAC equipment.
- Emergency mode operation: e.g., freeze operation.

4. Component Calibration

All temperature, airflow, fluid flow, pressure, and flow measuring components shall be measured and compared to the control system readout; verify and document:

- The air temperature sensors for each coil, heat exchanger. If the temperature is not reading within tolerance, the sensor will be reported to the control contractor for calibration.
- The room temperature, relative humidity, dewpoint temperature sensor, and $C0_2$ sensors. If the sensors are not reading within tolerance, the sensors shall be reported to the control contractor for calibration.
- The water temperature sensors for each coil, heat exchanger. If the temperature is not reading within tolerance, the sensors shall be reported to the control contractor for calibration.
- All air and water pressure sensor readouts. If the pressure is not reading within tolerance, the sensor shall be reported to the control

contractor for calibration.

- All flow measuring device readouts. If the flow readout is not recording within tolerance, the sensor shall be reported to the control contractor for calibration.

5. Point Verification

   - Point verification for the digital control system documents that every point is operational and the setpoint, flow, temperature, or pressure is reporting correctly to the graphic interface. Verify and document all points.

6. Dynamic Testing

   - Dynamic testing involves making a change of value at the sensor in order to observe the system's reaction and how it regains the original setpoint. Verify and document the system's response.

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. 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. Terminate all supply, return, outside air, exhaust air, relief air, ventilation air ducts, and pressure test them for leakage. Test pressure and leakage rate shall be as specified in Division 23 Section, HVAC Air Distribution System under Leakage Tests. Pressure testing shall be performed by mechanical contractor and witnessed by Test and Balance Engineer.
3. Ensure that all 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.
4. Verify that all supply - return - exhaust and transfer grilles; registers, and diffusers are installed, operational, and sealed tightly.
5. Ensure that air-handling systems, units, and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., are blanked and/or sealed to eliminate excessive bypass or leakage of air.
6. Ensure that all fans are operating and free of vibration. All fans and drives shall be checked for proper fan rotation and belt tension. Overload protection shall be of proper size and rating. A record of motor current and voltage shall be made to verify that the motors do not exceed nameplate rating. Record thermal overload ratings for all motors in the Test and Balance Report.
7. Make any necessary changes to the sheaves, belts, and dampers, as required by the balancing agency, at no additional cost to the owner.
8. Install clean filters.
9. Coils shall be clean with fins straightened, bearings shall be properly greased, belts shall be aligned and tightened, and the system shall be completely operational. The Contractor shall verify that all systems are operating within the design pressure limits of the piping and ductwork.
10. All 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.
11. All terminal units shall be installed and functional. Controls commissioning shall be complete.
12. For ductless 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 alignment and 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. Chemicals shall be added to closed systems to treat piping and inhibit corrosion. The system static pressure shall be adequate to completely fill the system without operating the pumps.
9. The operating parameters of the coils, pumps, and control devices shall be capable of obtaining design requirements.
10. 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 Automatic Temperature Control Contractor shall thoroughly check all controls, sensors, operators, and sequences before notifying the TAB Agency that the Energy Management System is operational. The Energy Management System Contractor shall provide technical support in the form of technicians and necessary computers to the TAB Agency for a complete check of those systems.
8. The Fire Alarm (FA) Contractor shall thoroughly check all detection devices, sequences, interlocks, and other components before notifying the TAB Agency that the system is operational, including the Fireman's Override Panel. The FA Contractor shall provide all documentation that identifies all fire and smoke detection devices, all smoke zones, and all alarm and event chart devices. The FA Contractor shall certify to the Contractor that the systems are totally operational prior to the start of TAB.

B. All control sequences, software, equipment, and components shall be started-up by a qualified technician. Start-up report shall be submitted to Engineer prior to the commencement of testing and balancing work. Testing and balancing shall not commence until start-up reports are completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

1.18 NOTIFICATION FOR TESTING AND BALANCING WORK TO BEGIN

A. The mechanical contractor shall notify the balancing agency in writing when all heating, ventilating, and air conditioning and plumbing systems are complete and ready for testing and balancing. The mechanical contractor shall attest that he has completed all items as herein described.

B. The following must be completed prior to start of system balancing:

1. All duct work and associated grilles/registers/diffusers installed and completed.
2. Piping systems completed, flushed and filled.
3. Equipment properly started by qualified personnel or start-up technicians.
4. Ceiling tiles installed.
5. Automation system (temperature controls) installed and completed for both air and water systems.
6. All equipment controlled in automatic (“Auto”) mode.
7. Access granted to the balancing contractor to the automation/controls system provided.

C. Mechanical Contractor shall notify the Construction Manager of the start date of this portion of the work.

1.19 DEFICIENCIES

A. Any deficiencies in the installation or performance of a system or component observed by the TAB agency shall be brought to the attention of the appropriate responsible person.

B. The work necessary to correct items on the deficiency listing shall be performed and verified by the affected Contractor before the TAB Agency returns to retest. Unresolved deficiencies shall be noted in the final report.

C. TAB Agency shall notify Construction Manager 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.

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. Test and Balance Engineer shall witness and record all leakage testing of ductwork. Leakage test data shall be included in final Test and Balance Reports.
15. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable air volume systems at maximum air flow rate, full cooling, and at minimum airflow rate, full heating.
16. Measure temperature conditions across outside air, return air, and exhaust dampers

to check leakage.

17. 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.
18. For all equipment specified with condensate overflow safety switches/floats test operation of such device and record results. Verify interlock with ATC system.
19. Outside air and exhaust/relief air measurements must be measured and submitted in all modes of operation including the following:

    a. Min Min Outside Air/Exhaust/Relief air mode (square footage outside air).
    b. Min Max Outside Air/Exhaust/Relief air mode (square footage and people outside air).
    c. Maximum outside air/exhaust/relief mode (full 100% economizer mode).

20. 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, balance valves heat exchangers and boilers 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 and verify proper operation of oil sensors at elevator pit sump pump and report results.
10. Test all A/C condensate pumps for proper operation.
11. Test condensate overflow safety switches.

E. Boilers:

1. Verify that boilers have been filled and started by others, and are in operation.
2. Current and Voltage - As applicable, test and record motor voltage and amperage, and compare data with the nameplate limits to ensure motor is not in or above the service factor.
3. Test and adjust water flow through water boilers.
4. Test and record temperature and pressure profiles of boilers.
5. Test flame failure alarms and low water cut-off alarms.
6. Test condensate block alarm.
7. Test Flow Switches.

F. Coils:

1. Tolerances - Test, adjust, and balance all hydronic coils within 5 percent of design requirements.
2. Verification - Verify the type, location, final pressure drop and GPM of each coil. This information shall be recorded on coil data sheets.

3.5 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. Where heat pump water heaters are specified, test in electric only mode, heat pump mode, and simultaneous mode.
2. Test and record outlet temperature of water heater at approximate design recovery.
3. Current and Voltage: As applicable, test and record voltage and amperage, compare data with nameplate limits to ensure water heater elements or burners do not exceed nameplate data.
4. Test discharge temperature and flow rate at all lavatory/counter sink mixing valves. Also measure time period for fixtures to obtain hot water.

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 water system procedures (here-in before specified) on the following hydronic systems.

1. Existing Campus secondary chilled water pumps.
2. For variable speed pumps, adjust existing differential pressure sensors serving existing campus secondary variable speed chilled water pumps as required and record setpoints in TAB report.
3. Refer to contract drawings for exact equipment.

3.7 FIRE AND SMOKE TESTING PROCEDURES

A. The TAB agency shall test fire damper to assure operation. It shall verify that an access door has been installed for each fire damper. For fire dampers, the TAB agency shall open the access door, disconnect the fusible link, and allow the damper to close. Operation should be smooth and the damper must close completely. The TAB agency shall then reset the damper. The TAB agency shall then reset the damper and observe its complete opening. Record results of tests within TAB report.

3.8 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.

3.9 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.
4. Test and calibrate all air flow monitoring stations for proper air flow.
5. Test and calibrate all differential pressure sensors. Record set point in Record and Information Books.

3.10 TEST AND BALANCE REPORTS

A. The test and balance report shall be complete with logs, data, and records as required herein. All logs, data, and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the balancing agency's certified test and balance engineer.

B. Six (6) hardcopies and one (1) electronic copy of the test and balance report are required and shall be submitted to the Engineer. If, in the opinion of the Engineer, test results or portions thereof are incomplete or inconclusive, repeat necessary portions of the work to the satisfaction of the Engineer.

C. The report shall contain the following general data in a format selected by the balancing agency:

1. Project Number
2. Contract Number
3. Project Title
4. Project Location
5. Project Architect
6. Project Mechanical Engineer
7. Test & Balance Agency
8. Test & Balance Engineer
9. Construction Manager
10. Mechanical Contractor
11. Commissioning Agent
12. Dates tests were performed
13. Certification
14. Duct Leakage Tests
15. Phone Numbers of all Individuals Listed Above

D. The test and balance report shall be recorded on report forms conforming to the recommended forms in the AABC National Standards.

E. The test and balance report shall include a table of contents with numbered pages.

3.11 TEST REPORT FORMS

A. Air Moving Equipment and Fan Test Forms - Submit fan curve showing design and operating points of operation. Also, record the following on each air-handling equipment

test form:

1. Manufacturer, model number, serial number, arrangement.
2. All design and manufacturer-rated data.
3. Total actual CFM by traverse if practical. If not practical, the sum of the outlets may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.
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. Boiler Test Forms - Record the following items on each chiller and boiler test form:

1. Manufacturer model number, serial numbers.
2. All design and manufacturer's rated data.
3. Service and location.
4. Actual pressure drop and related GPM primary side.
5. Actual pressure drop and related GPM, secondary side.
6. Primary side entering and leaving temperatures.
7. Secondary side entering and leaving temperatures.
8. Temperature control settings.
9. Electrical characteristics.
10. Test operation of flow switches.

D. Heating and Cooling-Coil Test Forms - Record the following items on each test form:

1. Manufacturer, location, service.
2. All design and manufacturer's rated data.

3. Rated and actual water pressure drop through each coil and related GPM.
4. Rated and actual static pressure drop across each coil.
5. Rated and actual entering and leaving water temperatures across each coil.
6. Wet-bulb and dry-bulb temperatures entering and leaving each cooling coil; dry-bulb temperatures entering and leaving each heating coil.
7. Air flow (Design and Actual).
8. For DX-coil, provide design and actual saturated suction temperature.
9. For DX-Coil, provide design and actual discharge pressures.

E. Airflow Monitoring Station Test Forms:

1. Identification /location.
2. Manufacturer.
3. Systems.
4. Size and Model Number.
5. Area.
6. Design Velocity.
7. Design Airflow.
8. Test Velocity.
9. Test Airflow.
10. Static Pressure Drop and Velocity Pressure.
11. Station Calibrated Setting.

F. Flow Measuring Station Test Forms:

1. Identification/location.
2. Manufacturer.
3. Size and Model Number.
4. Design and Actual Flow Rate.
5. Design and Actual Pressure Drop.
6. ATC flow rate versus field measured flow rate.

G. 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.

H. 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

I. 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.

J. 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.

K. Duct Leakage Test Forms:

1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable leakage duct capacity times leak factor.
6. Test apparatus.

    a. Blower.
    b. Orifice, tube size.
    c. Orifice size.
    d. Calibrated.

7. Test static pressure.
8. Test orifice differential pressure.
9. Leakage.

L. 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.

M. Ductless Unit Test Forms:

1. Manufacturer
2. Type, air conditioning, heat pump
3. Identification number
4. Location
5. All design and manufacturer's rated data.
6. Rated and actual entering and leaving dry bulb temperatures.
7. Rated and actual entering and leaving wet bulb temperatures.
8. Air flow (design and actual)
9. Provide actual saturated suction temperature.
10. Actual operating current, voltage and brake horsepower of each fan motor.
11. Final fan RPM.
12. Operation of refrigerant mitigation controls, fan interlock, refrigeration system shutdown, and refrigerant leak detection sensors.

N. Energy Recovery Ventilators Test Forms: Submit fan curve showing design and operating points of operation. Also, record the following on each air-handling equipment test form:

1. Manufacturer, model number, serial number, arrangement.
2. All design and manufacturer-rated data.
3. Total actual CFM by traverse if practical. If not practical, the sum of the outlets may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.
4. Suction and discharge static pressure of each fan, as applicable. Include pressure drops across coils, filters, energy wheels, and similar devices.
5. Outside-air, and exhaust air total CFM.
6. Actual operating current, voltage and brake horsepower of each fan motor.
7. Final RPM of each fan.
8. Fan and motor sheave manufacturer, model, size, number of grooves, bore, and center distance.
9. Belt size, quantity and make.
10. Total and external static pressure.
11. Rated and actual static pressure drop across each energy wheel, heat pipe, and coil.
12. Wet-bulb and dry-bulb temperatures entering and leaving each cooling coil, heat pipe and energy wheel. Dry-bulb temperatures entering and leaving each heating coil.
13. Rated and actual entering and leaving pressure at each hydronic coil.
14. Record carbon dioxide set points and actual readings for exhaust air stream at each

ERV and global CO2 sensor.

15. Record the supply fan and exhaust fan maximum hertz/speed and minimum hertz/speed. Provide measurements to ATC subcontractor for fan tracking control.
16. Test minimum air flow rate and maximum air flow rate. Submit amperage, air flow rates, RPM, hertz, and static pressure profile in all modes of operation.

O. Finned Tube (Bare Element and Pedestal) Test Forms - Record the following items on each test form:

1. Manufacturer, location, service.
2. All design and manufacturer's rated data.
3. Rated and actual water pressure drop through each piece of finned tube and related GPM.
4. Rated and actual entering and leaving water temperatures across each section of finned tube.
5. Entering and leaving air temperatures across each finned tube element.

P. Fan Coil Unit Data Test Forms:

1. Manufacturer.
2. Type.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Water Pressure drops (all coils).
8. Static pressure
9. Test amperage
10. Entering coil conditions (wet bulb and dry bulb).
11. Leaving coil conditions (wet bulb and dry bulb).
12. Water flow rates (all coils)
13. Test voltage.
14. Supply return and outside air flow rates.

Q. Elevator Sump Pump Test Forms:

1. Manufacturer, Model Number, and Serial Number.
2. Motor Horsepower – Design/Actual
3. Voltage/Phase/Hz/Amps
4. Verify ATC interlocks.
5. Test high water condition.

R. Air Cooled Ductless 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

S. Thermostatic Mixing Valve Test Forms

1. Manufacturer, Model Number, Series, Arrangement
2. All manufacturer data.
3. Verify all strainers are clean.
4. Leaving temperature actual and design.

T. 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. Record electrical characteristics

U. Condensate Over Flow Switches/Floats Test Forms

1. Manufacturer
2. Type
3. Location
4. Equipment shut down verification
5. ATC interlock verification

V. Electric Radiant Heat Panels 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.

W. Hydronic Unit Heater Test Forms:

1. Manufacturer.
2. Model/Serial #.
3. Location.
4. Design air flow rate and actual air flow rate.
5. Design entering/leaving water temperature and actual entering/leaving water temperature.

6. Design fluid pressure drop and actual fluid pressure drop.
7. Design heating capacity and actual heating capacity in BTU/hr.
8. Actual entering/leaving air temperature.

X. Fluid Filter Housing Test Forms:

1. Manufacturer.
2. Model Number.
3. Location.
4. Pressure in and out of unit in PSIG.
5. Flow rate in GPM as measured by venturi flow meter.
6. Autoflow valve differential pressure.

Y. Chemical Feed Tank (Bypass Feeder) Test Forms:

1. Manufacturer.
2. Model Number.
3. Location.
4. Pressure in and out of unit in PSIG.
5. Flow rate in GPM as measured by venturi flow meter.
6. Autoflow valve differential pressure.

END OF SECTION

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HEATING, VENTILATING, AND AIR CONDITIONING EQUIPMENT
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END OF SECTION 61

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 and pump 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 EXTRA MATERIALS

A. Provide one set of seals for each type and model of pump provided on the project.

B. Furnish a spare quantity of lime chips for each boiler condensate neutralizer.

C. Furnish spare sets of filter and bolts for all equipment.

1.9 SHORT CIRCUIT CURRENT RATINGS

A. Unless otherwise noted, all HVAC equipment shall include a nameplate that identifies the short circuit current rating (SCCR). Unless otherwise noted the SCCR rating for all HVAC equipment shall be a minimum of 65 KA.

1.10 PACKAGED EQUIPMENT BACNET CARDS

A. For all packaged units, furnish and install Bacnet cards for interface to the automatic temperature control system. Map over all Bacnet points and alarms and show on ATC system graphics. All alarms must be identified on ATC graphic.

PART 2 - PRODUCTS

2.1 CONVENTIONAL DUCTLESS SPLIT SYSTEM HEAT PUMP

A. The heat pump air conditioning system shall be a Mitsubishi Electric Series split type Sanyo, LG, Daikin, Samsung, or approved equal. The system to consist of a slim silhouette, compact wall mounted packaged evaporator section with matching Slim Line air cooled outdoor unit. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label. All wiring to be in accordance with the National Electrical Code (N.E.C.). The units shall be rated in accordance with ARI Standard 240 and bear the ARI label. A full charge of R32 or R454B for 50 feet of refrigerant tubing shall be provided in the condensing unit. A holding charge shall be provided in the evaporator. System SEER shall meet or exceed 1992 Federal Standards.

B. The units shall have a manufacturer's warranty for a period of one (1) year from date of installation. The compressor shall have a warranty of six (6) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of Mitsubishi Electronics America, Inc. This warranty does not include labor. Manufacturer shall have ten years experience in the U.S. market.

C. Capacity shall be as scheduled on the contract drawings.

D. The indoor unit shall be completely factory assembled and wired. The casing shall have a white finish. The evaporator fan shall be a high performance, forward curve line flow fan direct driven by a single motor. The fan shall be statically and dynamically balanced and run on permanently lubricated bearings. A manually adjustable change vane shall be provided. The vane shall have the ability to direct the air from horizontal to vertical. An adjustable guide vane shall be provided to manually change the air direction from lift to right. The evaporator coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phoscopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan with drain shall be provided under the coil. Split system heat pump manufacturer shall furnish condensate lift pumps for field installation within the indoor unit. Condensate pumps shall be complete with float switch sensor, alarm, reed switch, relay, contact, adapters, and detection block etc., for a completely operational system. Contractor shall mount, pipe, and wire condensate pump per split system heat pump manufacturer's recommendations. Condensate pump shall be model EE as manufactured by Sauermann or approved equal. The units' electrical power requirements shall be as scheduled on the contract drawings.

E. The outdoor unit shall be completely factory assembled, piped, and wired. The casing shall be fabricated of galvanized steel, bonderized and finished with baked enamel. The unit shall be furnished with a direct drive, propeller type fan arranged for horizontal discharge. The motor shall have inherent protection, be of the permanently lubricated type and resiliently mounted for quiet operation. The fan shall be provided with a raised guard to prevent contact with moving parts. The variable speed compressor shall be of the high performance rotary type with accumulator and internal thermal overloads. The variable speed compressor shall be mounted so as to avoid the transmission of vibration.

The refrigeration system shall have the capability to operate with a maximum height difference of 25 feet and overall refrigerant tubing length of 100 feet between indoor and outdoor sections without the need for line size changes, traps, or additional oil. Refrigerant flow from the condenser to be controlled by means of a capillary tube. The condenser coil shall be of nonferrous construction with smooth plate fins bonded to copper tubing. The coil shall be protected with an integral metal guard. The unit shall be controlled by the microprocessor located in the matching indoor unit. The unit electrical power requirements shall be as scheduled on the contract drawings. The outdoor heat pump unit shall be placed on vibration isolators and mounted on rooftop equipment rail or concrete pad as indicated. Inverter type compressor shall allow defrost without the need for auxiliary electric heat.

F. The control system shall consist of two (2) microprocessor section. One microprocessor section shall be factory wired and located within the indoor unit. It shall have the capability of sensing indoor coil temperature; receive and process commands from the hardwired remote controller; control the booster heater; and control the outdoor unit. The microprocessor within the wall mounted remote monitor and hardwired remote controller shall display set point; provide two (2) manually selected modes of cooling, normal and economy operation at 2 degrees above set point; provide manual heating selection; with set back operation of 4 degrees above set point for cooling and 4 degrees below set point for heating; and manual or automatic fan speed control. Automatic fan speed control shall be based upon the temperature difference between set point and room temperature maintaining lowest speed possible. The heating system shall be controlled so that only warm air is discharged whenever the indoor fan operates above the very low (VLO) speed. Heating shall be switched back to the heat pump only when the difference drops back to less than 3.6 degrees. The control voltage between the indoor unit and the outdoor unit shall be 12 volts D.C. The hardwired remote controller shall be wireless, using infrared line of sight for system control and shall include automatic ON/OFF timer; liquid crystal display; "I FEEL" control mode which adjusts temperature by tapping the button that describes the present condition "Too Cool", "Too Warm", or "OK". The optimum temperature set this way is memorized for immediate recall whenever the system is used again. The system shall be capable of automatic restart when power is restored after power interruption.

G. High condensate water safety shutdown: Each indoor unit’s detection unit shall be interlocked to alarm and stop the outdoor unit if a high condensate water level is sensed.

H. Refrigeration Mitigation Controls: Furnish units with listed refrigeration mitigation controls, fan interlocks, refrigeration system shutdown, and refrigeration leak detection equipment per ASHRAE 15 requirements.

I. Units shall provide low ambient cooling down to 0°F ambient temperature. Furnish with wind baffles.

J. Furnish units with filters and a spare filter with each unit.

2.2 HORIZONTAL ELECTRIC UNIT HEATERS

A. General: Provide horizontal electric unit heaters as indicated, of type and minimum

capacity as scheduled, and as specified herein.

B. Furnish and install Emerson-Chromalox type MUH, Trane, Qmark, Markel, Marcor, Indeeco, or approved equal horizontal unit heaters with heating and air delivery capacities as shown on the heating schedule. The cabinet shall be made of 18 gauge die formed, furniture grade steel. Individual adjustable louvers with 30 degree downward stops shall be furnished to provide desire control of discharge air. All metal surfaces of the casing shall be phosphate coated to resist corrosion and finished in a decorative two toned neutral grey-bronze brown baked enamel. Mounting brackets designed for either ceiling or wall swivel mounting shall be furnished. Heater to be of the draw-through air flow design to eliminate element hot spots and extend design life.

C. For safety, the electric heating bank shall consist of Chromalox or equal metal sheath heating elements. The elements shall have a copper clad steel sheath for strength and corrosion resistance and aluminum fins for faster heat transfer. Automatic reset thermal over-heat protection, shall be of the linear capillary type wired for instantaneous de-energizing in case of thermal overload. Heating bank to have protective air inlet louvers.

D. All heaters drawing in excess of 48 amperes shall be provided with factory installed subdivided circuits of 48 amps or less.

E. Motors shall be of the totally enclosed continuous heavy-duty all-angle operation equipped with built-in thermal overload protection.

F. Fans shall be aluminum, directly connected to fan motor, designed specifically for unit heater application.

G. Low voltage control transformers shall be provided allowing safer more precise temperature control. Temperature sensors shall be provided by ATC subcontractor including relays, as necessary to accomplish specified sequence.

H. Individual optional field installable control kits shall be provided with all models. All controls shall have pig tails and spade terminals for ease of wiring to centrally located terminal board. All heaters of 63 amperes or less shall be provided with power disconnect switches.

I. Furnish and install the following accessories for operation:

1. Wall/ceiling mounting bracket.
2. Field install temperature sensors with stainless steel wire guard.

J. All heaters shall be U.L. listed and meet the requirement of the National Electrical Code.

K. All units shall have built-in contactors and control circuit transformers to provide single source power connection. Built-in fuse blocks and factory supplied fuses shall be installed on all models. A wiring diagram and grounding LUG shall be included in each control compartment.

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. Sidewall Propeller Fans

1. Direct Drive
   a. Furnish and install direct driven propeller fans of the size, capacity, and electrical characteristics as shown on contract drawings.
   b. Sidewall fans shall be direct driven axial type.
   c. Propeller construction shall be of die-formed aluminum blades riveted to a steel hub. Hubs shall be securely attached to motor shafts with set screws.
   d. Motors shall be permanently lubricated, heavy-duty type carefully matched to the fan load and furnished of the specified voltage, phase and enclosure.
   e. The fan panel shall be steel construction with prepunched mounting holes, formed flanges and a deep spun venturi. All steel panels shall be coated with thermally fused polyester urethane to provide a lasting finish. Motor supports shall be heavy gauge welded wire, zinc plated. Four (4) neoprene vibration isolators shall be installed between the motor support and the motor mounts.
   f. The axial exhaust fans shall bear the AMCA certified rating seal for air performance.
   g. Fans shall be provided with OSHA safety guard. Supply fans shall be of the reverse flow configuration. Provide wall mount collars and 2-inch aluminum birdscreen with each fan as indicated on contract drawings. Motor operated dampers shall be provided by Mechanical Contractor and installed by ATC Contractor. Provide unit mounted solid state speed controller with each fan for balancing.
   h. Fans shall be model SDE for exhaust and SDS for supply as manufactured by Greenheck, ACME Engineering, Penn Ventilator, Cook, Twin City Fan and Blower or approved equal.

C. Power Roof Ventilators

1. Direct Drive

   a. Furnish and install direct driven power roof ventilators of the size, capacity, and electrical characteristics as shown on contract drawings.

b. Roof fans shall be centrifugal direct drive type.
c. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing and shroud shall be constructed of heavy gauge aluminum with a rigid internal support structure. The fan shroud shall have a rolled bead for added strength.
d. Motors shall be mounted out of the airstream on vibration isolators. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge containments. Motors shall be readily accessible for maintenance.
e. A disconnect switch shall be factory installed and wired from the fan motor to a junction box within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.
f. All fans shall bear the AMCA Certified Rating Seal for sound and air performance.
g. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.
h. Provide 12- inch high, fully insulated, aluminum roof curbs with each ventilator. Fan and roof curbs shall be provided by the same manufacturer.
i. Provide 2-inch aluminum birdscreen with each fan.
j. Motor operated dampers shall be provided by ATC subcontractor and installed by mechanical contractor. Provide unit mounted solid state speed controller with each fan for balancing.
k. Fans shall be model as manufactured by Greenheck Fan Corporation, ACME Engineering, Cook, Penn Ventilator, Twin City Fan and Blower or approved equal.

D. 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 a unit mounted solid state speed controller. Field install motor operated damper by ATC subcontractor.

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 HOT WATER CONDENSING BOILERS

A. General Description

1. Furnish and install as herein specified, shown or scheduled on the Contract Drawings, new Boiler/Burner units for water heating service and arranged for completely automatic operation firing on natural gas.
2. The boiler shall be a Lochinvar Model FIXL, Viessman, AO Smith, Raypack, Fulton, or approved equal, having a modulating input rating and shall be operated on (Natural Gas). The boiler shall be capable of full modulation firing down to scheduled minimum input rating. The boiler shall bear the ASME “H” stamp for 160 psi working pressure and shall be National Board listed. There shall be no banding material, bolts, gaskets, or “O” rings in the header configuration. The 316L stainless steel combustion chamber shall be designed to drain condensation to the bottom of the heat exchanger assembly. A built-in trap shall allow condensation to drain from the heat exchanger assembly. The complete heat exchanger assembly shall carry a ten (10) year limited warranty.
3. The boiler shall be certified and listed by C.S.A. International under the latest edition of the harmonized ANSI Z21.13 test standard for the U.S. and Canada. The boiler shall comply with the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard and the minimum efficiency requirements of the latest edition of the BTS2000 Standard. The boiler shall be certified for indoor installation. The boiler’s thermal efficiency shall be verified through third party testing by the Hydronics Institute Division of AHRI and listed in the AHRI Certification Directory.
4. Boiler/burner unit shall have been rated in accordance with Hydronics Institute Testing and Rating Standard for heating boilers, and shall be performance tested and listed by I.B.R. at +.10 inches water draft.The boiler, burner and installation shall meet all requirements of the State of Delaware Boiler Requirements, including ASME CSD-1, Amendments and Addenda, latest edition. The boiler and installation shall comply with all requirements of the local Boiler Inspector. Contractor must submit any deficiencies cited by the Boiler Inspector to the Engineer and Owner for review.
5. Boiler/burner unit(s) shall be as manufactured by Lockinvar, Viessmann, AO

Smith, Raypack, Fulton, or approved equal.

B. Boiler Construction/Installation

1. The boiler shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided. The burner shall be a premix design and constructed of high temperature stainless steel with a woven metal fiber outer covering to provide modulating firing rates. The boiler shall be supplied with a gas valved designed with negative pressure regulation and be equipped with a variable speed blower system, to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency. The boiler shall operate in a safe condition at a derated output with gas supply pressures as low as 4 inches of water column. The boiler shall be equipped with leveling legs.
2. The boiler shall utilize a 24 VAC control circuit and components. The control system shall have an electronic display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The boiler shall be equipped with; a temperature/pressure gauge, high limit temperature control certified to UL353, ASME certified pressure relief valve, outlet water temperature sensor, return water temperature sensor, a UL353 certified flue temperature sensor, outdoor air sensor, low water flow protection and built-in adjustable freeze protection.
3. The boiler shall feature the "Smart System" control with a Multi-Colored Graphic LCD display with Navigation Dial and Soft Keys for, password security, three loop temperature setpoints with individual outdoor air reset curves, pump delay with adjustable freeze protection, pump exercise, and USB PC port connection. The boiler shall have the capability to accept a 0-10 VDC input connection for BMS control of modulation or setpoint, enable disable of the boiler, variable system pump signal and a 0-10 VDC output of boiler modulation rate. The boiler shall have a built-in "Cascade" with sequencing options for "lead lag" or "efficiency optimized" modulation logic, with both capable of rotation while maintaining modulation of up to eight boilers without utilization of an external controller. Supply voltage shall be as scheduled on the Contract Drawings.
4. The boiler shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 42 data points for safety and operating control, i.e., Auxiliary Relay, Auxiliary Proving Switch, Alarm Contacts, Runtime Contacts, Manula Reset Low Water Cutoff, Flow Switch, High and Low Gas Pressure Switches, Tank Thermostat, Three Wall Thermostat/Zone Controls, System Supply Sensor, Outdoor Sensor, Building Management System Signal, Modbus Control Contacts and Cascade Control Circuit. A high voltage terminal strip shall be provided for supply voltage. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pumps, and the boiler pump.

    a. The boiler shall be installed and vented with a direct vent system. The flue shall be CPVC sealed vent material terminating with the manufacturers specified vent termination. A separate pipe shall supply

combustion air directly to the boiler from the outside. The air inlet pipe shall be PVC pipe. The air inlet must terminate on the roof top with the manufacturer's specified air inlet cap. The boiler's total combined air intake length shall not exceed 100 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 100 equivalent feet.

5. The boiler shall have an independent laboratory rating for Oxides of Nitrogen (NOx) of 20 ppm or less corrected to 3% O2. The manufacturer shall verify proper operation of the burner, all controls and the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
6. The boiler shall operate at altitudes up to 4,500 feet above sea level without additional parts or adjustments.
7. The boiler shall be suitable for use with polypropelene glycol, up to 50% concentration without contingencies.
8. The firing control system shall be Direct Spark Ignition with Electronic Supervision.
9. Optional Construction Codes:

    a. The boiler shall be constructed in accordance with Delaware Pressure Vessel Code, ASME Boiler Code, include CSD-1 with all amendments.

10. All boiler discharges shall be piped to floor drains. Blowdown valves shall be Brass, ball type and not less than one inch IPS and they shall discharge to a floor drain or away from the boiler as directed by the Engineer. Pipe ends shall be cut at a 45 Degree to prevent a cap or plug from being installed. All such discharge piping shall be supported by hangars or stand-offs to prevent the valve body from undue stress or strain. All boiler discharge piping shall be Type L copper piping.
11. Boiler drain valves shall be connected to the lowest water space available and shall be installed with pipe and fittings to connect the bottom blowoff full size to drain.
12. OS&Y stop valves shall be provided in the supply and return pipe connections to the boiler. Provisions shall be made for the expansion and contraction of the heating mains connected to the boiler by providing substantial anchorage at suitable points and assisted by the use of swing joints to allow the piping to expand and contact without imposing excessive forces on the boiler piping.
13. Supply and return piping connections and accessories up to first OS&Y gate valves shall be welded, flanged, or screwed.

C. Water Trim

1. Install a new A.S.M.E. schedule pressure relief valve set for 75 PSI: 3 ½ -inch diameter pressure/altitude gauge; high limit temperature control with manual reset; operating temperature controls; and a Hydrolevel safeguard #550 low water cut-off. A factory furnished (unit mounted) thermometer and pressure gauge shall be provided with each boiler.

D. Flame Safeguard

1. Burner shall be furnished with an electronic flame safeguard control and flame detector. The control shall be a Fireye Mircro M Flame Safeguard. Each type of

flame safeguard shall be furnished with a UV scanner. Furnish with dry contacts for interlock with ATC system.

E. Gas Burners

1. Furnish and install FM/Underwriters Labeled gas burner. The burner design, construction, components and installation shall meet all applicable code requirements.
2. Each burner shall be capable of burning natural gas, with a specific gravity of 0.60. Gas pressure applied to the burner gas train supply connection shall be a minimum of 7 In. W.C.
3. The burner shall be listed by Underwriters Laboratories and shall bear the appropriate U.L. label (in addition to the U.L. requirements, all equipment and installation procedures shall meet the requirements of FM codes, CSD-1, and the local Boiler Inspector). The burner shall be designed and constructed as an integrated combustion system package and shall be factory fire tested.
4. The U.L./F.M. gas valve train shall contain the following:

    a. Manual Shutoff cock.
    b. Main gas pressure regulator.
    c. Automatically operated main motorized gas valve with proof of closure interlock switch.
    d. Automatically operated auxiliary gas valve.
    e. Manual reset Low and High Gas Pressure switches.
    f. Manual leak test cock.
    g. U.L. listed leak test cock.
    h. Automatically operated main motorized gas valve with proof of closure shall carry a FM label.

5. All regulators and pressure relief valves shall be piped to the building exterior and terminated with a gooseneck and vermin screen as required in CSD-1.
6. A safety manual reset type limit control shall be provided to shut the burner down in the event of excessive temperature.
7. Modulation: Fully modulating as scheduled on the Contract Drawings.
8. For FM Modulation. Purge operation of the modulating motor shall provide electrical interlock at 60 percent air flow position of the burner damper and electrical interlock at the damper low fire start position before the ignition sequence can begin.
9. The burner electrical circuit shall contain a set of dry contacts for interlocking with ATC system if a flame failure, low water condition, or condensate blockage occurs. Coordinate requirements with ATC system.
10. The flame safeguard control system shall include Ultraviolet sensor for flame detection and provide fully automatic sequencing of prepurge and postpurge, blower motor, interrupted ignition system, and fuel/air flow components. Flame safeguard shall provide safety shutdown with manual reset on air flow failure. The flame safeguard control shall be Fireye Micro M Flame Safegaurd.
11. The burner shall be complete with an integral burner mounted control panel which shall house all required operating electrical components. All wiring within the combustion system shall be factory prewired to a terminal strip mounted within the control panel.

12. Appropriate electrical knockouts shall be provided on both sides of the panel to allow for necessary power and limit control wiring. The control panel shall be constructed of 16 gauge steel and shall be complete with a top switch and control section which shall be hinged to allow for full access to all panel mounted components. The control panel shall be painted in a color and finish identical to the burner being supplied.
13. The control panel shall include a control circuit transformer fused on both the primary and secondary windings - flame safeguard control as specified above - on-off switch - motor starters, relays, terminal blocks indicating lights, service switches, and power switches, and other electrical devices as required.

F. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Manual reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Hydro level 550 Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.
5. Primary gas safety controls: Labeled and listed by nationally recognized testing agency. Manual re-set type that requires intervention by operator or service technician ro re-set.

G. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

    a. Monitoring: On/off status, common trouble alarm low water level alarm.
    b. Control: On/off operation, hot water supply temperature set-point adjustment.
    c. Flame failure and low water condition alarms.

2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

H. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to nonfused disconnect switch and circuit breaker.

5. Provide each motor with overcurrent protection.

I. Additional Requirements:

1. High limit control.
2. Flow switch.
3. Burner mounting flange.
4. Inspection tappings (1 ½-inch, 3 per section).
5. Factory start-up including combustion analysis and, flue gas analysis report. (Submit to Engineer for approval - include in O&M Manual).
6. Furnish and install low water cut-offs that meet the requirements of A.S.M.E. Code CSD-1, latest edition. Low water cut-offs shall be probe type, Hydro Level Company Model 550 or approved equal . Low water cut-offs shall be fully testable with manual re-set. Manual re-set function shall not trip out due to power failures or bubbles. Provide low water cut-off with dry contacts for interfacing with ATC system. Install low water cut-off in a Model FOEM manifold fitting.
7. Control devices as required to perform sequence of operation including emergency shut-off switches, and central control and monitoring requirements.
8. Insurance certificate - Include in-shop drawings and O & M Manual.

2.5 BASE MOUNTED PUMPS - END SUCTION

A. Furnish and install base mounted centrifugal end suction pumps to circulate hydronic water to the various items of equipment throughout the building, associated with the HVAC system. Pumps shall have sizes and capacities as indicated on the drawings.

B. All pumps shall be suitable for the service and temperatures designated and shall conform to the following requirements. Each pump shall have a factory installed seal flushing line running from the seal area to the pump suction to insure removal of trapped air from the seal area, removal of sediment, and cooling of the seal to extend seal life. Provide and install Cuno five (5) micron filters in seal flushing lines. Provide two (2) sets of cartridges for each side - stream filter.

C. Pumps shall be cast iron bronze fitted and shall be suitable for up to 175 psi working pressure and up to 250 degrees F water temperature. Pumps shall have center-line discharge for positive venting and flanged bodies. Pumps shall incorporate a grease lubrication system and be so designed that the bearing assembly can be removed in one piece. A water slinger shall be provided between the mechanical seal and bearing areas. Pump shafts shall be stainless steel with a cupro-nickel sleeve, and be coupled to the motor shaft by a noiseless, non-metallic coupler with guard. Impellers shall be one piece cast bronze, dynamically balanced. Motors shall be 1750 rpm. For variable speed pumps, motors shall be inverter duty rated.

D. Pumps shall be designed so that they shall not overload at low heads and shall not develop excessive pressure under throttled flow conditions or overload motor anywhere on the operating curve. Operating performance curves shall be submitted for approval. Provide gauge tappings on each pump flange. Furnish dust caps at all oil fill tubes. Pump motors shall be non-overloading throughout the range of the curves.

E. When pumps are operated in parallel, pumps must be selected so as not to "run-out" to the end of the pump curve. Submit pump curves for parallel pump operation and single pump operation.

F. Units shall be provided with motors of not less than the horsepower indicated, suitable for the service and available electrical characteristics. Units shall be controlled as hereinafter specified. After installation and prior to operation, each pump shall be aligned. Motors shall be as specified hereinbefore.

G. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

H. Impeller: Bronze, fully enclosed, keyed to shaft.

I. Baseplate: Cast iron or fabricated steel with integral drain rim.

J. Pumps shall be primed and painted in baked enamel, rust resistant paint.

K. Electrical characteristics shall be as scheduled on the contract drawings. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA-70.

L. Pumps shall be FE series as manufactured by Taco, 2000 Series by Allis Chalmers, Aurora, Bell & Gossett, PACO, Armstrong, Patterson, or as approved equal.

2.6 IN-LINE CIRCULATING PUMPS

A. Furnish and install in-line circulating pumps as shown on the contract drawings. Pump and motor shall be equipped with sleeve bearings for quiet operation. Pumps shall be suitable for up to 175 psi working pressure and up to 300 degrees F water temperature as per ASA B16.1. Pump rating curves shall be the result of testing and rating in accordance with the procedures of the Hydraulic Institute.

B. Pump motors 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. Pumps shall incorporate a disc type lubrication system and be so designed that the bearing assembly can be removed in one piece. One bearing assembly shall be suitable for all sizes of the inline pumps furnished. Sump oil temperature may not exceed 180 degrees F when circulating 250 degrees F water with a 90 degree F ambient. Vent and drain openings at least 3 square inches in area and a water slinger shall be provided between the mechanical seal and bearing area. This water slinger shall be integral with shaft sleeve. All in-line circulating pumps shall be provided with all bronze construction when used in open system and shall be bronze fitted for closed system.

C. Provide gauge tappings on each pump flange.

D. Pump body shall be cast iron and pump shafts shall be alloy steel with cupro-nickel sleeve covering all wetted parts, and be coupled to the motor shaft by a noiseless non-metallic coupler. Impellers shall be one piece cast bronze, dynamically balanced. Pumps

shall have a two piece mechanical seal assembly easily replaceable without the use of special tools. Motors shall be resilient mounted, 1750 RPM, and require no external overload protection when used with single phase current.

E. Electrical characteristics shall be as scheduled on the contract drawings. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA-70.

F. In line pumps shall be Red Baron Series 110 in-line circulators or 1600 Series, as manufactured by Taco, Bell & Gossett, Thrush, Armstrong, Patterson, or as approved equal.

2.7 IN-LINE CLOSE COUPLED CIRCULATING PUMP

A. Furnish and install in-line closed coupled circulating pumps as shown on the contract drawings. Pump and motor shall be equipped with permanently lubricated bearings for quiet operation. Pumps shall be suitable for up to 150 psi working pressure and up to 225 degrees F water temperature as per ASA B16.1. Pump rating curves shall be the result of testing and rating in accordance with the procedures of the Hydraulic Institute.

B. The pumps shall be of the horizontal, permanently lubricated type, specifically designed and guaranteed for quiet operation.

C. Provide gauge tappings on each pump flange.

D. The pumps shall have a steel shaft supported by permanently lubricated, sealed precision ball bearings. The pumps are to be equipped with a water-tight seal to prevent leakage. Mechanical seal faces to be carbon on silicon carbide. The motor shall be non-overloading at any point on the pump performance curve.

E. The motor shall be of the drip-proof, sealed precision ball-bearing, quiet-operating construction. The permanent split-capacitor motor shall be equipped with thermal overload protection.

F. Pumps to be suitable for 0 degrees to 225 degrees F (107 degrees C) operating temperature at 150 psig (10 bar) working pressure.

G. Pumps shall be provided with all bronze construction when used in open systems and shall be bronze fitted for closed systems.

H. Electrical characteristics shall be as scheduled on the contract drawings. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA-70.

I. In line pumps shall be close coupled in-line circulators Model PL as manufactured by Bell & Gossett, Thrush, Armstrong, Taco, Patterson, or as approved equal.

2.8 VERTICAL IN-LINE PUMPS

A. Furnish and install vertical centrifugal in-line single stage pump(s), with capacities and characteristics as shown on the plans. Pumps shall be Taco Model VI, Bell and gossett, Thrush, Patterson, Armstrong or approved equal.

B. Pump volute or casing shall be constructed of class 35 cast iron. The pump shall be fitted with replaceable bronze wear rings, drilled and tapped for gauge ports at both the suction and discharge flanges and for drain port at the bottom of the casing. The pump shall be capable of being serviced without disturbing system piping. Pumps shall be bronze fitted for use in closed systems and all bronze construction in open systems.

C. The impeller shall be bronze and hydraulically balanced by either back vanes or back wear ring and balancing holes. The impeller shall be dynamically balanced and shall be fitted to the shaft with a key.

D. The pump shall be close coupled to a NEMA standard JM regreasble high efficiency motor. The pump shall incorporate a dry shaft design to prevent the circulating fluid from contacting the shaft. The shaft shall be covered with a replaceable bronze shaft sleeve. Motors shall be 1750 rpm. Pumps shall be designed so that they shall not overload at low heads and shall not develop excessive pressure under throttled flow conditions or overload motor anywhere on the pump curve.

E. When pumps are operated in parallel, pumps must be selected so as not to “run-out” to the end of the pump curve. Submit pump curves for parallel pump operation and single pump operation.

F. The pump shall have a factory installed seal flushing line running from the seal area to the pump suction to insure removal of trapped air from the seal area, removal of sediment and cooling of the seal to extend seal life. Provide and install Cuno 5 micron filters in seal flushing line.

G. The pump seal shall be EPT Ceramic rated to 250 degrees F. Pumps shall be finished in a baked enamel finish designed to resist rusting. Pumps shall be suitable for up to 175 psi working pressure and up to 250 degrees F water temperature. For pool applications the pump seal shall be Viton-carbon/Ceramic seal with extended flush line and cuno filter rated to 250 degrees F. Pumps shall be finished in a baked enamel finish designed to resist rusting. Pumps shall be suitable for up to 175 psi working pressure and up to 250 degrees F water temperature.

H. Electrical characteristics shall be as scheduled on the contract drawings. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA-70.

2.9 VARIABLE SPEED DRIVES

A. Provide variable speed drive controllers for Energy Recovery Units, Pumps, Equipment, as indicated on contract drawings. Drive shall be subject to the requirements of this section.

B. ERV variable speed drives shall be factory furnished by ERV unit manufacturer.

C. The adjustable frequency controller (AFC) shall convert three phase 60 Hertz utility power to adjustable voltage and frequency, three phase, AC power for stepless motor control from 5 percent to 110 percent of base speed.

D. The AFC shall be a voltage source type with a PWM output utilizing power transistor semi-conductors.

E. The AFC together with all options and modifications shall mount within a standard NEMA 1 enclosure or NEMA-4X for exterior installation suitable for continuous operation at ambient temperature of 0 to 40 degrees C. with relative humidity to 95 percent non-condensing. All high voltage components within enclosure shall be isolated with steel covers. The complete unit shall be UL approved and UL labeled.

F. Circuits shall provide DV/DT and DI/DT protection for semi-conductors. AFC shall be capable of starting into a rotating load without delay. Protective circuits shall cause instantaneous trip (IET) should any of the following faults occur:

1. Motor overload.
2. Shortcircuit.
3. Motor overtemperature fault.
4. Reverse phase.
5. 110 percent of controller maximum sine wave current rating is exceeded.
6. Output phase to phase and phase to ground short circuit condition.
7. High input line voltage.
8. Low input line voltage.
9. Loss of input phase.
10. External fault. This protective circuit shall permit, by means of the terminal strip, wiring of remote NC safety contacts such as high static, firestat, etc., to shut down the drive.

G. The following adjustments shall be available in the controller and retained in non-volatile memory:

1. Maximum frequency (15 to 400 Hz) factory set at 60 Hz.
2. Minimum frequency (3 to 60 Hz) factory set at 6 Hz.
3. Acceleration (.1 to 360 seconds) factory set at 20 seconds.
4. Deceleration (.1 to 360 seconds) factory set at 20 seconds.
5. Volts/Hertz ratio factory set for 460V at 60 Hz.
6. Voltage offset or boost factory set at 100 percent torque.
7. Current limit (50 percent to 110 percent sine wave current rating) factory set at 100 percent current.

H. The AFC shall have the following basic features:

1. Door-mounted operators controls consisting of a membrane command center which allows manual stop/start and speed control, local/remote indication and manual/or automatic speed control selection. In addition, the command center shall serve as a means to configure controller parameters such as min speed, max

speed, acceleration and deceleration times, Volts/Hz ratio, torque boost etc. Potentiometers shall not be allowed for these settings.

2. Main input disconnect to provide a positive disconnect between the controller and all phases of the incoming A-C line. This disconnect shall be mounted inside the controller enclosure and have through-the-door interlocking toggle with provisions for padlocking.
3. Electronic motor overload relay.
4. Automatic restart after power outage, drive fault or external fault, with drive in automatic mode. The circuit shall allow the user to select up to (10) restart attempts as well as the dwell time between attempts. The reset time between fault occurrences shall also be selectable. All settings shall be via the membrane command center.
5. Door-mounted LED display for digital indication of:

    a. Frequency output
    b. Voltage output
    c. Current output
    d. First fault indication
    e. Fan or Pump Speed (RPM)

6. Relay contacts for remote indication of drive fault and motor finning.
7. Three critical frequency avoidance bands, field programmable via the membrane command center. Each critical frequency avoidance band shall have a bandwidth adjustable via keypad entry of up to 10 Hz.
8. Three programmable preset speeds which shall force the AFC to a preset speed upon a user contract closure.
9. Isolated process follower to enable VFC to follow a 4-20 mA signal.
10. The AFC shall have the capability to ride through power dips up to 500 msec without a controller trip depending on load and operating condition.
11. Line reactor to minimize line surges, line notching, and voltage distortions. Line reactor shall be installed upstream of the drive.

I. Manual bypass-to-line with magnetic contactors to transfer motor from the variable frequency controller to full speed operation on utility supplied input power while the motor is at any speed. Two motor contactors, electrically interlocked shall be utilized, one contactor between the controller output and the motor and the other between the bypass power line and the motor, providing across-the-line starting.

J. Motor protection per National Electrical Code shall be provided in both the "controller" mode and the "bypass" mode by a motor overload relay. The 115 volt A-C relay control logic, allowing common start/stop commands in the "controller" mode and the "bypass" mode shall also be included within the enclosure.

K. The bypass shall include a door interlocked, main power input circuit breaker providing positive shutdown of all power to both the bypass circuitry and the VFC. The bypass circuit shall also include a second input disconnect to the VFC. This disconnect shall provide the ability to safely troubleshoot and test the controller, both energized and de-energized, while operating the bypass mode.

L. The VFC and all components shall be supplied within a single NEMA 1 enclosure, and

shall be U.L. Listed as a single unit. Furnish all components necessary to provide a minimum lead length between motor and drive of 400 ft. The VFC shall not generate damaging transistor pulses greater than the limits set by NEMA MG-1 at 400 Ft lead length.

M. The VFC manufacturer shall maintain and staff nationwide service centers. These service engineers shall be employed by the manufacturer and provide start-up service including physical inspection of drive and connecting wiring and final adjustments to meet specified performance requirements.

N. The VFC shall carry a full parts and labor warranty for two years from date of substantial completion.

O. The variable speed drive shall be ABB, or approved equal of Accutrol, Cutler Hammer, Graham, York, Baldor, AC Tech, Trane, Emerson, Danfos, Yaskawa, Toshiba, or as approved equal.

P. The variable speed drive manufacturer shall coordinate with the ATC contractor and provide all necessary devices whether optional or not to perform complete and automatic operation as described in the sequence of operation. All safeties, including freezestats, duct smoke detectors, and high static pressure sensors shall be enabled when variable speed drives are in manual or bypass.

Q. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

1. Network Communications Ports: Ethernet and RS-422/485.
2. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet; protocols accessible via the communications ports.

R. Variable speed drives shall be carefully selected for the duty required. Variable speed drives shall be specifically designed for the specified equipment to be controlled. Pump drives shall be selected for pumps and fan drives shall be selected for fans.

2.10 COMBINATION COALESCING AIR AND DIRT SEPARATOR

A. Furnish and install as shown on the drawings a Spirotherm steel, Taco Series 4900, Caleffi , Armstrong, Wessels, or approved equal air elimination and dirt separator. All fittings shall be fabricated steel, rated for 150 psig design pressure and selected for less than 1 foot of water pressure drop and velocity not to exceed 4 feet per second through the unit at specified GPM. All units shall include an integral copper bundle of Spirotubes or approved equal, to act as the turbulence suppressive coalescing medium which must completely fill the fitting's internal area. Units are to remove free and entrained air during system start up and continue to eliminate dissolved air and dirt through continual circulation and the coalescing action of the Spirotubes. Each fitting is to have a separate air and venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral float

actuated brass air vent. There shall be no restriction in the connection from the venting chamber to the vent. The fittings are to include a valve side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill. Units shall include a bottom connection for use as a blow down connection for periodic cleaning. Unit shall have the bottom of the vessel extended for dirt separation with the system connection nozzles equal distant from the top and bottom of the vessel. Air separator shall be primed and finished in rust resistant paint. Units shall be Spirovent dirt models of the size required to meet pressure drop and velocity criteria.

B. A blowdown connection and valve shall be provided to facilitate routine cleaning of the strainer and the separator. Unit shall include a removable lower head to facilitate removal of the tube assembly for cleaning.

C. A manufacturer's data report for pressure vessels, for U-1 as required by the provisions of ASME Boiler and Pressure Vessel code, shall be furnished for each air separator upon request. Manufacturer to furnish data sheet specifying air collection efficiency and pressure drop at rated flow.

D. Conventional tangential or centrifugal non-coalesing air separators shall not be acceptable.

2.11 EXPANSION TANKS

A. Furnish and install as shown on the drawings, pre-pressurized captive air bladder type expansion tank pre-charged with air. Tank shall be suitable for a maximum working pressure of 125 psi and constructed and certified to ASME Section VII. It shall have a replaceable elastomeric bladder suitable for a maximum operating temperature of 240 degrees F (115 degrees C). Expansion tanks shall be primed and finished in rust resistant paint. It shall have an integral steel base ring for vertical mounting and saddle for horizontal mounting. Expansion tank shall be as manufactured by Taco, Bell & Gossett, Wessels, Amtrol, Armstrong or as approved equal.

2.12. HYDRAULIC SEPARATOR/BUFFER TANK

A. Provide and install a heating water combination hydraulic separator/buffer tank for use with boilers of the size, dimensions, and capacity as indicated on the contract drawings/schedules. Tank shall be as manufactured by Lochinvar (Model BVU), Cemline, or approved equal.

B. The hydraulic separator/buffer tank shall be constructed in accordance with ASME Boiler and Pressure Vessel Code Section VIII Div. 1, Part U requirements, stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. The tank shall be furnished with flanged source (boiler) system connections and flanged load connections for system supply and return. Tank size, piping tapping size and piping tapping quantity shall be as scheduled on contract drawings. Provide relief valve tapping, drain pipe tapping and temperature sensor tappings as scheduled on contract drawings. The tank shall be constructed with a built-in air separator with automatic air vent. Provide 12x16 manway for tank.

C. The hydraulic separator/buffer tank shall have a working pressure of 125 PSI (at 400 degrees Fahrenheit) and shall be channel iron skid mounted with lifting lugs. The hydraulic separator/buffer tank shall carry a five-year warranty against tank failure resulting from defects in materials or workmanship.

D. The hydraulic separator/buffer tank shall be constructed with a heavy gauge galvanized steel jacket assembly, primed and pre-painted on both sides with a minimum dry film thickness of 0.70 mills. The buffer tank / hydraulic separator shall be completely encased in a minimum of 2" thick, high density, HCFC free, polyurethane foam insulation to meet the energy efficiency requirements of the latest edition of the ASHRAE 90.1 Standard.

E. Tank shall be factory furnished with all inlet, outlet, thermometer, relief-valve, temperature sensor and air vent tappings.

F. Provide factory furnished and installed A.S.M.E. pressure/ temperature relief valve. Pipe relief valve to nearest floor drain with union on discharge piping.

G. Mount tank on a 4-inch high housekeeping pad.

H. Provide factory furnished and installed A.S.M.E. pressure/ temperature relief.

2.13 HYDRONIC SYSTEM FLUID FILTER HOUSINGS AND FILTERS

A. Furnish and install Adey or approved equal magnetic and non-magnetic side stream filters with filter housings.

B. Standard of acceptance: ADEY® MagnaClean® (Model Midi 2” as scheduled on the contract drawings).

C. The magnetic and non-magnetic filter shall be a side-stream filter.

D. The magnetic and non-magnetic filter shall come with High Power, NdFeB, neodymium magnets, 5-50-micron superior spun-bonded cartridge filters, and 5-50-micron needlefelt bag filters. Furnish a 4-pack of 5-micron, 10-micron, 20-micron, and 50-micron filters in addition to spare filters.

E. The magnetic and non-magnetic filter shall provide adaptive filtration: magnetic and non-magnetic combined.

F. The magnetic and non-magnetic filter body shall be made of 316L stainless steel with a 304 stainless clamp assembly.

G. The magnetic and non-magnetic filter shall be supplied with an automatic air-vent. This and the needlefelt bag filters shall promote air separation from the system water.

H. The magnetic filter magnets should be removeable to facilitate routine cleaning/servicing.

I. The magnetic and non-magnetic filter shall be rated for 145 psi (10 bar) maximum working pressure.

J. The magnetic and non-magnetic filter shall have a temperature rating of 14°F to 302°F.

K. The magnetic and non-magnetic filter shall have versatile installation options: Floor-standing and supported pipe clip options for easier installation & servicing.

L. The magnetic and non-magnetic filter shall be supplied with EPDM seals.

M. The magnetic filter shall include a threaded blow down connection to allow for magnetite and debris to be regularly cleaned out of the unit. Furnish adapters to convert factory fittings to NPT fittings.

N. Furnish the filter housing and filters with the following Magnetic Dirt Filters Accessories:

1. Magnetic Thermal Jacket
2. Thermal Jacket
3. Cartridge filters (5-50-micron)
4. Needlefelt bag filters (5-50-micron)

2.14 FLOOR MOUNTED FINNED TUBE RADIATION

A. Furnish and install pedestal mounted finned tube radiation of the capacity, size, and arrangement as indicated on the contract drawings. All ratings shall be IBR approved. Units shall be installed in a neat and workmanlike manner in accordance with specifications and manufacturer recommendations. Finned tube radiation shall be model E3-2W as manufactured by Trane, Vulcan, Slant-Fin, Dunham Bush, Rittling, or approved equal.

B. Element types, as indicated on plans, shall have integral fin collars which space the fins and provide fin-to-tube surface firmly bonded by mechanical expansion of the tube to ensure durability, eliminate noise from loose fins and assure performance at cataloged ratings. Elements shall be positively positioned front-to-back, with provisions for silent horizontal expansion and contraction.

1. Enclosures shall be as scheduled on the plans, constructed of 16-gauge (15mm) thickness steel and shall mount into a continuous roll-formed captive channel mounting strip which permits hinge-type mounting and access at the top and invisible fastening onto rigidized, 14-gauge (1.9mm thickness) steel enclosure brackets at the bottom. Enclosure brackets shall be spaced at not more than four-foot (1.2m) intervals.
2. Front panels shall be individually removable to facilitate cleaning, servicing or replacement. All accessories shall fasten to the enclosure assembly in a manner which prevents contact with the back wall during installation.
3. Cabinet air outlets of stamped sheet metal or the manufacturer shall supply a bar type extruded aluminum grille to provide strong linear styling.

C. Pipe enclosure shall be as scheduled on the plans, constructed of solid (16-gauge 1.5mm thickness) steel and shall mount into a continuous roll-formed captive channel mounting strip which permits hinge-type mounting and access at the top and fastening at the bottom

with visible fasteners by others. Front panels shall be solid metal top and bottom, one piece wrap around and be individually removable to facilitate servicing or replacement.

D. All enclosures, mounting strips and accessories shall be cleaned, phosphatized and painted with one coat of prime, baked enamel finish in color as selected by Architect.

1. End panels, inside and outside corners and enclosure extensions shall be diformed and shall lock to enclosure assembly without visible fasteners.
2. Dampers (hydronic units only) shall reduce heating capacity up to 70 percent when closed and shall be factory mounted on the element. The control dial shall be jam-proof and have a mechanism which prevents damage to the dial or damper.
3. Access panels shall be installed where valves, balancing cocks or traps are indicated on the plans.
4. Type E3-2W three-sided pedestal mounted element covers and accessories shall be provided. Enclosure of 16-gauge (1.5mm) steel only. Back panels, still extensions, mullion channel, stamped sheet metal, front air inlet grilles, tamper proof screw assemblies and pilaster covers shall be provided. To prevent dirt streaking, contractor shall either apply dirt guard gasket to mounting strip or caulk along top of mounting strip.

2.15 HORIZONTAL HOT WATER UNIT HEATERS

A. Provide and install horizontal hot water unit heaters of the size, capacity and electrical characteristics as indicated on the contract drawings. Horizontal unit heaters shall be Trane Model S, Dunham Bush, Modine, or approved equal.

B. Casing shall be two-piece with "picture frame" front formed into wrap around sides, top and bottom. Furnish each unit with louvered fin diffuser for versatility in lateral diffusion. Casing shall be 18 gauge back panel with deep-drain fan orifice for extreme rigidity. Steel supply and return pipe top connectors bolted to back. Casings phosphatized to prevent corrosion and finished with a green baked enamel finish.

C. Fan shall be high efficiency Model A with aluminum blades, factory balanced and sturdy for standard applications.

D. Coils shall be hot water, single tube single serpentine design. Fins shall be aluminum sigma-flow, mechanically bonded to seamless copper tubing. All coils one-row deep in air flow direction. Coils shall be tested at 300 psig air under water. Coils shall be suitable for operation at 200 psig or 325 degrees F.

E. Motors shall be totally enclosed, class "B" insulated shaded pole and permanent split capacitor. All motors shall have built-in overload protection. Sleeve bearing motors can be oiled. Ball bearing motors are permanently lubricated. Units shall be U.L. listed.

2.16 VERTICAL CABINET UNIT HEATERS

A. Furnish and install vertical sloped top cabinet unit heaters of the size, capacity, and

electrical characteristics shown on the contract drawings. Units shall be Trane, Model J, Dunham Bush, Modine Corp, Rittling, or approved equal.

B. Front panels shall be fabricated of 16 gauge galvanized steel. All other panel parts shall be fabricated of 18 gauge galvanized steel. All panels shall be made by channel form. Hanged access door shall be constructed of 20 gauge steel and shall be flush with top panel. All cabinet parts shall be finished in a baked on enamel finish in color as selected by Architect.

C. Water coils to be 5/8 inch OD seamless copper tubes mechanically bonded to configured aluminum fins with continuous fin collars and sleeved coil end supports. Maximum working pressure 300 psig, factory test pressure 450 psig (air). Supply and return connections on same side of units.

D. Fans shall be centrifugal, forward curved, double width of non-corrosive, molded, fiberglass-reinforced thermo-plastic materials. The fan board assembly shall include a quick disconnect motor plug.

E. Motor shall have integral thermal overload protection and start at 78 percent or rated voltage. Motor to be factory installed and tested prior to shipping.

F. Filters to be accessed by pivoting hinged bottom panel. Filters shall be 1 inch woven glass filters. Furnish spare set of filters with each unit.

G. Provide each unit with a sloped top and extended end pocket (to conceal piping). Unit shall be provided with front bar grille inlet and top bar grille outlet.

H. Unit shall be U.L. listed.

I. Provide each unit with factory installed integral disconnect switch.

J. Custom Metal Pipe Enclosure (Cabinet Unit Heater Piping)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Trane
    b. Herman/Nelson
    c. Hydon Corporation
    d. Rosemex
    e. Slant/Fin

2. Enclosure: Minimum of 14 gauge (1.9 mm thickness) thick ASTM A 6533/A 653M, 660 galvanized steel, removable front cover.

    a. Full height back.
    b. End caps.
    c. Inside and outside corners.
    d. Joiner pieces to snap together.
    e. Enclosure height: 14 inches (Height does not include sloped top, see

detail).

f. Enclosure depth: 8 inches.

g. Finish: Baked enamel finish by manufacturer to match color of unit casing. Color of console and pipe enclosure selected by Architect.

h. Piping and Insulation Brackets: Primed and painted steel to support front panel and piping. Insulation vapor barrier must be completely continuous and unpenetrated.

i. Enclosure exact length to be field measured based on location of console unit and piping chase.

j. Pipe enclosure shall be fully removable.

2.17 DUCTLESS FAN COIL UNITS

A. General:

1. The supplied product shall be a Modine/Airedale, Aeremec, Carrier, Airstream, Multiaqua, or approved equal, four (4) pipe chilled/hot water ceiling cassette unit.

B. Cases:

1. The unit casing shall manufactured from lightweight galvanized sheet steel with integral fan mounting rails for added strength. Fire resistant foam insulation (to UL94 VO) shall be fitted internally to provide both thermal and acoustic insulation.

C. Coils:

1. Chilled water units utilize large surface area coils positioned to optimize heat transfer and airflow. Each coil shall be manufactured from refrigeration quality copper tubes with mechanically bonded aluminum fins and shall be circuited from headers to ensure low water pressure drops.

D. Condensate Pump:

1. A condensate pump and check valve shall be fitted to carry water out of the unit and stop water from flowing back into the condensate tray. The pump is shall be fixed to a mounting bracket which can be withdrawn from the side of the chassis and shall incorporate an inspection hole to allow a visual check of the pump during operation. A float switch shall be fitted to stop the cooling action should the pump become blocked or fail.

E. Air Vanes:

1. Air outlet vanes shall designed to prevent condensation from forming. Vanes shall be manually adjustable on the 2 x 2 model units but driven by an electric motor on all other model units. Where fitted, the motorized air vanes can be set to auto sweep or can be stopped in a fixed position. Polystyrene blanking pieces are supplied with Cassette packing so that up to two fascia discharge slots can be

blanked off.

F. Fans & Fan Motor:

1. All units shall utilize ECM fans that are statically and dynamically balanced for quiet operation. Fan impellers are made from either aluminum or fire-retardant plastic (UL94 VO) for light weight and corrosion resistant operation. Fans shall be driven by ECM motor allowing good heat dissipation and an increased motor efficiency. Fans shall come complete with thermal overload protection and sealed-for-life lubricated bearings.

G. Step Up Transformer:

1. The unit shall be fitted with an appropriate 115 volt to 230 volt step up transformer.

H. Filter:

1. MERV 8 or 10, 2" thick radial pleated disposable cotton and synthetic blend filters. Minimum Efficiency Reporting Value of MERV 8 or 10 per ASHRAE standard 52.2.
2. Furnish spare set of filters with each unit.

I. Electro-Mechanical Controls:

1. The unit shall include an electro-mechanical controller that includes the recessing relays and safety switch for proper operation. The ATC contractor shall field install unit controllers and control valves to fully control and monitor the units operation per the sequence of operations.

J. Options - Factory Installed:

1. Alarm Interlock Relay: The unit shall include a relay for unit failure notification. Normally open contact available for field connection.
2. Start / Stop Terminals: The unit shall include terminals for remote start/stop of the unit. The unit is enabled when contact between the terminals is closed.
3. Hot Water Coil: A hot water heating coil shall be factory fitted in addition to the chilled water coil to provide heating. The coil shall be manufactured from refrigeration quality copper tubes with mechanically bonded aluminum fins.
4. Disconnect Switch: The unit shall be fitted with a power disconnect switch located on the control panel, sized for the full load amperage of the unit to enable the unit to be disconnected from the power supply prior to any maintenance.

K. Junction Box: Units shall have the fan speed switch and optional controls wired to the control box. Furnish all units with factory installed/wired fused disconnect, motor starter, and relay package.

2.18 DUCTED ECM FAN COIL/BLOWER COIL UNITS

A. Provide and install horizontal or vertical direct drive, ECM, fan coil/blower coil units of the type, capacity, and electrical characteristics as shown and scheduled on the plans. The units shall be installed in a neat and workmanship like manner in strict accordance with specifications. Fan coil units shall be as manufactured by York (Model AVD & AHD). Fan coil/blower coil units fully equal to the specified manufacturer and those manufactured by York, BCH, Price (Genesis Series), Daikin, and Trane are acceptable provided they meet connection limitations. All fan coil/blower coil units shall be U.L. and CSA approved. All units shall be rated in accordance with ARI Industry Standard 440. Conform to ANSI/NFPA 70 code for internal wiring of factory wired equipment.

B. Basic Unit: The basic unit shall be fabricated of 18 gauge galvanized steel. Interior surfaces of coil section shall be lined with 2 inch coated glass fiber insulation meeting NFPA-90A requirements. The fan and motor assembly shall be easily removable for serviceability.

C. Cabinet: All models shall be double wall and thermally insulated with 1-inch thick insulation meeting NFPA-90A and U.L.94-5v requirements. The cabinet shall include a solid removable hinged access panel with handles. The supply air connection shall be on the front or top of each unit with a one inch duct collar. The return air connections shall be on the rear or side of each unit with a one inch duct collar. Refer to floor plans for duct arrangement.

D. Cooling and Heating Sections:

1. Access to coils from drive side or opposite connection side of unit for service and cleaning shall be provided. Coil headers and return bends shall be fully enclosed within unit casing. Coil connections shall be factory sealed with grommet on exterior and gasket sleeve between outer wall and inner liner where each pipe extends through the unit casing to minimize air and condensate leakage.
2. Cooling Coils:

    a. Cooling performance shall be as specified on the unit schedule.
    b. Water coil fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Seamless copper tubes shall be mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins. Coil casing shall be constructed of galvanized steel.
    c. Water coils shall be provided with headers of seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Coil connections shall be copper sweat connections with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain connections shall be furnished on the coil connection, external to the cabinet. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point.
    d. Drainpan shall be constructed from stainless steel, pitched and sloped in

direction of airflow to drain connection to allow for condensate drainage. Drainpan shall be positioned above 1" thick insulated double wall panel. Condensate drain connections shall be provided on both sides of drain pan. Secondary drain connection shall be provided.

e. Coil casing shall be constructed of Galvanized steel.

3. Water Heating Coil:

a. Heating performance shall be as specified on the unit schedule.
b. Hot water coil fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Seamless copper tubes shall be mechanically expanded into the fins to provide a continuous primary-to-secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
c. Water coils shall be provided with headers of seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Coil connections shall be copper sweat connections with connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain connections shall be furnished on the coil connection, external to the cabinet. Vent connections provided at the highest point to assure proper venting. Drain connections shall be provided at the lowest point.

E. Supply Fan:

1. The supply fan shall be a DWDI forward-curved type. Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer on all three planes at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed.
2. Fan and motor assembly shall be mounted on vibration type isolators inside cabinetry.
3. Units shall be certified in accordance with the central station air handling units certification program that is based on ARI Standard 430.

F. Bearings and Drives:

1. Basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.
2. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.
3. Variable and adjustable pitch sheaves selected so required RPM is obtained with sheaves set at mid-position and rated based on motor horsepower. Contractor to furnish fixed sheaves at final RPM as determined by balancing contractor.

G. Electrical:

1. Motor shall be a high efficiency ECM type and must meet EPAct minimum motor efficiency standards. Electrical characteristics shall be as shown on the

schedule.

2. A junction box shall be furnished and mounted by fan manufacturer for field power connection to motor.

H. Junction Box: Furnish all units with factory installed/wired fused disconnect, motor starter, and relay package.

I. Fans: Fans shall be of the centrifugal, forward-curved, double width, double inlet, corrosion resistant type. Fan wheels shall be direct driven and statically and dynamically balanced. Fan wheels shall be painted or galvanized, and housings shall be galvanized steel. Provide adjustable sheaves for fan. Furnish spare set of belts.

J. Drain Pan: Units shall have a drain pan fabricated of 304 stainless steel. Pans shall be insulated with closed cell, polyurethane, sprayed-on foam. Ceiling models shall be provided with an auxiliary drain pan of galvanized steel with a 1-inch MPT drain connection. Steel sleeved auxiliary drain pans shall be provided to permit piping through the auxiliary drain pan. Provide a positively sloped, easily removable non-corrosive drain pan under cooling coils according to ASHRAE 62. Drain pans shall be easily removable without disconnecting piping, wiring or unit removal.

K. Filters: All units shall have 2 inch deep flat pleated filters with a minimum of MERV-8 rating. Furnish spare set of filters with each unit.

L. The ATC controls contractor shall furnish the terminal control unit controller for installation on each fan coil/blower coil unit by the unit manufacturer. These devices shall be delivered to the unit manufacturer's factory in sufficient time for the manufacturer to meet their schedule obligations. The relay for fan shall be provided by the unit manufacturer who shall also provide the interlock wiring between the relays and the DDC control unit. The unit manufacturer shall also provide a 24 VAC power source at each terminal unit. The cost of factory mounting, wiring, enclosure to meet local code and any factory testing and programming of the terminal control unit shall be included by the fan coil unit manufacturer.

M. All fan coil/blower coil units shall be sound tested using a qualified reverberant room per ARI Standard 350-82.

2.19 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).

2.20 EXTERIOR PIPE ROLLER SUPPORTS

A. Furnish and install pipe roller supports for all exterior piping as indicated on contract

drawings. Pipe roller supports shall be constructed of heavy gauge galvanized steel, continuous welded corner seams, 2 x 4 treated wood nailer, heavy gauge galvanized steel counterflashing with galvanized steel channel track attached.

B. Roller assembly shall consist of galvanized steel channel track, galvanized steel fittings, washers, nuts, and painted cast iron roller. Installation shall permit both vertical and horizontal adjustment. Units shall be Pate Model RAC, RTS, or approved equal.

2.21 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.

2.22 WATER TREATMENT SERVICES

A. Complete chemical water treatment service shall be provided by an organization regularly engaged in water treatment, ARC, Inc., RCCO Corp., Aquatel Ind., Inc., Mogul Corp., Oilin, Inc., HVAC Services, Inc., Feedwater Treatment Systems, Inc., Eco-Lab, Kurita, or approved equal. The service shall provide all equipment, chemicals and labor necessary to prevent corrosion, inhibit scale build-up and minimize organic growth for a period of 2 years starting from building acceptance. Service visits for the purpose of adding chemicals to feeding equipment, regulating bleed-off, inspecting and adjusting water treatment equipment, and obtaining samples of laboratory analysis shall be performed at monthly intervals for closed systems and every two weeks for open systems during the entire guarantee period. Chemicals shall not be injurious to water side equipment and construction materials. Records of all injurious to water side equipment and construction materials. Records of all service visits, chemical additions, laboratory tests, etc., shall be maintained and shall be provided to owner after each visit during guarantee period. Instruct mechanical contractor in field on piping and wiring of chemical feeding equipment.

B. The chilled water system shall be cleaned and flushed under this Division, but chemical treatment shall be performed at existing central chilled water plant by the Owner and is not included in this scope of work.

C. Systems to be protected shall include hot water heating system. Services shall include flushing and cleaning of piping systems specified under Division 23 Section, "HVAC Piping, Fittings, and Valves" section, furnishing and installing all chemical treatment equipment and accessories to perform the water treatment specified below. Maintain complete records of the treatment program for each system.

D. Contractor shall perform an analysis of the building water supply as a basis of the chemical treatment. Contractor shall provide the Owner with written instructions for

chemical feeding bleed-off, blowdown control and testing procedures, provide all required chemicals, filters and testing during the guarantee period, and provide all required test kits.

E. Contractor shall maintain the following conditions in each system:

SYSTEMS	Hot Water System
ph	8.0 to 10.5
Inhibitor for Scale & Corrosion Cycles	---
Cycles*	---
Organic Growth	---
Buffered Nitrate	1000 ppm to 180 degrees F 2000 ppm to 180 degrees F
Chromate (Low)	
Molybdate	100 to 150 ppm
Sulfite	---
Sodium Nitrite	1000 to 1500 PPM
Corrosion Inhibitor	100 to 150 (as Molybdate)
*Actual cycles of concentration to be determined from analysis of make-up water.	

F. Chemical Feeding Equipment: Provide chemical feeding equipment, as specified below, to introduce chemicals into each system only when the system is operating.

1. Closed Recirculating Systems

   a. Five (5) gallon steel by-pass feeder installed across circulating pump suction and discharge lines, with tank and piping insulated using the same thickness and type of insulation as provided for the piping system. Provide filter. Unit shall contain quick opening cap and shall be suitable for working pressure of 175 psig. Tank shall be primed and finished in baked enamel paint.

2. Replace bypass feeder filter monthly during the entire 2-year warranty period.

G. Boilers shall be boiled out with an alkaline type boiling out compound to remove grease, oil, mill scale and other foreign matter. The compound should be used at the rate of 1-1/2 pounds per 20 boiler horsepower. After boiling out period, the boilers should be completely drained, flushed, refilled with fresh water and vented. All water treatment

chemicals shall comply with Delaware Water Resources laws and regulations.

H. Closed Recirculating Systems shall be filled and sufficient detergent and dispersant added to remove all dirt, oil, and grease. System shall be circulated for at least 48 hours after which a drain valve at the lowest point shall be opened and allowed to bleed while the system continues to circulate. The automatic make-up valve shall be checked to be sure it is operating. Bleeding shall continue until water runs clear and all detergent is removed. A sample of water shall be tested and if PH exceeds the PH of the make-up water, flushing shall be resumed. After chemical cleaning is satisfactorily complete, open the inlet and outlet valves to each coil and close the bypass valves. Also, clean all strainers.

I. Before adding cleaned chemicals to the closed system, all coils should be isolated by closing the inlet and outlet valves by opening the bypass valves. Also clean all strainers.

2.23 ENERGY RECOVERY VENTILATORS

A. Provide and install ERV's (Energy Recovery Ventilators) as shown on contract drawings. ERV's shall be as manufactured by Venmar, Aaon, Daikin, VTS, Addison, or approved equal.

1. Energy Recovery Ventilator shall be Model Energy Pack as manufactured by Venmar or approved equal provided all specifications are met. Venmar equipment is used as the basis of design. Units shall be listed per UL 1812 and bear the UL label. Energy transfer ratings shall be in accordance with ASHRAE Standard 84 and ARI 1060. Wheels shall be ARI 1060 certified. Performance to be as scheduled on plans. Exhaust discharge and outside air intake shall not be located on the same side of the rooftop units.

B. Factory Testing and Quality Control

1. Standard Factory Tests: Units shall be factory run tested to ensure proper functioning of components. Fans shall be factory run tested to ensure structural integrity and proper rpm and shall be statically and dynamically balanced for continuous operation at the maximum rated fan speed and motor horsepower in accordance with AMCA 204. All electrical circuits shall be tested to ensure correct operation before shipment of unit. Units shall pass quality control and be thoroughly cleaned prior to shipment.

C. Unit Construction Description

1. General: Provide factory fabricated Air Handling Units with capacity as indicated on the schedule. The units consist of factory assembled components as shown on drawings, including but not limited to fan and motor assemblies, energy recovery device(s), all necessary dampers, hoods (outdoor units only), plenums, filters, drain pans, wiring, controls and other accessories as outlined in the schedule, enclosed in a single or multiple piece casing as shown on the mechanical drawings. Units shall be stand alone controlled, except where noted, with all control devices provided and wired for single-point power connection by the Manufacturer unless otherwise outlined in the schedule. Units shall have overall

dimensions as indicated and fit into the space available with adequate clearance for service as determined by the Engineer. Tags and decals to aid in service or indicate caution areas shall be provided. Electrical wiring diagrams and Installation, Operation and Maintenance Instructions Manual shall be attached to the control panel access doors within each unit. Units shall be UL or ETL listed. Units shall be shipped in one piece or shall be split for shipment to accommodate freight as required, as shown on mechanical drawings.

2. Unit Base and Floor: Unit perimeter base shall be completely welded and constructed from (6") structural tubing and shall accommodate curb or concrete pad installation as shown on drawings. Unit base floor shall be constructed from four-break formed steel panels, made from 14 gauge hot rolled steel (HRS). Floor panels shall be welded to each other, creating I-beams at each floor panel junction. Floor panel junctions shall be located at 14" increments (maximum) or less, in order to provide floor rigidity and support as required for internal components. Unit floor panels shall be welded to perimeter base frame steel tubing. Unit floor shall be insulated from underneath with 3", R20 polyurethane closed cell spray foam and protected with 24 gauge galvanized steel liners. Unit floor construction shall include two-stage thermal break, using gasket between base floor framing and liners underneath and floor membrane on top. Unit base and floor shall be factory covered with top coat industrial grade membrane to ensure air- and water-tightness as well as walk-on grip. Floor membrane shall be high performance, sprayed, plural-component pure polyurea elastomer, based on amine-terminated polyether resins, amine chain extenders and prepolymers. Floor membrane shall be flexible, tough, resilient monolithic membrane with good water and chemical resistance and shall resist to temperatures up to 250°F. Floor membrane materials shall be free of solvents and VOC's, shall be suitable for use in compartments handling conditioned air and shall comply with the requirements for the Standard for Heating and Cooling Equipment, ANSI/UL 1995, third edition, dated 02/18/2005, Section 5.10 and Section 18. Single wall floor construction with glued and pined insulation and no subfloor is not acceptable; non-insulated floor construction is not acceptable. Entire base frame is to be painted with a phenolic coating for long term corrosion resistance. Base frame shall be attached to the unit casing frame at the factory. When rigging, base frame deflection shall be less than 1/360 of the unit length. All major components shall be supported by the base without sagging or pulsating.

3. Rigging Provision – Single Piece Units: The unit base frame shall include lifting lugs located at the corner of the unit (and along the sides as required by design) and sized to allow rigging and handling of the units. Rigging shall be performed using all lifting lugs at all times and in strict accordance with the instructions provided within the Installation, Operation and Maintenance Instructions Manual. Lifting lugs may be removed after rigging; however, bolts shall be set back in place after lug removal.

4. Rigging Provision – Multiple Piece Units: Units shipped in multiple sections shall be engineered for field assembly. The unit section base frame shall include lifting lugs located at the corner of the unit (and along the sides as required by design) and sized to allow rigging and handling of the units. Rigging shall be performed using all lifting lugs at all times and in strict accordance with the

instructions provided within the Installation, Operation and Maintenance Instructions Manual. Peripheral lifting lugs may be removed after rigging; however, bolts shall be set back in place after lug removal. Lifting lugs located along a section side corresponding to a unit section split shall be removed without bolts being set back in place afterwards. Units shall be provided with all necessary gaskets, caulking, hardware and instruction for assembly on site by Installing Contractor. Compression points shall be provided at the base frame, along the sides at 18" increments and at the top for aligning and joining section splits.

5. Unit Casing: Unit wall and roof rigid frame shall consist of 16 gauge pre-painted galvanized formed steel corner posts and 16 gauge G90 galvanized formed steel (1" x 2") intermediate frame posts, providing stable construction allowing for removal of any panel without affecting unit structural integrity. Exterior casing panels shall be attached to the gasketed (1" x 2") steel frame with corrosion resistant fasteners. Air Handling Unit casing shall be of the no-through-metal design. Casing shall incorporate insulating thermal breaks as required so that, when fully assembled, there is no path of continuous unbroken metal to metal conduction from inner to outer surfaces. Provide necessary support to limit casing deflection to L/200 of the narrowest panel dimension. If panels cannot meet this deflection, additional internal reinforcing is required. Units shall be designed for outdoor or indoor installation as indicated on the schedule. Indoor units weatherized for outdoor use are not acceptable. Outdoor units shall have a double sloped roof with 3% minimum roof pitch to prevent water accumulation, rain gutters above all access doors and roof joint seams of the T-shape construction, with minimum height of 1", metal strip sealed and encapsulated. Outdoor units shall be designed to resist snow, ice and wind loads, and if provided with weather hood(s), equipped with birdscreen and rain gutters. Indoor units shall have a flat roof. Hoods shall be shipped loose for field assembly. Internal partition on dual air tunnel units shall be insulated and constructed in the same manner and thickness as the unit cabinet outer liners. All panel seams shall be caulked and sealed for an air-tight unit. AHU exterior casing envelope shall be suitable to attain a maximum air leakage rate equal to 1.0% of design CFM when unit is operating at design static pressure.

   Unit outside surfaces shall be made of pre-painted steel unless otherwise specified. All galvanized steel surfaces requiring paint shall be made of satincoat finished galvanized steel of the specified gauge(s). All galvanized steel surfaces without any paint shall be made of galvanized steel of the specified gauge(s).

   a. Options:
      i. Corrosion resistant exterior paint finish complete with one coat of air dried epoxy paint, which shall withstand 1,000 hours of salt spray as per ASTM B-117.
      ii. Color selection shall be by the Architect.

6. Double Wall Construction: Units shall entirely be made of double wall construction. Single wall construction with coated insulation is not acceptable. Exposed insulation edges in the airstream are not acceptable. Unit panels shall be made of 18 gauge galvanized steel outer liners and 24 gauge galvanized steel inner liners.

7. Insulation: Unit wall and roof panels shall be insulated with 3" thick, R12.5, 1.5 lb./cu. ft. non-compressed fiberglass insulation. Unit internal partition (dual air tunnel units) shall be insulated with 2" thick, R8.3, 1.5 lb./cu. ft. non-compressed fiberglass insulation. Insulation shall meet the erosion requirements of UL 181 facing the airstream and fire hazard classification of 25/50 (per ASTM-84 and UL 723 and CAN/ULC S102-M88). All insulation edges shall be encapsulated within the panels. All perforated sections shall have insulation with black acrylic coating.

8. Access Doors: Full size access door(s) allowing for periodic maintenance and inspections shall be provided for all serviceable components as shown on the plans. Removable panels are not acceptable. Doors shall be solid double wall insulated construction. Insulation shall be the same as unit panels. Both the inner and outer liners shall be made of the same material as unit cabinet outer liner construction. The door hinge assembly shall be die cast zinc with stainless steel pivot mechanism, completely adjustable. Hinges shall allow doors to open at 180° with no shear effect on the hinge side of the perimeter gasket. The door frame shall be extruded aluminum with a built-in thermal break barrier and full perimeter gasket. The door gasketting shall employ a double seal comprising of an adhesive neoprene compressible foam gasket on the outer door panel and an "automotive style" neoprene bulb gasket fixed onto the inner door frame for out-swing doors, "rippled" foam for in-swing doors. There shall be a minimum of two heavy duty cast, UV rated, nylon handles per door. Door handles shall be operable from both inside and outside of the unit. On all access doors where moving parts could cause injury, an ETL, UL 1995 and OSHA approved tool operated safety latch shall be provided.

   Note: If Manufacturer cannot provide thermal break door design it must be noted as an exception on the bid.

   a. Options:
      i. Doors shall open against pressure.
      ii. Access doors all sections shall be equipped with hold-open device.
      iii. Access doors all sections shall be equipped with handle inter-linkage system to be able to open each door by operating only one handle.

9. Condensate/Drain Pans: IAQ style drain pans shall be provided as shown on the drawings. Drain pans shall be fabricated from 18 gauge stainless steel, except under coils, where drain pans shall be fabricated from 14 gauge stainless steel. All drain connections shall be piped and trapped for proper drainage. Drain pans shall be sloped at a minimum of 1.5% with a threaded drain pipe connection ending through the side of structural base frame. Drain pipe shall be schedule 40, 1¼" nominal, MPT stainless steel pipe. All drain pan corners shall be welded.

10. Enthalpy Wheel Heat Exchanger:

    a. Quality Assurance
       i. The wheel shall bear the AHRI 1060 Certified label. Wheels tested in independent laboratories, whether according to AHRI

Standard 1060 or not, are not acceptable unless actually certified by AHRI. Wheel Manufacturer membership in AHRI is not an acceptable substitute for AHRI Certified™ performance.

ii. The energy recovery wheel shall be a UR recognized component and bear the UR label.

iii. The energy recovery wheel shall comply with the requirements of UL 723. The media shall have flame spread index (SPI) of less than 25 and a smoke developed index (SDI) of less than 50 when rated in accordance with ASTM E84.

iv. The energy recovery wheel shall comply with the IBC Certification and OSHPD Seismic Qualifications.

b. Performances – Effectiveness, Pressure Drop, Exhaust Air Transfer Ratio (EATR) and Outdoor Air Correction Factor (OACF)

i. Sensible, latent and total effectiveness along with pressure drop, EATR and OACF ratings, shall be clearly documented in the AHRI 1060 Certified Directory (http://www.ahridirectory.org/ahridirectory).

ii. To reduce fan operating costs, the energy recovery wheel shall not exceed an OACF of 1.15 for rotors up to 70" and 1.08 for rotors up to 120" at 5" w.c. pressure differential when no purge is used. The result shall be clearly shown in the AHRI 1060 Directory.

c. Rotor Media and Desiccant

i. The rotor media shall be made of 2 mils minimum thickness aluminum. The media shall be coated to prohibit corrosion and shall be suitable for seacoast applications. Non-metallic substrates made from paper, plastic, synthetic or glass fiber media are not acceptable.

ii. All surfaces shall be coated with a non-migrating desiccant specifically developed for water transfer in vapor phase. Etched or oxidized surfaces are not acceptable.

iii. Desiccant must be a polymer hygroscopic or 3 angstroms molecular sieve (3A).

iv. Desiccant shall be bactericide and non-corrosive.

v. The rotor shall be constructed of equal width, alternate layers of corrugated and flat aluminum sheet material to create a flat and smooth surface and ensure laminar flow thus preventing any dust or particle accumulation inside the rotor.

vi. Corrugation pattern shall be of closed triangular shape to prevent any cross leakage between airstreams. Open type corrugation or embossments, since they increase fan operating costs, are not acceptable.

vii. Dry particles up to 800 microns shall freely pass through the media to minimize air pressure drops and prefiltering requirements.

viii. Furnish spare rotor belt.

d. Seals

i. The rotor shall be supplied with AirLoop™ labyrinth seal facing the media, polymer contact seal along the depth of the wheel and S-type labyrinth seal along the wheel's periphery. Wheels using

less effective seals like brush seals or standard 4 pass labyrinth seals are not acceptable.

ii. The AirLoop labyrinth seals shall be installed with no gap between the seal and media. Labyrinth seals that require an installation gap or seals that will damage the media if they come in contact with it are not acceptable.

iii. All seals shall be designed to withstand pressure differentials of up to 10" w.c.

iv. The AirLoop labyrinth seals shall be factory adjusted. Field adjustments shall be possible using common tools.

e. Options:

i. Wheel shall be segmented to allow removal in pieces.

ii. Wheel shall be provided with a field adjustable purge section.

11. Heat Pipe Heat Exchanger: Energy transfer ratings shall be AHRI Certified to Standard 1060 and bear the AHRI certification seal for AHRI Air-to-Air Energy Recovery Ventilation Equipment Program based on AHRI 1060. Ratings in accordance with AHRI 1060 without certification are not acceptable. Heat exchanger shall be tested in accordance with ASHRAE 84-91. Heat pipe shall transfer heat between airstreams in a counter flow configuration. Core shall be 1" ID seamless, integrally finned aluminum 1,350 tube with a 0.166" minimum wall thickness. The maximum center-to-center spacing shall be 2-1/8" for tubes and 1-7/8" for rows. Fins shall be extruded from and integral with the tube wall and shall have a 0.017" minimum fin thickness. Fin density shall be 11 per inch. Fin surface from the root to the tip of the fin should have a minimum of 0.437" between fin heights. Expanded and or wrapped fin and tube design construction is not acceptable. Tube shall have an integral internal circumferential capillary wick structure. Capillary structure shall not interfere with tube wall integrity. Tubes shall be individually processed, charged with refrigerant, hermetically sealed and factory tested. Heat pipe frame shall be fabricated from galvanized steel. Intermediate tube supports shall be furnished if required. A partition made from galvanized steel shall isolate the two airstreams and not allow cross-contamination. End covers made of galvanized steel shall be provided to protect tube ends. A drain pan shall be provided in the exhaust section for condensate collection.

a. Options:

i. Heat pipe shall be coated with heresite corrosion resistant coating on supply and exhaust sides.

ii. Drain pans shall be provided on each side of the heat pipe for condensate collection or servicing.

12. Unit Fans: Fan assemblies shall be designed for heavy duty industrial applications. All fans shall meet the airflow performance specified and shall not exceed the break horsepower or sound power levels specified on the mechanical equipment schedule. Fan performance shall be based on testing and be in accordance with AMCA 210 for performance and AMCA 300 for sound. Fans shall be selected for stable operation, at least 20% under the first critical speed of the fan, with a steep pressure/volume curve. Fan shaft shall be turned, ground and polished solid steel, finished off with a corrosion resistant coating and rated at maximum rpm below critical speed. Fan wheel and sheaves shall be keyed to the shaft. Fan drives shall be designed for a 1.3 service factor. Pulleys shall be

factory mounted with final alignment and belt adjustment completed before unit start-up. Motor (driver) and fan (driven) pulleys shall be of fixed pitch. Bearings shall be heavy duty, grease lubricated, self-aligning ball or pillow block type, selected for a minimum average bearing life (L-50) in excess of 200,000 hours at maximum operating speed in accordance with AFBMA 9 Standards. Inlet cones shall be precision spun or die formed. Inlet cones shall be aerodynamically matched to the wheel side plate to provide streamlined airflow in the wheel and ensure full loading of the blades. Fan and motor assemblies shall be mounted inside the unit casing, on a base equipped with 1" deflection spring vibration isolators and supplied with flexible connections. Fans shall be balanced per ANSI/AMCA 204-96 fan application category BV-3 using a digital signal analyzer at the design rpm with belts and drives in place to a vibration velocity less than or equal to 0.157" per second measured horizontal and vertical at each bearing pad. Vibration amplitudes are in inches per second-Peak. All values are filter-in at the fan speed. Removable shipping restraints shall be provided to protect the fan, motor and base during shipment.

a. Plug Fan (PF) SWSI Fans
   i. Fan shall be single width single inlet arrangement 3 plenum fan. Fan blades shall be hollow airfoil in shape, welded to the center and wheel side plates. Fan bearings shall be heavy duty type. Rigid support for the inlet bearing must be removable for access to the wheel. Inlet cone shall be precision spun.

b. Motors shall be invertor duty rated, heavy duty, constructed to NEMA Standard MG 1, general purpose, continuous duty, Design B. Temperature rating shall be 122°F, maximum temperature rise at 104°F [40°C] ambient for continuous duty at full load (Class B Insulation). Motors shall be T-frame mounted on an adjustable steel base that allows for belt alignment and tensioning, within the unit casing. All motors shall be tested to IEEE Standard 112 test method B and rated per NEMA MG1, Part 31 "Inverter Fed Motors". Motor bearings shall be ball or roller type with inner and outer shaft seals, grease lubricated and designed to resist thrust loading where belt or other drives produce lateral or axial thrust in motors. All motors shall be specifically designed to meet or exceed all EPAct requirements for energy efficiency and include Class F insulation. Motor shall be of minimum size as indicated in the equipment schedule, 1,800 rpm, open drip proof (ODP) and have a 1.15 service factor. Motor torque shall efficiently accelerate the drive loads. Unless indicated, motor shall not operate in the service factor range.

c. Provide shaft grounding rings for all variable frequency drive motors.

d. Variable Frequency Drives (VFDs)
   i. Each variable air volume supply and exhaust air fan shall be provided with separate variable frequency drives with bypass. Drives shall be factory mounted with adequate ventilation provided. The variable frequency drive shall convert input voltage (with +/−10% tolerance), three-phase, 60 Hz (+/−2 Hz.) utility power to adjustable voltage/frequency, three-phase, A–C

power step less motor control from 5% to 105% of base speed. The variable frequency drive shall produce an adjustable A–C voltage/frequency output of complete motor speed control and an input power factor near unity over the entire speed range. The VFD shall be automatically controlled by a control signal. The VFD shall be self-contained, totally enclosed in a NEMA 1 ventilated cabinet and capable of operation between 0°C and 40°C. The VFD shall be UL listed. Components used in all options shall be UL listed. The VFD shall have a hand/off/auto operator switch, drive switch with run or stop command and panel mounted digital display capable of indicating unit status, frequency and fault diagnostics. Variable frequency drives shall comply with all requirements specified under Part 2 "Variable Speed Drives" of this specification section.

e. Fan assemblies shall be provided with the following options:
   i. Fan drives shall be equipped with adjustable motor sheaves.
   ii. Extended lubrication lines with copper tubing mounted on the fan assembly access side.
   iii. One spare set of fan belts.
   iv. Motors shall be premium efficiency.
   v. Motors shall be inverter duty rated.

13. Chilled Water and Hot Water Coils – General Information: Coils shall be submerged in water and tested to a minimum dry air/nitrogen pressure of 300 psig standard copper tube coils. Coils shall display a tag with the Inspector's identification as proof of testing. Tubes shall have a nominal thickness of 0.020" unless otherwise specified. Fins shall be made of 0.0075" thick aluminum unless otherwise specified. Tubing, return bends and headers shall be made of seamless UNS 12200 copper meeting ASTM B75 and ASTM B251 Standards. Coil return headers shall be equipped with factory installed 1.2" FPT air vent connections placed at the highest point available on the face of the header (except for evaporator coils). Casings and endplates shall be made of 16 gauge galvanized steel, meeting ASTM A527 Standard unless otherwise noted. Double flanged casings on the top and bottom of finned height shall be provided to allow for coil stacking. Piping, control valve and valve operator shall be supplied and installed by the ATC subcontractor.

14. Hydronic Coils: Hydronic coils shall be designed to withstand 250 psig maximum operating pressure and a maximum water temperature of 300°F for standard duty copper tube coils. Standard construction fluid MPT connections shall be made from red brass meeting ASTM B43 Standard or Schedule-40 steel pipe as a minimum. Provide intermediate drain pans on all stacked cooling coils. The intermediate pan shall drain to the main drain pan through a copper downspout.

    Fins shall be made of 0.0075" thick aluminum and mechanically bonded to copper tubes.

15. Filters: Provide filters of the type indicated on the schedule. Factory fabricated filter sections shall be of the same construction and finish as the unit. Outside and

exhaust air inlets shall be equipped with galvanized steel racks that permit filter slide out removal (side access) for units equal or less than 78" tall and universal holding frames with upstream access (face loading) for units taller than 78". Face loaded pre and final filters shall have Type 8 frames as manufactured by AAF, FARR or equal. Side service filter sections shall include hinged access doors. Internal blank-offs shall be provided by the air unit Manufacturer as required to prevent air bypass around the filters. The filters shall be as manufactured by Farr, Purolator, AAF or equal. Filters shall be in compliance with ANSI/UL 900: Test Performance of Air Filters. Filter air velocity shall not exceed 500 fpm through each filter bank. Units shall be equipped, to a minimum, with 2" thick, MERV 13 pleated filters.

a. High Efficiency Rigid Filters
   i. Filters shall be 12" deep high performance, pleated, totally rigid and totally disposable type. Each filter shall consist of high density glass fiber media, media support grid, contour stabilizers and enclosing frame. Filter media shall be laminated to a non-woven synthetic backing to form a lofted filter blanket. The filter media shall have an average efficiency of 85% (MERV 13). The media support shall be a metal grid with an effective open area of not less than 96%. The metal grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull-away. The metal grid shall be formed in such a manner that it affects a tapered radial pleat design. The grid shall be designed to support the media both vertically and horizontally. Filters shall be listed Class II under UL Standard 900. Filters shall be tested per ASHRAE Standard 52.1-76. Contour stabilizers shall be permanently installed on both entering air and exit airsides of the filter media pack to ensure that the tapered radial pleat configuration is maintained throughout the life of the filter. The filter shall be capable of withstanding a 10" w.g. pressure drop without noticeable distortion of the media pack. The enclosing frame shall be constructed of galvanized steel. It shall be constructed and assembled in such a manner that a rigid and durable enclosure for the filter pack is affected. The periphery of the filter pack shall be continuously bonded to the inside of the enclosing frame, thus eliminating the possibility of air bypass. The enclosing frame shall be equipped with protective diagonal support members on both the entering air and air exit sides of the filters.

16. Dampers: Unit shall be equipped with all necessary dampers required for the system as shown on the mechanical drawings. Dampers shall be designed for operating temperatures between −40°F and 212°F. Air leakage through a 48" x 48 damper shall not exceed 10.3 cfm/sq. ft. against 4" w.g. differential static pressure at standard air condition. Standard air leakage data to be rated in accordance with AMCA certified rating program. Outside air dampers shall be opposed blade motorized and exhaust air dampers shall be parallel blade motorized type. For other dampers, see Manufacturer's recommendations. Damper actuators drive voltage shall be with 24 VAC for 2 position or 0–10V for modulation. Flat or formed metal blades are not acceptable.

Damper construction shall be as follows: damper frame shall be of extruded aluminum or galvanized steel; damper blades shall be of extruded aluminum; dampers shall be of opposed blade type or parallel blades where indicated; damper blade ends shall be sealed with neoprene edge seals with bottom and top blade wiper seals.

a. Provide the following:
   i. Outside air damper (motorized, spring return)
   ii. Exhaust air damper (motorized, spring return)

17. Rain Hoods: Rain hoods shall be fabricated from same material as unit casing with ¼" wire mesh inlet screen. Hoods sized to minimize moisture carry over and shall be same color as unit.

18. Roofcurbs: Roofcurb shall be supplied by the unit Manufacturer for field assembly. Manufacturer's curb shall be standard double wall, 18" height, 2" thick fiberglass insulation. Curb shall consist of formed 18 gauge galvanized steel sections.

    a. Options:
       i. Pitch roofcurb shall match building roof.
       ii. Curb can be provided with wood nailor.
       iii. Curb shall be arranged so all hydronic pipes enter unit within roof curb to protect the same from freezing.

D. Electrical Power and Controls

1. All wiring and electrical connections shall be of copper wires, copper bus bars and copper fittings throughout. Power supply terminals shall be identified with permanent markers.

2. All high voltage wiring conduit shall consist of flexible metal conduit. All low voltage and signal wiring shall consist of Belden cable.

    a. All high and low voltage wiring shall be run in Liquidtite flexible metal conduit.

3. When unit section splits are present, low voltage wiring shall be split using quick connectors for quick and easy field installation. Additionally, for each set of quick connector, the male branch in one unit section and the corresponding female branch in the next unit section shall be identified with the use of a color coded or numbered label. At each high voltage line split, a junction box shall be provided in one of the sections; the wiring in the section where the junction box is located and the matching wiring in the next section shall be identified with the use of a color coded or numbered label.

4. The unit shall feature a mounted permanent nameplate displaying, at a minimum, the Manufacturer, serial number, model number, date of manufacture and current and voltage readings. The unit must have an ETL or UL Listing and bear the appropriate mark.

5. A recessed integral electrical control compartment shall be furnished on the end of the unit. The compartment shall be constructed to NEMA 3R requirements for

outdoor units, provided with a hinged access door and a locking device. All components, except those not mounted directly in the unit, shall be factory mounted and wired to a labeled terminal strip. All components shall be identified using printed self-adhesive labels, consistent with the numbering used in the wiring diagrams. Control components shall include, but are not limited to, single-point connection power distribution block, sub and control circuit fuses or circuit breakers, control transformers, motor starters and overloads for single-speed operation. The control system shall be factory mounted in the control compartment and shall be a stand alone microprocessor-based Direct Digital Control system, with necessary sensors and interfaces to monitor and operate all functions as outlined in the equipment/control schedule, flow schematic, sequence or required for complete unit operation. A unit mounted intelligent programmable interface device shall be included for communication, display and setpoint control. Control panel compartment heaters and thermostats or cooling fans with grilles or registers shall be provided if control panel components cannot be protected from their minimum or maximum ambient temperature ratings. For automatic unit start-up an external dry contact must be provided by others (ex: building management system (BMS), BACnet, time clock, etc.). The DDC controller shall be factory programmed and factory run tested prior to shipment to verify functions and logic.

6. A flow schematic with sensor and component identification and location, interlocks and sequence of operation shall be included with submittals.

7. A wiring schematic and a bill of materials shall be completed in ladder/logic format, with component labeling according to line numbers, once a release for production has been received. The wiring schematic, bill of materials and flow schematic shall be included within the units control compartment.

8. The unit shall be provided with fluid furnished and installed, Direct Digital Control system, including all provisions. All safety controls shall be manual reset.

9. The units shall be provided with the following features:

    a. Unit shall be provided with a fused disconnect or circuit breaker mounted within the control enclosure with a door interlocked handle (weatherproof) on the exterior.
        i. The unit Manufacturer shall provide a field start-up by a qualified Factory Technician (to be covered as part of the unit pricing from the Manufacturer).
        ii. The control system with necessary sensors and interfaces shall be field supplied, programmed, mounted, wired and run tested by the Control Contractor. The Control Contractor shall coordinate sensors, interfaces, mounting locations and logic with the unit Manufacturer. The control system shall be mounted in the control compartment.
        iii. Unit shall have a 120 VAC GFI receptacle for a separate 120 volt power supply. Electrical power wiring shall be provided by under Division 26.

iv. Fan motors shall have variable frequency drive with drive bypass and line reactors.

E. Demand Control Ventilation Components:

1. Energy recovery ventilator fans shall be controlled by a variable frequency drive, as manufactured by Yaskawa or approved equal. Outdoor air and exhaust air fans shall be controlled simultaneously to maintain desired building pressure. Variable frequency drive shall be pre-programmed at the factory and shall assure that minimum outdoor air and exhaust air volumes are always maintained. The variable frequency drive shall be factory mounted in the unit cabinet and wired.

2. Energy recovery ventilator shall be equipped with field installed controls by the ATC subcontractor for demand control ventilation capabilities that enable the varying of outdoor air and exhaust air volumes based on building occupancy. A sensor shall be located in the exhaust air stream to monitor average CO2 levels of the occupied spaces. A variable frequency drive shall receive a 0-10 volt signal from the CO2 sensor and control the outdoor air volume to maintain a maximum of 1,000 ppm of CO2 in the occupied space. Outdoor air and exhaust air fans shall be controlled simultaneously to maintain desired building pressure. Variable frequency drive shall be pre-programmed at the factory and shall assure that minimum outdoor air and exhaust air volumes are always maintained. The variable frequency drive shall be factory mounted and wired. Additional space CO2 sensors shall be required (refer to plans for quantity and location) and interlock with ERV and demand controlled ventilation. Refer to ATC control diagram and sequence of operation.

3. Furnish each energy recovery ventilator with the following:

   a. Supply air fan variable frequency drive.
   b. Exhaust air fan variable frequency drive.
   c. Phase loss protection.

4. The CO2 sensors shall modulate air flow rates in a linear fashion from minimum to maximum based on CO2 measurement and reset schedule. Coordinate with ATC Subcontractor.

F. Extra Materials:

1. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

2. Filters: Furnish one set of each type of filter.

3. Fan Belts: Furnish one set of link type belts for each belt drive fan in energy recovery ventilator.

4. Wheel Belts: Furnish one set of belts for each belt driven energy wheel.

G. BAS Interface: Field-installed hardware and software to enable the BAS to monitor, control, and display Variable Frequency Drives status and alarms. Allows VFD to be

used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

1. Network Communications Ports: Ethernet and RS-422/485.

2. Embedded BAS Protocols for Network Communications: ASHRAE 135 BACnet; protocols accessible via the communications ports.

2.24 ELECTRIC RADIANT HEATERS

A. Electric Radiant Ceiling Panel

1. General: Provide electric radiant ceiling panels as indicated on the drawings. The electric ceiling heating panel shall be AZTEC, as manufactured by Berko, a Division of Marley Electric Heating, CP series as manufactured by Qmark or as approved equal. The construction and design shall permit it to be: recessed ceiling-mounted with the use of Recessed Mounting Kit, fit into standard or custom designed modules of a T-bar suspended ceiling, surface-mounted with the use of a Surface Mounting Kit, or exposed with the use of a surface mounting kit and duct strap attached to roof structure. In finished spaces with hard ceilings, install units recessed. Panels shall be UL listed. Panels shall include the custom features listed below.
2. Heating Assembly: The heating assembly shall be UL and CSA approved and shall consist of powdered graphite encapsulated in a plastic laminate with heavy duty copper buss bars running the entire length, backed by 1-inch, 1-pound density high temperature fiberglass insulation to insulate against heat loss to the ceiling and separated from the inside of the panel by a dielectric insulation to assure uniform heat transfer throughout the entire radiating surface of the heater.
3. Thermal Cutout: A thermal cutout shall be built into all high density panels to automatically shut off the heater in the event of overheating and reactivate the heater when temperatures return to normal.
4. Wiring: For connection to the main power supply, the heater shall be completely prewired, with the lead wires housed in a 40-inch length of flexible metal conduit and connector for J-Box mounting. Appropriate diagrams shall appear on the back of the panel. Provide modular connectors, pre-wired system for unit mounted end to end. Coordinate with Division 26.
5. Panel Assembly: The metal heating panel, containing the completely prewired heating assembly, shall be of 22 gauge formed galvanized steel front and 24 gauge formed galvanized steel back. Sides are overlapping front and back panels riveted together.
6. Finish: The front of the heating panel shall be multi-faceted cystalline type surface finished with high temperature silicone paint.
7. Controls: All radiant heaters shall be thermostatically controlled. When more than one radiant heater is shown in a space, provide the minimum number of thermostats required to control the total quantity of heating panels in the space. Thermostats, control transformers and associated controls shall be provided by the Manufacturer. Coordinate requirements with Division 26 and ATC Subcontractor.
8. Features: Radiant heating panels shall be provided with the following features:

a. Painted frame to match heater.
b. Factory silicone scaled for shower rooms.
c. Seal tight flexible conduit and connectors for shower rooms.

9. Temperature sensors shall be furnished and installed by the ATC Subcontractor. Provide and install stainless steel guards to protect all space temperature sensors.

2.25 BARE ELEMENT FINNED TUBE RADIATION

A. Furnish and install bare element finned tube radiation of the capacity, size, and arrangement as indicated on the contract drawings. All ratings shall be IBR approved. Units shall be installed in a neat and workmanlike manner in accordance with specifications and manufacturer recommendations. Finned tube radiation shall as manufactured by Trane, Vulcan, Slant-Fin, Dunham Bush, or approved equal. Finned tube radiation shall be installed within enclosures provided under the Architectural Division of these specifications.

B. Element types, as indicated on plans, shall have integral fin collars which space the fins and provide fin-to-tube surface firmly bonded by mechanical expansion of the tube to ensure durability, eliminate noise from loose fins and assure performance at cataloged ratings. Elements shall be positively positioned front-to-back, with provisions for silent horizontal expansion and contraction.

1. Enclosure brackets and element hangers shall be installed not farther than 4' apart. Brackets shall be die-formed form 3/16" thick stock, 1 ½-inch wide, and shall be lanced to support and position lower flange of enclosure. Enclosures shall be firmly attached to brackets by set screws, operating from under the enclosure. Devices which do not provide positive fastening of enclosures are not acceptable. Brackets shall be inserted in pre-punched slots in mounting channel to insure correct alignment and shall be fastened securely to wall at bottom.
2. Sliding saddles shall support heating elements and provide positive positioning of element in enclosure to insure maximum heating efficiency while preventing any possibility of fin inspringement on brackets or enclosure joints during expansion or contraction. Element supports shall be a double saddle design fabricated from 16-gage zinc-coated steel. Saddle shall slide freely on saddle support arm bolted to support bracket. Support arm shall allow 1 ½-inch height adjustment for pitch. The element support saddle shall allow 1 5/8-inch lateral movement for expansion and contraction of heating element.

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. Boiler and water heater minimum clearances shall be provided per the State of Delaware Requirements.

B. Coordinate vibration isolation requirements with all equipment in accordance with Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment.

C. Coordinate all electrical requirements with Division 26.

D. Coordinate all indoor and outdoor equipment pad locations and sizes with approved shop drawing submittals. Provide operating weights of equipment to Structural Engineer for review. Coordinate equipment pad locations and sizes with the Concrete Contractor or General Contractor. Furnish anchor bolts which are to be inserted in concrete pads to concrete installer.

E. Verify piping arrangements of all equipment with the contract drawings. Piping details shall be strictly adhered to concerning valves, fittings, components, etc. At coils, where a rebuildable and repairable autoflow valve is installed in the line without the need for draining or shutting of the water, the same may be utilized as the isolation valve and additional shut-off valve is not required.

F. Connect all equipment, devices and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

G. Testing: After installing HVAC equipment, devices and components and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

H. Remove and replace malfunctioning units with new units and retest.

I. All mechanical penetrations or terminations in exterior walls shall be flashed and caulked watertight. Furnish and installed lintels as required.

J. Arrange for equipment such as boilers and energy recovery units to be shipped to project in modules where space constraints require the same. Field erect components as required.

3.3 FIELD QUALITY CONTROL

A. Where indicated provide the services of a factory authorized service representative to examine the field assembly of components, installation, piping, electrical connections, controls, and clearances. Submit factory start-up check list to Engineer for information purposes. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.

B. Where factory start-up of equipment is not specified, provide field start-up by qualified technician to examine the field assembly of components, installation, piping, electrical connections, controls and clearances. Record equipment manufacturers standard start-up information and submit to Engineer for review. Testing and balancing work shall not commence until start-up reports have been completed, reviewed by Engineer, and forwarded to Testing and Balancing Agency.

C. Charge all refrigerant systems with refrigerant and oil and test for leaks. Repair leaks and replace lost refrigerant and oil.

D. Fill all hydronic systems with water and/or antifreeze (when required after flushing and test for leaks. Repair leaks and replace lost water and/or antifreeze. Coordinate with water treatment owner’s contractor.

E. Submit to Engineer a written table of all relief valve and make-up water valve settings for each system. Provide an additional copy in the Operations and Maintenance Manuals.

F. Verify proper motor sizes, voltages, thermal overloads, nameplate data, etc. All equipment voltages and current shall be recorded to insure that motors are operating below their service factors. Test and Balance Engineer shall record electrical data before continuous or permanent operation.

G. Verify refrigerant mitigation controls including fan interlocks, control interlocks, and refrigerant leak detectors.

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 CONVENTIONAL DUCTLESS UNITS EQUIPMENT INSTALLATION REQUIREMENTS

A. Mount indoor and outdoor units as detailed on contract drawings.

B. Supply initial charge of refrigerant and oil as required.

C. Install all interlock and control wiring between indoor units, outdoor units thermostats, and condensate pumps.

D. Install indoor ceiling cassette on vibration isolators.

E. Install outdoor units on concrete pads or on roof curbs as indicated on drawings.

F. Comb out fins on condensing unit where deformed or bent. Replace or repair broken fins.

G. Install condensate lift pumps, float switches, alarm, unit shut down wiring and detection block units per manufacturer's recommendations.

H. For wall mounted units, locate condensate pumps above ceiling. Install all piping, tubing between indoor unit, adapter, detection block, and condensate pump.

I. For wall mounted units field wire power wiring, alarm circuits, control cable, safety circuit connection, alarm, and condensate pump. Condensate pump shall be powered

from indoor unit power wiring. Coordinate condensate pump electrical characteristics with indoor unit electrical characteristics.

J. Install wind baffles when required for low ambient operation. Locate wind baffles facing the predominant wind direction in winter.

K. Test refrigeration mitigation controls including fan interlocks, refrigerant leak detection devices, and refrigeration system shutdown controls.

3.7 ELECTRIC HEATING EQUIPMENT INSTALLATION REQUIREMENTS

A. Examine heating units for compliance with requirements for installation tolerances and other conditions affecting performance of units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Connect heating units and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris; repair damaged finishes, including chips, scratches, and abrasions.

D. Install and mount electric radiant heat panels from building structure as required to accommodate ceiling type. Field furnish all accessories necessary to mount radiant heat panels.

3.8 FAN INSTALLATION REQUIREMENTS.

A. Install fans with resilient mounting and flexible electrical leads.

B. Install flexible connections and vibration isolators as specified in Division 23 Section, Common Work Results for HVAC and Division 23 Section Vibration Controls for HVAC, Plumbing and Fire Protection Equipment. Ensure metal band of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Provide safety screens/guards on all fans and permanently mount after final testing and balancing.

D. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fans have been test run under operation.

E. Provide sheave required for final air balance.

F. Install fans according to manufacturer's written instructions.

G. Adjust damper linkages for proper damper operation.

H. Adjust belt tension.

I. Lubricate bearings.

J. Replace fan and motor pulleys and belts as required to achieve design conditions.

K. Mount, install, and wire speed controllers for direct drive fans. Speed controllers for direct drive fans shall be mounted adjacent to fan and wired in accordance with the NEC.

3.9 BOILER INSTALLATION REQUIREMENTS

A. Install boilers in accordance with NFPA-54, Boiler and Pressure Vessel Safety Act including ASME CSD-1, Amendments and Addenda, latest edition, State of Delaware Requirements. Coordinate inspection of boiler by local Boiler Inspector or authority having jurisdiction. Correct any and all violations noted by Boiler Inspector at no additional cost to the Owner.

B. Install boilers on concrete housekeeping pads.

C. Provide connections of fuel source piping in accordance with codes listed above. All gas regulators and gas pressure relief valves shall be piped to the building exterior and terminated with a gooseneck and vermin screen as required in CSD-1. Gas regulator and gas relief valve pipe material shall be in accordance with A.S.M.E. Code.

D. Provide piping connections and accessories as specified and detailed on drawings. For hot water piping all piping up to the first OS&Y gate valve on each side of the boiler shall be welded, flanged or screwed. Grooved joint piping is not acceptable until after the OS&Y gate valve on each side of the boiler.

E. Pipe all relief valves to nearest floor drain. Support relief valve piping in accordance with A.S.M.E. requirements. Relief valve pipe material shall be in accordance with A.S.M.E. Code. Install no more than one (1) elbow on safety relief valve discharge pipe located close to the valve outlet downstream of the union.

F. Provide for connection to electrical services.

G. Provide for connection to gas piping including strainer, shut-off valve, unions, and regulators.

H. Install boilers level and plumb, according to manufacturer's written instructions and referenced standards.

I. Assemble boiler sections in sequence and seal between each section. Assemble boiler trim according to manufacturer's written installation instructions.

J. Install electrical devices furnished with boiler, but not specified to be factory mounted. Mount, install, and wire low water cutoffs and gas train valves. Low water cut offs and gas train valves shall be installed per manufacturers recommendations and wired in accordance with the National Electric Code.

K. Connect breeching to boiler outlet, full size of outlet.

L. Electrical: Comply with applicable requirements in Division 26.

M. 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.

N. Manufacturer's Field Service: Engage a factory authorized service representative to supervise the field assembly of components and installation of boilers, including piping and electrical connections. Report results in writing.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Submit flue gas and combustion analysis reports to Engineer.

3. Record design and actual draft available at appliance vent connection.

O. Hydrostatically test assembled boiler and piping, according to applicable sections of the ASME Boiler and Pressure Vessel Code.

P. Flush and clean boilers on completion of installation, according to manufacturer's written instructions.

Q. After completing boiler installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's touch up paint.

R. Furnish and install condensate neutralizers with lime chips and pipe discharge as indicated. Connect condensate neutralizers to boilers and flue pipes.

S. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

T. Examine mechanical spaces for suitable conditions where boilers will be installed.

U. Proceed with installation only after unsatisfactory conditions have been corrected.

V. Equipment Mounting:

1. Install boilers on cast-in-place concrete equipment base(s).

2. Mount valves and devices at heights required by the Boiler Inspector.

W. Install gas-fired boilers according to NFPA 54.

X. Assemble and install boiler trim.

Y. Install electrical devices furnished with boiler but not specified to be factory mounted.

Z. Install control wiring to field-mounted electrical devices.

AA. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. All boiler relief valve and drain piping shall be Type L copper piping.

BB. Install piping adjacent to boiler to allow service and maintenance.

CC. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve. Drain valves shall be brass, ball type and not less than 1-inch. Pipe ends shall be cut at 45 degree angle to prevent a cap or plug from being installed.

DD. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. All relief valve discharge piping shall be fully supported to prevent undue stress or strain.

EE. Connect gas piping to boiler gas-train inlet with union and shut-off valve. Piping shall be at least full size of gas train connection. Provide a reducer if required. Furnish and install gas pressure regulators as required by the Boiler Manufacturer. Furnish and install main gas shut-off valve for each boiler not more than 60 inches above the finished floor.

FF. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

GG. Connect flow switch to hot water piping and interlock with boiler and ATC system.

HH. Install piping from safety relief valves to nearest floor drain.

II. Boiler Venting:

1. Install flue venting kit, flue stack thermometer, condensate piping, condensate neutralizers, roof curbs, cleanouts, and combustion-air intake.

2. Connect full size to boiler connections.

3. For condensing boilers connect flue and combustion air ducts full size to boiler.

JJ. Ground equipment according to Division 26, Section "Grounding and Bonding."

KK. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

LL. Perform the following tests and inspections with the assistance of a factory-authorized

service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

MM. Remove and replace malfunctioning units and retest as specified above.

NN. Prepare test and inspection reports.

OO. 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 two visits to Project during other than normal occupancy hours for this purpose.

PP. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.

2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.

3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.
    b. Test for boiler efficiency at low fire 20, 40, 60, 80, 100, 80, 60, 40, and 20 percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.

5. Provide analysis equipment required to determine performance.

6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.

7. Notify Architect in advance of test dates.

8. Document test results in a report and submit to Architect.

QQ. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

3.10 HVAC PUMP INSTALLATION REQUIREMENTS

A. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer.

B. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.

C. Provide drains for bases and seals, piped to and discharging into floor drains.

D. Check, align, and certify alignment of base mounted pumps prior to start-up. Prior to starting pumps, the alignment of the pumps and their motors or other drivers shall be carefully checked. Alignment should be checked for both offset and angularity. Alignment by means of a Laser for all pumps. Alignment by straight edge across the pump couplings shall not be acceptable. Submit laser pump shaft alignment results to Engineer for review and insert a copy in the Operation and Maintenance Manuals.

E. Install base mounted pumps on concrete housekeeping pads, with anchor bolts, set and level, and grout in place. See Division 23 Section, Vibration Controls for HVAC, Plumbing and Fire Protection Equipment for inertia pad requirements. After alignment is correct, tighten foundation bolts evenly but not too firmly, completely fill baseplate with non shrink, non metallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

F. Lubricate pumps before start-up.

G. Provide side-stream filtration system for base mounted pumps. Install across pump with flow from pump discharge to pump suction from pump tappings. Install flow indicator, filter housing with cartridge filter, shut-off valves, and flow control valves. Install 30 micron filter for start-up and 5 micron filter for system operation.

H. Install pumps according to manufacturer's written instructions.

1. Install pumps according to HI 1.1 1.5, Centrifugal Pumps for Nomenclature, Definitions, Application and Operation.

I. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.

J. Suspend in line pumps using continuous thread hanger rod and vibration isolation hangers. Install kindorf pump supports for vertical in-line pumps and maintain clear space above for future motor replacement.

K. Set base mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1 1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.11 HYDRONIC EQUIPMENT AND SPECIALTIES INSTALLATION REQUIREMENTS

A. Provide manual air vents at system high points and as indicated.

B. For automatic air vents provide vent tubing to nearest drain.

C. Provide air separator on suction side of system circulation pump and connect to expansion tank.

D. Provide valved drain and hose connection on strainer blow down connection.

E. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

F. Support pump fittings with floor mounted pipe and flange supports.

G. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment and in accordance with ASME requirements.

H. Pipe all relief valve outlets to nearest floor drain.

I. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

J. Install equipment exposed to finished area after walls and ceiling are finished and painted. Avoid damage.

K. Protection: Provide finished cabinet units with protective covers during balance of construction.

L. Baseboard Radiation: Locate on outside walls and run pipe cover continuously wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Install end caps where units butt against walls.

M. Finned tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Align cabinet joints with window mullions. Install wall angles where units butt against walls.

N. Unit heaters: hang from building structure, with pipe hangers anchored to building, not

from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

O. Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units. Recessed units shall be provided with cabinet but shall also have an Architectural screen.

P. Install bare baseboard units level and plumb, according to manufacturer's written instructions, rough in drawings, the original design, and referenced standards.

1. Center units under windows.

2. Install continuously within enclosures.

3. Install bar grilles in casework.

Q. Install finned tube radiation units level and plumb, according to manufacturer's written instructions, rough in drawings, the original design, and referenced standards.

1. Use methods and accessories to accommodate thermal expansion.

2. Install cabinet continuously around corners, using manufacturer's outside and inside corner fittings.

3. Use manufacturer's standard wall trim.

4. Install manufacturer's access fitting for access to valves and other fittings.

5. Install air seal gasketing between wall and enclosure mounting channel.

6. Terminate unit enclosures with manufacturer's end caps.

R. Testing: After installing and connecting units, demonstrate product capability and compliance with requirements.

S. Remove and replace malfunctioning units with new units and retest.

3.12 INCREMENTAL EQUIPMENT INSTALLATION REQUIREMENTS

A. Coordinate installation of all incremental units (fan coil units) with architectural and electrical work.

B. Fan-coil Units: Install as indicated. Coordinate to assure correct recess size for recessed units.

C. Units with Cooling Coils: connect drain pan to condensate drain

D. 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.

E. Vacuum out all units and replace filters prior to turning over the same to the owner.

F. Electrical: Connect units to wiring systems and to ground as indicated and instructed by manufacturer.

G. 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.

H. 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.

I. Lubricate bearings on fan.

J. Check fan-wheel rotation for correct direction without vibration and binding.

K. Start unit according to manufacturer's written instructions.

1. Complete manufacturer's startup checks.

L. After starting and performance test, change filters.

M. Prior to installing all fan coil units provide mock-up for one ducted unit and one ductless unit. Installation shall be reviewed by Owner’s Mechanical Inspector and Engineer of Record. Provide three (3) days notice.

3.13 WATER TREATMENT INSTALLATION REQUIREMENTS

A. Systems shall be operational, filled, started, flushed, and vented prior to cleaning. Use water meter to record capacity in each system. All strainers shall be pulled and cleaned.

B. Place terminal control valves in open position during cleaning. Open bypass valves on coils and close isolation valves on coils during initial flushing.

C. Verify that electric power is available and of the correct characteristics.

D. Use neutralizer agents on recommendation of system cleaner supplier and approval of Architect.

E. Flush open systems and closed systems with clean water for four (4) hours minimum. Drain completely and refill. Where indicated add antifreeze.

F. Remove, clean, and replace strainer screens.

G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

H. Test and submit antifreeze concentration where the same is utilized and submit concentration at substantial completion.

I. Test inlet, outlet, and differential pressure at chemical feed tank (bypass feeder).

J. Set flow rate of autoflow valve serving chemical feed tank and fluid filter housings and record final gpm utilizing venturi flow meter fitting.

K. Field insulate and jacket tanks.

3.14 ENERGY RECOVERY VENTILATOR INSTALLATION REQUIREMENTS

A. Examine areas to receive energy recovery units for compliance with requirements for installation tolerances and other conditions affecting performance of energy recovery units. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Install energy recovery units as indicated, according to manufacturer's written instructions.

C. Install CO2 sensor/control/interlock wiring to variable frequency drives and to ATC system. Install global CO2 sensor to monitor ambient outside air CO2 level.

D. Install and interlock space CO2 sensors.

E. Install heat wheels so supply and exhaust flow in opposite directions and rotation is from exhaust side to purge section to supply side.

1. Provide access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.

2. Provide removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.

F. Install and interlock air flow monitoring stations as indicated on the contract drawings.

G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

H. Ducts and fan installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.

I. Ground Equipment

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

J. After completing system installation, including outlet fittings and devices, inspect and clean exposed finishes. Remove dirt and construction debris and repair damaged finishes.

K. Install quantity and size of refrigerant piping per manufacturer’s requirements.

L. Startup Services: Engage a factory-authorized service representative to commission units as specified below.

1. Energize and verify correct rotation of heat wheels and fans.

2. Adjust seals and purge.

3. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

4. Verify sequence of operation.

5. Record fluid temperatures, fluid pressure drops, and flow rates**.**

6. Verify and record minimum and maximum air flow rates for the supply and exhaust air fan.

7. Verify and record the minimum and maximum supply/exhaust fan speeds/ hertz and incorporate into the fan tracking sequence of operation.

8. Test A/C condensate overflow safety switch.

9. Verify and record the minimum and maximum supply/exhaust fan speeds/hertz and incorporate into the fan tracking sequence of operation.

10. Test freeze protection pumps.

M. Training

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventative maintenance.

2. Review data in the operation and maintenance manuals. Refer to Division 01 Section, Demonstration and Training.

3. Schedule training with Owner, through Architect, with at least 7 days advance notice.

3.15 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.

3.16 HYDRAULIC SEPARATOR/BUFFER TANK INSTALLATION REQUIREMENTS

A. Install tank level and plumb on concrete pad.

B. Arrange piping for easy tank replacement.

C. Install automatic air vent and pipe discharge to a floor drain.

D. Field insulate and jacket tank as specified.

E. Install flange and/or union connections at all taps, openings and fittings.

F. Install drain valve consisting of a tee fitting and ¾ inch ball valved pipe to a floor drain.

G. Where required fill tank with treated water after flushing with fresh water.

H. Install relief valve and pipe discharge with union to a floor drain.

3.17 HYDRONIC SYSTEM FLUID FILTER HOUSINGS AND FILTERS INSTALLATION REQUIREMENTS

A. Install filter housing and filters per the manufacturer's requirements. Furnish four (4) sets of each size filter (i.e. 4 sets of 5 micron filters, 4 sets of 10 micron filters, 4 sets of 20 micron filters, and 4 sets of 50 micron filters.)

B. Install filter housing level and plumb on a concrete pad.

C. Arrange piping for easy filter housing replacement and to accommodate the closure system.

D. Install automatic air vent and pipe to discharge to a floor drain.

E. Field insulate and jacket the filter housing.

F. Install flange and/or union connections at all taps, openings, and drain connections.

G. Install drain valve consisting of a tee fitting and ball valve piped to a floor drain.

H. Install filters in increments and furnish a complete set of spare filters.

I. Install 3-valve bypass arrangement as detailed on the contract drawings.

J. Install relief valve and pipe discharge with union to a floor drain.

K. Install autoflow valve and venturi flow meter as detailed on the contract drawings. Test and balance flow rate.

L. Test and record inlet, outlet, and differential pressure at design flow rate.

M. Once the free-flowing magnetic material capture is greatly reduced, the cartridge filters shall be introduced. The first filter shall be the 50-micron filter and working down to the 5-micron filters including intermediate steps using 10-micron filters and 20-micron filters. System should be cleaned to the 5-micron filter stage prior to substantial completion.

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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, chilled water piping, stormwater piping, and cooling coil drain piping, etc. vapor barrier performance is extremely important. All penetrations and seams of the ASJ and exposed ends of insulation must be sealed with vapor barrier coating. The ASJ must be protected with either a coating or a suitable vapor retarding outer jacket. Vapor seals at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion. Vapor Barrier Coating: Foster 30-65; Childers CP-34 or Vimasco 749. Permeance shall be 0.03 perms or less at 45 mils dry as test by ASTM E96.

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
Chilled Water Piping 2 ½-inches & Larger	2-inch thickness
Chilled Water Piping 2-inches & Smaller	2-inch thickness
All Branch Runouts to Unit Heaters/Fin Tube	1-inch thickness
Horizontal and Vertical portions of Stormwater piping that	1-inch thickness

PIPING INSULATION THICKNESS SCHEDULE SERVICES	THICKNESS
collects A/C condensate	
Heating Hot Water Piping 2-inches & Larger	2 –inch thickness
Heating Hot Water Piping 1-½ -inches & Smaller	1 ½ -inch thickness
All Drain Piping from Cooling Coils/Evaporators	1-inch thickness
Chemical Feed System	1-inch thickness
All Existing and New Above Grade Floor Drain Piping Serving AHU Condensate Drains include Drain Sumps and Auxiliary Drain Pipes from Auxiliary Pans	1-inch thickness
All Refrigerant Piping	1-inch thickness
Piping within Fan Coil Unit Enclosures	½-inch thickness
Pumped Condensate Piping	1-inch thickness
Boiler Combustion Air Intake Pipes/Ducts	1-inch thickness

B. Direct buried heating water piping shall be provided with field installed insulation as hereinbefore specified.

2.4 EQUIPMENT INSULATION MATERIALS AND THICKNESSES

A. The following equipment shall be insulated with Fiberglass Rigid Board Insulation or Foam Plastic Insulation:

1. Chilled Water Pump and Hot Water Pump Bodies.
2. Air Separators.
3. Expansion Tanks/Pressure Tanks.
4. Chemical Feed Tanks.
5. Freeze Protection Pump Bodies.
6. Fluid Filter Housings.
7. All Pump Volutes and Strainers.

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 at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

D. Boards shall be scored to allow them to conform to curved or irregular surfaces.

E. Mechanical fasteners shall be utilized to hold insulation to surface with bands as required to hold the curvature of the material.

F. Support rings shall be provided to support the top head insulation where required.

G. Outdoor installations require a weather barrier for protection of the insulation jacketing.

H. Insulation types materials shall be suitable for temperatures encountered by each item of equipment.

2.5 DUCTWORK INSULATION MATERIALS AND THICKNESSES

A. Insulate all supply, return, relief, combustion air, plenums, exhaust, (for ERV projects) and outside air intake ductwork with fiberglass exterior duct insulation with factory-applied foil facing. All exposed fiberglass duct insulation shall be 2-inch rigid or non-flexible board type 3.0 pcf minimum density, 0.23 max. "K" factor at 75 degrees F mean temperature, with white vinyl A.S.J. max, polymer coating vapor barrier facing. All concealed fiberglass duct insulation shall be 2-inch flexible blanket type, 1.0 pcf minimum density. All concealed insulation shall be 0.27 max. "K" factor at 75 degrees F mean temperature with reinforced foil-scrim Kraft vapor barrier facing. Unless otherwise noted, the minimum installed R-value shall be 6.0 HR x ft2 x ºF/btu.

B. Refer to Division 23 Section, HVAC Air Distribution System and contract drawings for location of all sound-lined ductwork. Sound-lined ductwork from the discharge or supply side of all ducted fan coil units and energy recovery units 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. Exposed dual wall ductwork located in finished areas shall not require additional exterior

insulation. Exposed dual wall supply ductwork located in mechanical room, fan rooms, penthouse, mezzanines and boiler rooms shall require additional rigid exterior insulation as hereinafter specified.

E. Contractor-applied internal linings shall be as specified and installed as hereinafter specified.

F. 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.

G. 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.

H. 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.

I. All airflow monitoring stations shall be externally insulated similar to adjacent ductwork as hereinbefore specified.

2.6 ACCESSORY MATERIALS

A. Accessory materials installed as part of insulation work under this section shall include, but not be limited to:

1. Closure Materials - Butt strips, bands, wires, staples, mastics, adhesives; pressure-sensitive tapes.
2. Field-applied jacketing materials - sheet metal, plastic, canvas, fiber glass cloth, insulating cement; PVC fitting covers, PVC jacketing.
3. Support Materials - Hanger straps, hanger rods, saddles.
4. Fasteners, weld pins/studs, speed clips, insulation washers.
5. Metal mesh or expanded metal lagging.

B. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

2.7 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, traps, and mechanical joints.

5. Factory-fabricated tank heads and tank side panels.

2.8 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 or duct systems has been completed prior to installing insulation.

3.4 INSTALLATION

A. Piping Systems

1. General:

a. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
b. Install insulation on piping subsequent to installation of heat tracing, painting, testing, and acceptance tests.
c. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.
d. Maintain the integrity of factory-applied vapor barrier jacketing on all pipe insulation, protecting it against puncture, tear or other damage. Seal all tears, punctures and other penetrations of the pipe insulation vapor barrier coating.
e. On exposed piping, locate insulation and cover seams in least visible location.

2. Fittings: Cover valves, fittings, unions, flanges, strainers, flexible connections, expansion joints, pump bodies, drain valves, strainers, blowdowns, backflow preventers, autoflow valves, flow measuring stations, and similar items in each piping system using one of the following:

    a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
    b. Cold pipe fittings: Apply a tack coat of vapor barrier coating and reinforcing mesh to produce a smooth surface. After ½ hour, apply a second coat of same vapor barrier coating, UL labeled, Type C, for cold water piping.
    c. Hot pipe fittings and Type H for hot water piping: Apply tack of breather mastic. Wrap fitting with fiberglass reinforcing cloth overlapping adjoining sections of pipe insulation by 2-inches. Apply a second coat of Type C or Type H breather mastic over the reinforcing cloth, working it to a smooth finish.
    d. Insulation cement equal in thickness to the adjoining insulation.
    e. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.

3. Penetrations: Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise specified.
4. Joints:

    a. Butt pipe insulation against hanger inserts. For hot pipes, apply 3-inch (7.5cm) wide vapor barrier tape or bank over butt joints. For cold piping, apply wet coat of vapor barrier lap cement on butt joints, and seal joints with 3-inch (7.5cm) wide vapor barrier tape or band.
    b. All pipe insulation ends shall be tapered and sealed, regardless of service.

5. Indoor piping shall be ASJ max with SSL-II closure system as manufactured by Owens Corning, Johns Manville, Knauf or approved equal.
6. Exterior above ground piping shall be insulated with ASJ max SSL-II closure system insulation. Fiberglass insulation with aluminum jacketing shall be utilized for exterior above ground applications. Seal all aluminum jacketing laps with 1/8" bead of metal jacketing sealant to prevent water entry.
7. All floor drain piping that is indicated to receive A/C condensate shall be fully insulated to prevent condensation.

B. Equipment Insulation:

1. General:

    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 boiler 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 and equipment insulation shall have a field applied PVC jacket cover neatly cut and pasted over ductwork and equipment insulation. PVC shall be high gloss white and shall be 20 mils thick.

B. Unless otherwise noted, all exposed pipe insulation required to be insulated shall be jacketed with a PVC Jacketing with fitting covers. PVC jacket shall be color fade resistant, white high gloss, U.S.D.A. authorized as manufactured by Proto Corporation or approved equal. PVC jacketing shall be high impact, ultraviolet resistant PVC. Minimum thickness shall be 20 mils, roll stock ready for shop or field cutting and forming.

C. Exposed areas include, but are not limited to, all mechanical equipment rooms/fan rooms, mezzanines, penthouses, boiler rooms, kitchens, electric rooms, storage rooms, janitor closets, IDF rooms, MDF rooms, and stairwells, 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 SECTION

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. The automatic temperature control system ATC and central control and monitoring system (CCMS) shall be electric/electronic direct digital control (DDC), Alerton as installed by Albireo Energy, Johnson Controls (Metasys), Johnson Controls FX (Facility Explorer) as installed by Modern Controls, Honeywell, Siemens, Automated Logic Corporation, Reliable Controls, Schneider Electric as installed by Tri-M, Advanced Power, Trane, and TAC Controls by Schneider Electric installed by Automation and Control Concepts or Niagara. All work associated with the automatic temperature control system shall be performed by personnel regularly and directly employed by the Automatic Temperature Controls Contractor. Control System shall be web based, allowing the client access via a standard web browser.

F. Coordinate controls with controlled equipment. Upon completion of the work, calibrate and adjust all controls for proper function. Electric wiring, including interlock wiring for all equipment shall be furnished and installed under this section. All electrical work shall conform to the applicable requirements of Division 26.

G. All automatic temperature control dampers, valves and separable wells for immersion elements furnished by the Control Manufacturer shall be installed by the Mechanical Contractor or his sheet metal subcontractor under the Control Manufacturer's supervision.

H. Reference is hereby made for this contractor to become familiar with Division 26 of these specifications. Familiarization is for coordination purposes only. The control contractor shall provide all necessary relays, contactors, interlock wiring etc. not provided under Division 26 for the automation of the ATC and CCMS systems as required by the sequence of operation and input/output schedule. The control contractor shall coordinate all requirements with the building Fire Alarm System. The control contractor shall provide all additional devices and interlock wiring required for the automation of the ATC system

and monitoring of the CCMS system.

I. Furnish all labor, materials, software, equipment and services necessary for and incidental to furnishing and installing a complete direct digital control, automatic temperature control system to meet the requirements of the sequence of operation described on the Drawings.

J. Unless the necessary items are specified to be provided with mechanical equipment by Division 23, the ATC contractor shall coordinate with Division 23, Mechanical, and shall furnish and install all items necessary to meet the requirements of the Sequence of Operation and the Central Control and Monitoring System (CCMS) indicated on the drawings and as required in this specification.

K. The control system shall include all necessary and specified control equipment properly installed in accordance with the specifications and drawings and shall include, but not be limited to the automatic temperature control and energy management system of the following:

1. Airflow Monitoring Stations
2. Blower Coil Units (Ducted Fan Coil Units)
3. Boilers
4. Building Facilities
5. Building Demand and Energy Consumption
6. Carbon Dioxide Sensors
7. Chilled Water Systems
8. Condensate Overflow Safety Switches
9. Control Valves
10. Dampers and Actuators
11. Dewpoint Temperature Sensors
12. Differential Bypass Valves/Transmitters/Sensors
13. Domestic Hot Water Systems
14. Domestic Water Consumption/Meters
15. Ductless Units
16. Duct Detector Fan Interlocks
17. Energy Recovery Ventilators
18. Elevator Sump Pumps
19. Electric Radiant Heat Panels
20. Electric Unit Heaters
21. Electric Meter and Submeter Monitoring
22. Exterior Lighting Systems
23. Fan Coil Units
24. Flow Measuring Stations
25. Flow Switches
26. Finned Tube Radiation
27. Fire Fighter Override Switch
28. Freeze Protection Pumps
29. General Exhaust Systems
30. Heat Pipes
31. Heating System
32. High Temperature Alarms
33. Hot Water Coils

34. Hydraulic Separators/Buffer Tank
35. Intake Hood Damper and Actuator
36. Lighting Systems (Interior and Exterior)
37. Mechanical Room Heat and Ventilation Control
38. Miscellaneous interlocks required for gas systems, ventilation systems, etc.
39. Minimum flow provision control valve and interlocks.
40. Plumbing Systems
41. Pumps
42. Radiant Heat Panels
43. Refrigeration Mitigation Controls.
44. Relative Humidity/Temperature Sensors
45. Sensors (i.e., temperature, relative humidity, CO_2, etc.)
46. Unit Heater/Baseboard Radiation Control
47. Variable Speed Drives
48. Ventilation Systems
49. Water Heaters

L. All labor, material, equipment and software to meet the functional intent of the system, as specified herein and as shown on the drawings, shall be included. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the owner.

M. Where equipment is specified to be provided by equipment manufacturer or where packaged controls are specified map out all points provided by the manufacturer so the same can be viewed by ATC system. As a minimum all points indicated in the point list and control diagram must be viewable and adjustable from the ATC system. Coordinate with equipment manufacturer.

1.2 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Main tracking/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

H. UPS: Uninterruptible Power Supply.

I. NAE: Network Automated Engine.

1.3 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
2. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
3. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
4. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
5. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
6. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
7. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Water Temperature: Plus or minus 1 deg F (0.5 deg C).
b. Water Flow: Plus or minus 5 percent of full scale.
c. Water Pressure: Plus or minus 2 percent of full scale.
d. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
e. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
f. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
g. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
h. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
i. Relative Humidity: Plus or minus 5 percent.
j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
l. Air Pressure (Space): Plus or minus 0.01-inch wg (2.5 Pa).
m. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
n. Carbon Dioxide: Plus or minus 50 ppm.
o. Electrical: Plus or minus 5 percent of reading.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.5 COORDINATION

A. Coordinate location of temperature sensors, relative humidity sensors, CO_2 sensors, dewpoint temperature sensors, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 28 Section, "Fire Alarm System" to achieve compatibility with equipment that interfaces with that system.

C. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

D. Coordinate equipment with Division 26 Section, Electricity Metering to achieve compatibility of communication interfaces.

E. Coordinate equipment with Division 26 Section, Panelboards to achieve compatibility with starter coils and annunciation devices.

1. Coordinate equipment with Division 26 Section, Motor-Controllers to achieve compatibility with motor starters and annunciation devices.

1.6 WORK BY OTHERS

A. Automatic temperature control valves, air flow stations, pipe taps, flow meters, and separable wells for immersion elements furnished by the control manufacturer shall be installed by the mechanical contractor under the control manufacturer's supervision. The control contractor shall deliver to the mechanical contractor valves and wells for installation within the various systems.

B. All automatic dampers furnished by the control manufacturer shall be installed by the mechanical contractor under the control manufacturer's supervision.

1.7 QUALITY ASSURANCE

A. Supplier shall have an in-place support facility with technical staff, spare parts inventory and all necessary test and diagnostic equipment. The fully staffed and equipped office shall be within a 60 mile radius of the job site.

B. The systems shall be complete in all respects, and shall be installed by skilled personnel. The Control Contractor shall have a successful history in the installation and maintenance of automatic temperature control systems similar in size and performance to that specified herein.

C. Refer to Contract Drawings for sequences of operations, control diagrams, and points lists.

D. All electrical wiring in connection with the Automatic Temperature Control System shall be furnished and installed by the ATC Contractor. This shall include all interlock wiring between the air handling units, fans, pumps, heating systems, boilers, switches, dampers, heat pumps, energy recovery ventilators, ductless units, condensing units, static pressure controllers, hydraulic separators, flow measuring stations, airflow monitoring stations, etc.

E. Bids by wholesalers, contractors or franchised dealers or any other firm whose principal business is not that of manufacturing or installing automatic temperature control systems, shall not be acceptable. Bid documents that are not complete in their response to these

documents or take exception to any of the capabilities defined within these documents shall not be acceptable.

F. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

H. Comply with ASHRAE 135 for DDC system components.

1.8 GUARANTEE AND INSTRUCTION

A. The control system including all components, system software, parts and assemblies herein specified shall be free from defects in workmanship and materials under normal use and service. After completion of the installation, the Control Manufacturer shall regulate and adjust all thermostats, control valves, control motors, and other equipment provided under this contract. If within two (2) years from the date of acceptance by Owner any of the equipment herein described is proved to be defective in workmanship or materials, it will be replaced or repaired at no additional cost to the Owner. The Control Manufacturer shall, after completion, provide any service incidental to the proper performance of the Control System under guarantees outlined above for a period of two (2) years. Normal maintenance of the system is not to be considered part of the guarantee. All corrective modifications made during warranty service periods shall be updated on all user documentation including "as-built" shop drawings and on user and manufacturer archived software disks.

B. The control contractor shall completely check out, calibrate and test all connected hardware to insure that the system performs in accordance with the approved specifications and sequences of operation submitted.

C. Upon completion of the work, the control drawings encased in heavy plastic shall be provided where directed. Layout shall show all control equipment and the function of each item indicated.

D. The temperature control contractor's office shall be within a 100 mile radius of the job site.

E. The contractor shall respond to the job site with qualified technicians within a 4 hour period for any emergency relating to the control system or energy management systems.

F. This agreement shall include emergency service during normal working hours.

1.9 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing equipment, fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with LonWorks or Bacnet.

D. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

E. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

F. Qualification Data: For Installer and manufacturer.

G. Field quality-control test reports.

H. Submit screen shots of ATC system graphics at substantial completion.

I. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section, Operation and Maintenance Data, and Division 23 Section, Common Work Results for HVAC include the following:

1. Maintenance instructions and lists of spare parts for each type of control device.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

J. Upon completion of the work, provide a complete set of “as-built" drawings and application software on CD, USB, or other type of electronic storage device. Drawings shall be provided in format as acceptable to the Owner’s files. Submit as-built drawings and specification to Owner's representative for review and approval prior to final project closeout.

1.10 SOFTWARE LICENSE AGREEMENT

A. The owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. All software and hardware upgrades shall be included in two (2) year warranty period.

B. Software license agreement shall not apply on projects where existing ATC system is being extended.

C. Minimum of four (4) software license seats shall be provided. Storage of all software shall be coordinated with the College’s IT Manager.

1.11 ELECTRICAL SURGE PROTECTION

A. It is the responsibility of the ATC/FMS contractor to provide adequate surge protection for all wall mounted control panels required for this project.

1. Devices under surge protection shall be of design that loss of memory will not occur in the event of the surge protection device being activated due to surge/spike conditions.
2. Surge protection devices will be required to be hard wired, with the exception of peripheral devices that use standard 110VAC plugs for connections (i.e. Modems).
3. Surge protection devices are to be rated for 120 VAC single phase, 20 (or greater) amps capacity.
4. Surge Protection devices to include internal fuse protection, audible surge alarm & LED indicators.
5. Surge protectors to have clamping voltage of 480V peak, maximum surge current rating of 50,000 amps. Unit to have NEMA 12 enclosure with wall mounting bracket and conduit connection.

1.12 TRAINING

A. The Automatic Temperature Controls (ATC) Contractor shall include in his bid, provisions for additional computer training at the company's regular school or training center. The ATC contractor shall include in his bid all costs associated with sending one (1) individual to the ATC contractors school for a period of not less than one (1) day. This training is in addition to the aforementioned training required under the General Provisions.

B. The training time period shall be coordinated with the school system's facility Engineer. The schedule training period shall be arranged at the owner's convenience.

C. Cost shall include all training material, instruction books, and two copies of video tape with sound DVD of training session.

D. Upon completion of the work, the Control Contractor shall have completely adjusted the entire control system. All training shall be by the control contractor and shall utilize specified manuals and as-built documentation.

E. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.

1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs. Include a minimum of 8 hours' dedicated instructor time on-site.
3. Review data in maintenance manuals. Refer to Division 01 Section, Contract Closeout.
4. Review data in maintenance manuals. Refer to Division 01 Section, Operation and Maintenance Data.

5. Schedule training with Owner, with at least seven days' advance notice.
6. Control Contractor shall also attend and participate in separate HVAC equipment systems training in addition to ATC training.

1.13 ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.14 DELAWARE TECHNICAL COMMUNITY COLLEGE SPECIFIC REQUIREMENTS

A. The ATC Subcontractor shall include in his bid all costs associated with incorporating the following specific requirements:

1. All holiday schedules shall incorporate a 12 month block. Coordinate exact holidays, schedules, calendars, occupied, unoccupied periods with Owner prior to writing software. All schedules shall be reviewed and approved by the Owner.
2. Relays for ATC equipment shall not be located in ceilings. All relays shall be located in equipment control panels and/or mechanical rooms.
3. All exhaust fans shall be assigned a designated point. Utilizing relays to provide digital point for exhaust fans shall not be acceptable.
4. Graphics on ATC computer shall in addition to basic requirements indicate the percentage open or closed on all valves and dampers.
5. The ATC Computer Graphics shall incorporate the final room numbers actually utilized in the library. All room names utilized in the graphic display shall be reviewed and approved by the Owner.
6. The ATC Computer Graphics shall indicate for each item of equipment the “on” or “off” status and command shall be “run” or “stop”.
7. The ATC Computer Graphic shall indicate for each duct smoke detector the “on” or “off” status and command.
8. All temperature sensors, equipment, relative humidity sensors, current sensors, CO2 sensors, differential pressure sensors, etc. indicated on ATC Control Diagrams and point list shall be displayed on the ATC Computer Graphic. Measured value or status shall be displayed.
9. The exact space temperature set points, relative humidity set points, changeover set points. etc., shall be coordinated with Owner prior to final data entry. All items indicated in sequences of Operation as “adjustable” shall be reviewed and approved by Owner prior to implementation of the same.
10. The outside air relative humidity and outside air temperature shall be monitored on ATC system and reported on ATC Computer Graphics. See Floor plans for exact locations.
11. Provide a graphic of all floor plans indicating location of all equipment interlocked with ATC System including all control panels.
12. Graphic shall also indicate area of building served by each item of equipment. Graphics shall indicate all global sensor readings.
13. For the chiller system and heating water system provide a single command on the control system to allow all control valves to be manually opened for balancing by activating a single command.

14. All equipment shall be labeled with name of equipment, area served, and area location (room name/number).
15. Scheduling of HVAC equipment/zones shall be such that for afterhours use the ATC system shall allow a temporary override of the pre-set occupied/unoccupied schedule by zone and for specific equipment in a zone. This must allow the library staff the ability to operate as few or many zones as desired without operating entire portions of the building.
16. Provide "Loss of Heat" monitoring and alarm on ATC system if any space temperature sensor in the building drops below 50 degrees Fahrenheit (Adjustable).
17. Provide additional software package and license so that Owner can install software on Owner provided laptop. Assist owner with installation of software.
18. For boilers, the percent output and firing mode shall be displayed on the computer graphic.
19. Provide a "demand toggle control" switch on ATC system to automatically reduce HVAC electric demand (power) by automatically modifying setpoints to pre-determined values. Coordinate pre-determined setpoint values with Owner and document in the As-Built Documents.
20. Scheduling of HVAC equipment/zones shall be such that for afterhours use the ATC system shall allow a temporary override of the pre-set occupied/unoccupied schedule by zone and for specific equipment in a zone. This must allow Delaware Technical and Community College the ability to operate as few or many zones as desired without operating entire portions of the building.
21. Alarms shall be delayed during optimal start stop to avoid nuisance alarm triggers.
22. Global unoccupied setpoints shall be 70 degrees F in heating mode and 74 degrees F in cooling mode. Coordinate/confirm with Owner all setpoints.
23. All status indicators for fans or pumps shall be provided by differential pressure sensors. Current sensors are NOT acceptable to be utilized for equipment status unless indicated on the control diagram.
24. Position of all H-O-A switches and other switches shall be reported on ATC graphic with equipment.
25. All text alarms shall clearly identify what they are within the body of the text. i.e. "freeze protection pump failure", "ERV XX-", "Duct smoke detector trip", etc. Coordinate all text alarms and verbiage with Owner.

1.15 GLOBAL SENSORS

A. General

1. Furnish and install global sensors and report the same on the automatic temperature control system.
2. Global sensors shall monitor and trend the following conditions:

    a. Outside air temperature.
    b. Outside air relative humidity.
    c. Outside Air CO_2 level in ppm.
    d. Chilled water supply temperature
    e. Chilled water return temperature.
    f. Heating water supply temperature

g. Heating water return temperature.
h. All ventilation fan speeds where variable frequency drives are specified.
i. Outside air carbon dioxide level.
j. All ventilation fan amperage where variable frequency drives are specified.
k. All pump or fan speeds where variable frequency drives are specified.
l. All pump amperage's where variable frequency drives are specified.
m. All fan amperages where variable speed fans are indicated. Graphic shall also indicate area of building served by each item of equipment.
n. Main Distribution Frame (MDF), and I.T. server room space temperature sensor.
o. Global holiday schedules:
    i. Provide all interlock wiring and programming to allow a global holiday schedule for all equipment except the administration equipment. Global holiday schedule shall allow the Owner to shut down the entire building's HVAC systems if an unscheduled event occurs when school is cancelled.
    ii. System shall also be capable of individual scheduling of equipment as specified or all can be globally modified at once.
p. All equipment interlocked with ATC system shall be able to be turned on/off via ATC system as specified. Changing temperature set point alone is not acceptable method for turning equipment on/off.
q. Where valve or damper position is indicated ATC graphic shall indicate percentage open or percentage closed.

PART 2 - PRODUCTS

2.1 BUILDING MANAGEMENT SYSTEM

A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B. The Building Management System shall consist of the following:

1. Standalone Network Automation Engine(s)
2. Field Equipment Controller(s)
3. Input/Output Module(s)
4. Local Display Device(s)
5. Distributed User Interface(s)
6. Network processing, data storage and communications equipment
7. Other components required for a complete and working BMS

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

E. Automation Network

1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
3. Network Automation Engines (NAE) and/or system controllers shall reside on the automation network.
4. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.

F. Control Network

1. Network Automation Engines and/or system controllers shall provide supervisory control over the control network and shall support all three (3) of the following communication protocols:

    a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9.
    b. LonWorks enabled devices using the Free Topology Transceiver (FTT-10a).
    c. The Johnson Controls N2 Field Bus or equivalent.
    d. Tridium FX-40
    e. Honeywell Webs
    f. TAC Controls by Schneider Electric
    g. Siemens P1/P2 Serial

2. Control networks shall provide either "Peer-to-Peer," Main-Tracking, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
3. DDC Controllers shall reside on the control network.
4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
5. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (main or tracking) that will communicate on the BACnet MS/TP Bus.
6. The Conformance Statements shall be submitted with the BAS Submittals.

G. Integration

1. Hardwired

    a. Analog and digital signal values shall be passed from one system to

another via hardwired connections.

b. There will be one separate physical point on each system for each point to be integrated between the systems.

2. BACnet Protocol Integration – BACnet

a. The neutral protocol used between systems will be BACnet over Ethernet and comply with the ASHRAE BACnet standard 135-2003.
b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.

H. Dedicated Web Based User Interface

1. Where required by the Owner, the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability. Coordinate with Owner to determine computer type (i.e. PC (Windows based) or Macintosh (Apple)).
2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.

a. Microsoft Edge Internet Explorer for user interface functions
b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries.

3. Computer Hardware – The personal computer(s) shall be configured as follows:

a. Description: A tower or all-in-one computer designed for normal use at a single, semipermanent location.
b. Performance Requirements:
   i. Performance requirements may dictate equipment exceeding minimum requirements indicated.
   ii. Energy Star compliant.
c. Personal Computer:
   i. Minimum Processor Speed: 3 gigahertz (GHz). Dual Core Processer.
d. RAM:

i. Capacity: 16GB.
ii. Speed and Type: 1333 MHz, SDRAM.

e. Hard Drive:
i. Media: Solid state.
ii. Number of Hard Drives: One.
iii. Capacity: 250GB.

f. Optical Read and Write Drive:
i. Include with at least 2 MB of data buffer.
ii. Type: SCS1 CD-ROM Drive with Read/Write Capability.
iii. Average access time of 150 ms or less.

g. At least four expansion slots.

h. Video Card:
i. Resolution: 1920 by 1200 pixels.
ii. RAM: 4 GB.
iii. Controller Speed: 4GHz.

i. Sound Card:
i. At least 128 voice wavetable synthesis.
ii. Capable of delivering three-dimensional sound effects.
iii. High-resolution 16-bit stereo digital audio recording and playback with user-selectable sample rates up to 48,000 Hz.

j. Two (2) Network Interface Cards: Include cards with connection, as applicable.
i. 10-100-1000 base TX Ethernet with RJ45 connector port.
ii. 100 base FX Ethernet with SC or ST port.

k. Wireless Ethernet, 802.11 a/b/g/n.

l. Optical Modem: Full duplex link for connection to optical fiber cable provided.

m. I/O Ports:
i. Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.
ii. One serial port.
iii. One parallel port.
iv. Two PS/2 ports.
v. One RJ-45.
vi. One stereo line-in and headphone/line-out on back panel.
vii. One microphone and headphone connector on front panel.
viii. One IEEE 1394 on front and back panel with PCI-e card.
ix. One ESATA port on back panel.

n. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.

o. Keyboard:
i. 101 enhanced keyboard.
ii. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.
iii. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

p. Pointing Device:
i. Either a two- or three-button mouse.
ii. Wireless operation within up to 72 inches (1800 mm) in front of

workstation.

q. Flat Panel Display Monitor:
   i. Display:
      1. Color display with 21 inches diagonal viewable area.
      2. Digital input signal.
      3. Aspect Ratio: 16 to 9.
      4. Antiglare display.
      5. Tilt adjustable base.
      6. Energy Star compliant.
      7. Resolution: 1920 by 1200 pixels at 60 Hz.
      8. Number of Displays: One.

r. Speakers:
   i. Two, with individual controls for volume, bass and treble.
   ii. Signal to Noise Ratio: At least 65 dB.
   iii. Power: At least 4 W per speaker/channel.
   iv. Magnetic shielding to prevent distortion on the video monitor.

s. I/O Cabling: Include applicable cabling to connect I/O devices.

t. Uninterruptable Power Supply.

I. User Interface Application Components

1. Operator Interface

a. An integrated browser based client application shall be used as the user operator interface program.

b. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3 or on the drawings, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.

c. The user interface software shall provide help menus and instructions for each operation and/or application.

d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
   i. User access for selective information retrieval and control command execution
   ii. Monitoring and reporting
   iii. Alarm, non-normal, and return to normal condition annunciation
   iv. Selective operator override and other control actions
   v. Information archiving, manipulation, formatting, display and reporting
   vi. FMS internal performance supervision and diagnostics
   vii. On-line access to user HELP menus
   viii. On-line access to current FMS as-built records and documentation
   ix. Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals

and regulations for individual FMS applications.

x. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.

2. Navigation Trees

a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.

b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.

c. The navigation trees shall be "dockable" to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.

3. Alarms

a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:

i. Log date and time of alarm occurrence.

ii. Generate a "Pop-Up" window, with audible alarm, informing a user that an alarm has been received.

iii. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.

iv. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.

v. Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.

vi. Any attribute of any object in the system may be designated to report an alarm.

b. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions

c. The FMS shall annunciate application alarms as required.

4. Reports and Summaries

a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
   i. All points in the BMS
   ii. All points in each BMS application
   iii. All points in a specific controller
   iv. All points in a user-defined group of points
   v. All points currently in alarm
   vi. All points locked out
   vii. All BMS schedules
   viii. All user defined and adjustable variables, schedules, interlocks and the like.
b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
   i. Weekly schedules
   ii. Exception Schedules
   iii. Monthly calendars
b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
e. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.
f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Password

a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation

capabilities deemed appropriate for each user, based on an assigned password.

b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.
c. The system shall allow each user to change his or her password at will.
d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
e. A minimum of five levels of access shall be supported individually or in any combination as follows:
    i. Level 1 = View Data
    ii. Level 2 = Command
    iii. Level 3 = Operator Overrides
    iv. Level 4 = Database Modification
    v. Level 5 = Database Configuration
    vi. Level 6 = All privileges, including Password Add/Modify
f. A minimum of 100 unique passwords shall be supported.
g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.

7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
8. Dynamic Color Graphics

    a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
    b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.
    c. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
    d. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
        i. All graphics shall be fully scalable
        ii. The graphics shall support a maintained aspect ratio.
        iii. Multiple fonts shall be supported.
        iv. Unique background shall be assignable on a per graphic basis.
        v. The color of all animations and values on displays shall indicate

the status of the object attribute.

e. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device

f. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.
   i. The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
   ii. In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.

g. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.

9. Historical trending and data collection

   a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
      i. Any point, physical or calculated, may be designated for trending. Two (2) methods of collection shall be allowed:
         1. Defined time interval
         2. Upon a change of value.
      ii. Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.

   b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis. Trend data shall be available for a minimum of twelve (12) months.

10. Trend data viewing and analysis

   a. Provide a trend viewing utility that shall have access to all database points.
   b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
   c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
   d. Displays shall be able to be single or stacked graphs with on-line selectable

display characteristics, such as ranging, color, and plot style.

e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.

g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.

J. Network Automation Engine (NAE)/ System Controllers

1. The Network Automation Engine (NAE)/ System Controllers or approved equal shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.
3. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

    a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
    b. The NAE shall support up four (4) concurrent users.
    c. The web based user shall have the capability to access all system data through one NAE.
    d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
    e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
    f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
    g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
    h. The web based UI shall support the following functions using a standard version of Microsoft Edge Internet Explorer:
        i. Configuration
        ii. Commissioning
        iii. Data Archiving
        iv. Monitoring
        v. Commanding
        vi. System Diagnostics
    i. Systems that require workstation software or modified web browsers are not acceptable.
    j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

4. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
5. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
6. Hardware Real Time Clock – The NAE shall include an integrated, hardware-based, real-time clock.
7. The NAE shall include troubleshooting LED indicators to identify the following conditions:

    a. Power - On/Off
    b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
    c. Ethernet Connection Speed – 10 Mbps/100 Mbps
    d. FC Bus – Normal Communications/No Field Communications
    e. Peer Communication – Data Traffic Between NAE Devices
    f. Run – NAE Running/NAE In Startup/NAE Shutting Down/Software Not Running
    g. Bat Fault – Battery Defective, Data Protection Battery Not Installed
    h. Fault – General Fault
    i. Modem RX – NAE Modem Receiving Data
    j. Modem TX – NAE Modem Transmitting Data

8. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

    a. Up to two (2) USB port
    b. Up to two (2) URS-232 serial data communication port
    c. Up to two (2) RS-485 port
    d. One (1) Ethernet port

9. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
10. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

11. Certification – The NAE shall be listed by Underwriters Laboratories (UL).
12. Controller network – The NAE shall support the following communication protocols on the controller network:

    a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
        i. A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (main or tracking) that will communicate on the BACnet MS/TP Bus.
        ii. The Conformance Statements shall be submitted 10 day prior to bidding.
        iii. The NAE shall support a minimum of 100 control devices.
    b. The NAE shall support the Johnson Controls N2, Tridium FX-40, or Honeywell Webs or approved equal Field Bus.
        i. The NAE shall support a minimum of 100 N2 control devices.
        ii. The Bus shall conform to Electronic Industry Alliance (EIA) Standard RS-485.
        iii. The Bus shall employ a main/tracking protocol where the NAE is the main.
        iv. The Bus shall employ a four (4) level priority system for polling frequency.
        v. The Bus shall be optically isolated from the NAE.
        vi. The Bus shall support the Metasys Integrator System.

2.2 WIRING

A. The multi-conductor cable for field wiring of electronic analog sensors shall be minimum No. 22 AWG, 300 volt, thermoplastic with stranded copper wire and 100 percent shield coverage. The number of conductors in each sensor cable shall be as determined by the Contractor. 2/c #22 shielded cables shall be Belden Cat. #8451 3/c #20 shielded cables shall be Belden Cat. #9770 or approved equal.

B. Conductors for digital sensors or contact control shall be the same as for the analog sensors, except the grounded shield is not required.

C. Individual conductors shall be color coded and in addition shall be numbered in the field to identify the particular terminal to which attached. Field numbering shall be performed with Brady or approved equal markers wrapped around the wire near the terminal connection. All wires shall be terminated with pressure type connectors suitable for wire size, material and terminal connection.

D. All exposed wiring or wiring concealed in partitions shall be installed in a designated conduit raceway. The conduit shall conform to Division 26 of the specification. Where wiring is installed in an air plenum the same shall be plenum rated cable.

E. All junction boxes shall have covers painted safety green, and be rigid steel.

F. All wiring between differential pressure transmitters and variable frequency drive pump controllers shall be shielded and grounded at the pump controller end. Directly route the

variable frequency drive pump controller to the differential pressure transmitter(s).

G. All wiring between air flow monitoring stations and variable frequency drive fan controllers shall be shielded and grounded at the fan controller end. Directly route the variable frequency drive fan controller to the air flow monitoring stations.

H. Where a motor disconnect is indicated downstream of a variable frequency drive (VFD) provide interlock wiring from the auxiliary contacts on the disconnect to the VFD to de-energize when the disconnect is turned "off".

2.3 CONTROLLERS

A. Temperature, relative humidity, and CO2 sensor covers shall be stainless steel wire guard type with vandal proof screws. All room relative humidity, CO2, and temperature sensors shall be mounted 4'-0 inches above the finished floor, except in stairways, corridors and toilets, which shall be 7'-0 inches. Provide insulating bases where temperature sensors are located on exterior or unconditioned walls. Each temperature sensor shall have adjustable limit stops and adjustable sensitivity. User adjustment shall be 2 degrees F above and below set points or as determined by the Owner. Room temperature sensors shall include range of 55 degrees F to 85 degrees F set point adjustment. Temperature sensors shall include set-point adjustors, U.L. approved for mounting base in air plenums, and RJ-11 jack for communications. Room temperature sensors shall be fully adjustable and shall display set point and actual temperature.

B. Space sensor wiring shall be installed concealed where possible. Should the Division 23 Contractor be unable to do so then surface metal raceway shall be utilized as specified in Division 26.

C. Low Limit Thermostats: Freezestats shall have a minimum 20 foot (averaging sensing element) capillary tube sized to the basis of one linear foot of capillary tube for each square foot of coil surface. Thermostat sensitivity shall be adjustable. Freezestats shall stop all fans and close the outside air damper if air temperature drops below 35 degrees F and open hot water heating valves. Low limit thermostats shall include hardwire interlock to fans and the building automatic control system. Low limit thermostats shall remain active even when H-O-A switches are in "HAND". Additional requirements are indicated in Sequence of Operation.

D. Room temperature sensors shall be accessible to ADA occupants.

E. All global sensors shall be monitored in accessible locations. Exterior sensors shall be provided with sun shield and be installed to prevent bird nesting.

2.4 DAMPERS

A. Control Dampers

1. The temperature control contractor shall provide all automatic control dampers of the types indicated on the plans and not specified to be integral with other

equipment. Frames shall be not less than 16 gauge galvanized steel. Blades shall not be over 6 inches wide airfoil shaped double skin construction of 14 gauge equivalent thickness. Bearings shall be stainless steel sleeves with 2 inch shafts. Blade edge seals shall be vinyl blade with flexible metal compressible jamb seals of the tight-seal spring type. Dampers and seals shall be suitable for temperature ranges of -40 to 250 degrees F.

2. All proportional or modulating control dampers shall be opposed blade type and all two-position dampers shall be parallel blade type.
3. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6 inches.
4. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage and flow characteristic data for all control dampers with the temperature control submittal. Maximum leakage shall be 3 CFM/Sq. Ft. at static pressure of 1 inch W.C. for a damper width of 48 inches.
5. Ultra-low leakage dampers shall have blade edges shall to be fitted with replaceable, snap-on, inflatable seals to limit damper leakage to 2 percent at applied static pressure.
6. Low pressure rectangular control dampers shall be Type CD60 airfoil low leakage damper as manufactured by Ruskin or as approved equal of American Warming and Ventilating, Air Balance and Arrow.
7. Round control dampers shall be Type CERS25 with blade edge seals as manufactured by Ruskin or as approved equal.
8. Provide damper end switch for all control dampers where indicated. Damper end switch shall provide “proof of open” prior to allowing fan to energize. Damper end switch shall be Model TS-475 Mechanical Damper Arm Switch (no-mercury) as manufactured by MDI, Inc. or approved equal. Install per manufacturer’s recommendations on control damper. End switch shall have the following features:
    a. Housing Material: Glass filled PBT (polybutylene terephthalate).
    b. Bracket Material: Plated steel.
    c. Operation: Steel ball actuated sub-miniature snap action switch.
    d. Operating angle: 15 degrees. (Contact closes at 10 degrees above horizontal and contact opens at 5 degrees below horizontal).

B. Duct Smoke Detectors

1. Duct Smoke detectors shall be provided by the Electrical Contractor and installed by the Mechanical Contractor. All wiring, interlocks, etc., to be provided by Electrical Contractor. Wiring from duct smoke detectors to fans shall be by ATC Contractor. Duct smoke detectors shall be tested by the Test and Balance Engineer as specified in Division 23 Section, Testing Adjusting & Balancing for HVAC and Plumbing.

C. Damper Operators

1. Electric damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range.
2. Use devices which are quiet in operation and which in the event of power failure, will "fail safe" by spring action in either the normally open or normally closed

position as required for freeze, moisture, smoke, or fire protection.

3. Electric actuators requiring a 24 VAC power supply will be utilized. Motors shall be specifically designed and sized with proper torque according to requirements of the device it is to be used on (i.e.: valve, damper). Each actuator will accept the proper control input as the system is designed, (i.e.: floating, 0-10VDC, 4-20Ma etc.) without the need for any additional interface devices.
4. For all exterior damper operators provide NEMA 4X stainless steel corrosion resistant enclosure. Damper operator enclosure shall be model ZS-300 as manufactured by Belimo or approved equal.

2.5 PRESSURE INDEPENDENT HYDRONIC CONTROL VALVES

A. All automatic control valves 2 inches and smaller shall be screwed type, and valves 2 ½ inches and larger shall be flanged. Valves shall be factory-rated to withstand the pressures encountered. Valves shall have stainless-steel stems and spring loaded Teflon packing with replaceable seats and discs. All control valves must be capable of withstanding the shut-off head of the pumps, they are connected to without the valve seat lifting. Valves shall have stainless steel stems and spring loaded Teflon packing with replaceable seats and discs.

1. All modulating straight-through water valves shall be provided with equal-percentage contoured throttling plugs and shall be pressure independent type. All three-way valves shall be provided with linear throttling plugs such that the total flow through the valve shall remain constant regardless of the valve's position modulating. Valves shall be sized for a pressure drop equal to the coil they serve but not to exceed 5 psi. Valves shall have replaceable seats and discs. Pressure independent control valves shall be as manufactured by Griswold, Delta P, Warren Controls, Danfos, Bray, or approved equal.
2. Pressure Independent Actuated Ball Valves (PIC-V) for Flows up to 85 GPM

    a. The modulating control valves shall be pressure independent.
    b. Valves shall accurately control flow within +/-5% (including manufacturing tolerance) independent of system pressure fluctuation by maintaining a constant pressure differential across the control valve so that the valve only repositions on a change in load demand.
    c. The pressure independent modulating control valve shall include a Pressure Compensating Cartridge, Actuated Ball Valve, 2 PT’s, Manual Air Vent, Union, and Manual Isolation Ball in a single valve housing.
    d. The valve shall have an accuracy of +/- 5% including manufacturing tolerances and pressure variations.
    e. Valve housing shall consist of forged brass, rated at no less than 360 psi at 250°F.
    f. A venturi flow meter fitting shall be field installed so that the flow rate can be read by means of differential pressure. Valve shall include factory or a field installed venturi metering station so that the flow rate can be read by means of differential pressure. Venturi metering station shall not require any straight runs of piping before or after meter. Provide separate flow meter fitting if venturi flow meter is not integral to PIC valve assembly.
    g. Both the ATC and shutoff valve shall have stems that are field repairable

with the valve in the line. The body design shall allow inspection or repair of the stem without disturbing piping connections or draining water. The repairable stem shall include two Teflon seals and one EPDM O-ring for protection against chemicals and modulating temperature.

h. Valve shall have a union end connection with factory installed air vent to allow for venting of the coil or heat pump.

i. The control valve shall accurately control the flow from 0 to 100% full rated flow.

j. The ATC portion of the valve shall use the full 90 degrees of the stroke for control. Stroke limiting of the valve shall not be acceptable.

k. A flow tag shall be furnished with each valve.

l. A universal mounting plate shall allow installation of actuators meeting the system electrical requirements and valve torque requirements as provided by Honeywell, Invensys, Johnson Controls, KMC, Schneider, Neptronic, or Siemens.

m. The actuator and plate can be rotated after mounting.

n. The actuator mounting assembly shall accommodate no less than 1 ½" of insulation.

o. Pressure Compensating Cartridge (PCC)
   i. PCC shall automatically compensate for pressure changes in valve and shall maintain a constant pressure drop across the flow limiting actuated ball.
   ii. The operating pressure range shall be available with the minimum range requiring 3 PSID to actuate the cartridge and the maximum 8 psid to actuate the cartridge
   iii. Valve internal control mechanism includes a diaphragm and full travel linear coil spring.
   iv. Valves shall include an accessible/ replaceable cartridge.
   v. Dual pressure/temperature test valves for verifying the pressure differential across the cartridge and flow limiting ball shall be standard.

p. Actuated Ball Valve
   i. Valve ball shall consist of chemically plated nickel brass or stainless steel.
   ii. Actuator stem shall be removable/ replaceable without removing valve from line.
   iii. Manufacturer shall be able to provide ball insert to limit flow to maximum flow rate with ±5% accuracy. Insert shall be constructed of a Glass-Filled Polymer. The insert shall be press fit to the inside of the ball. Clipping the insert onto the exiting side of the ball shall not be acceptable.
   iv. Each maximum flow rate selected shall use a different characterizing disc so that stroke limiting is not required.
   v. Valve shall have a minimum rangeability as follows: ½"-40:1, ¾"-160:1, 1" to 3"-400:1
   vi. Valve shall have EPDM O-rings behind Reinforced Teflon (PTFE) ball seals.
   vii. The valve shall have a minimum close-off pressure differential rating of 100 psi with 35 in-lbs of torque for 1/2" to 2" sizes.
   viii. Actuator shall provide minimum torque required for full valve

shutoff position.

q. Isolation Ball Valve
   i. Valve shall include a 600 WOG manual isolation ball valve.
   ii. Stem shall be removable/replaceable with the valve in the line.

r. The control valve actuator will be furnished by the controls contractor under Section 230900.

s. Pressure independent valves shall come as one complete assembly from Griswold Controls or approved equal and shall include a supply side combination shutoff/ strainer valve.

3. MVP Pressure Independent Control Valves for Flows above 85 GPM.

a. Pressure Independent Flow Control Valve 2.5" and Larger
   i. The modulating control valves shall be pressure independent.
   ii. Valve shall accurately control flow within +/-5% (including manufacturing tolerance) independent of system pressure fluctuation by maintaining a constant pressure differential across the control valve so that the valve only repositions on a change in load demand.
   iii. Contactor shall install pressure independent flow control valves where indicated in drawings.
   iv. Valve shall be electronic, pressure independent, modulating 2-way control device.
   v. Balancing valves shall not be required where pressure-independent valves are installed.
   vi. Install venturi flow meter fitting to measure flow rate in gallons per minute.
   vii. Valve shall include a venturi flow meter fitting so that the flow rate can be read by means of differential pressure. Venturi flow meter fitting shall not require any straight runs of piping before or after meter. Provide separate flow meter fitting if not integral to control valve.

b. Valve Actuator
   i. Valve actuator housing shall be rated to IP44 insulation.
   ii. Actuator shall be driven by a 24Vdc motor, and shall accept 2-10 Vdc, 4-20mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals.
   iii. Actuator shall be capable of providing 4-20mA or 2-10 Vdc feedback signal to the control system so that the gpm can be determined.
   iv. External LED readout of current valve position and maximum valve position setting shall be standard.
   v. Maximum flow setting shall be adjustable to 51 different settings within the range of the valve size by changing the settings electronically on the actuator.
   vi. Optional fail safe system to power valve to either open or closed position from any position in case of power failure shall be provided per the sequence of operations and the automatic temperature control diagrams.

c. Valve Housing

i. 2.5"–6": Housing shall be constructed of Ductile Iron ASTM A536-65T, Class 60-45-18 rated at no less than 580 psi static pressure and 248°C.

d. Pressure Regulation Unit

i. Pressure regulation unit shall consist of 304 Stainless Steel and hydrogenated acrylonitrile butadiene rubber (1/2"–1-1/2") or 316 Stainless Steel and EPDM (2"–6").

ii. Flow regulation unit shall be accessible for maintenance without disturbing the piping.

iii. Valve shall have a maximum of 8.6 psid to actuate the pressure regulating cartridge.

iv. Dual pressure/temperature test valves for verifying accuracy of flow performance shall be available for all valve sizes.

4. Optional accessories shall include a stem packing lubricator for factory or field assembly. Valve stem packing shall be low friction, tight sealing Teflon.
5. Unitary valves shall be straight-through or three way type as specified in the sequence of operation with high-pressure connections suitable for copper pipe and rated for 250 psig. Stems shall be polished stainless-steel and packing shall be ethylene-propylene suitable for both chilled water and 250 degree hot water service. Straight-through valves shall have back-seating feature, to allow packing to be replaced without draining system.
6. All valves shall use guided valve plugs for good seating and reliable operation. Valves ½ inch to 1 inch shall be ANSI Class 125 brass body with screwed ends. Valves 1-1/4 inches to 2 inches shall be ANSI Class 150 brass body with screwed ends. Valves 2-1/2 inches to 4 inches shall be Class 125 cast iron body with bronze trim and flanged ends. Valves 6 inches and larger shall be Class 125 steel body with bronze trim and flanged ends. Butterfly valves shall be DeZurick HIGH performance or Keystone Keylock, Lug style as specified in Division 23 Section, HVAC Piping, Fittings, and Valves.
7. All heating coil valves shall be normally open to the coil.

B. Control Valve Operators

1. Electric valve actuators shall be properly sized to provide sufficient torque to position valves 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. Spring return valves are required for all control valves where coils are exposed to outside air conditions.
3. Electric actuators requiring a 24VAC 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, 4-10Ma etc.) without the need for any additional interface devices.

2.6 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.

2.7 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.

2.8 UNINTERRUPTIBLE POWER SUPPLY

A. Furnish, size and install uninterruptible power supplies (UPS’s) at all ATC panels.

B. Provide all interlock and power wiring from U.P.S. to control panels as required such that all components are powered via the UPS. For hard-wired equipment furnished with pigtails/wire leads, e.g. control power transformers, splice pigtails/wire leads in junction box to a flexible cord with NEMA 5-15P Plug, which shall be plugged into the UPS.

C. UPS's shall be sized for the ATC panel load and shall provide at least 10 minutes of full load power in the event of a power outage.

D. UPS shall be furnished with plug and cord and shall be powered from emergency power receptacle(s) in ATC panels.

2.9 DESKTOP WORKSTATIONS

A. Description: A tower or all-in-one computer designed for normal use at a single, semipermanent location.

B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. Energy Star compliant.

C. Personal Computer:

1. Minimum Processor Speed: 3 gigahertz (GHz).
2. RAM:
    a. Capacity: 16GB.
    b. Speed and Type: 1333 MHz, SDRAM.
3. Hard Drive:
    a. Media: Solid state.
    b. Number of Hard Drives: One.
    c. Capacity: 250GB.
4. Optical Read and Write Drive:
    a. Include with at least 2 MB of data buffer.
    b. Type: SCS1 CD-ROM Drive with Read/Write Capability.
    c. Average access time of 150 ms or less.
5. At least four expansion slots.
6. Video Card:
    a. Resolution: 1920 by 1200 pixels.
    b. RAM: 4 GB.
    c. Controller Speed: 4GHz.
7. Sound Card:
    a. At least 128 voice wavetable synthesis.
    b. Capable of delivering three-dimensional sound effects.
    c. High-resolution 16-bit stereo digital audio recording and playback with user-selectable sample rates up to 48,000 Hz.
8. Two (2) Network Interface Cards: Include cards with connection, as applicable.
    a. 10-100-1000 base TX Ethernet with RJ45 connector port.
    b. 100 base FX Ethernet with SC or ST port.

D. Wireless Ethernet, 802.11 a/b/g/n.

1. Optical Modem: Full duplex link for connection to optical fiber cable provided.
2. I/O Ports:
    a. Two USB 3.0 ports on front panel, six on back panel, and three internal on motherboard.

b. One serial port.
c. One parallel port.
d. Two PS/2 ports.
e. One RJ-45.
f. One stereo line-in and headphone/line-out on back panel.
g. One microphone and headphone connector on front panel.
h. One IEEE 1394 on front and back panel with PCI-e card.
i. One ESATA port on back panel.

3. Battery: Life of at least three years to maintain system clock/calendar and ROM, as a minimum.

E. Keyboard:

1. 101 enhanced keyboard.
2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad, and 12 programmable function keys.
3. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

F. Pointing Device:

1. Either a two- or three-button mouse.
2. Wireless operation within up to 72 inches (1800 mm) in front of workstation.

G. Flat Panel Display Monitor:

1. Display:

a. Color display with 21 inches diagonal viewable area.
b. Digital input signal.
c. Aspect Ratio: 16 to 9.
d. Antiglare display.
e. Tilt adjustable base.
f. Energy Star compliant.
g. Resolution: 1920 by 1200 pixels at 60 Hz.
h. Number of Displays: One.

H. Speakers:

1. Two, with individual controls for volume, bass and treble.
2. Signal to Noise Ratio: At least 65 dB.
3. Power: At least 4 W per speaker/channel.
4. Magnetic shielding to prevent distortion on the video monitor.

I. I/O Cabling: Include applicable cabling to connect I/O devices.

2.10 CENTRAL CONTROL AND MONITORING SYSTEM (CCMS) (HARDWARE DESCRIPTION)

A. General

1. The Facilities Management Control System (FMCS) shall be comprised of a network of various independent, Stand-alone Digital Controllers (SDC'S), Mechanical System Digital Controllers (MSDC's), Air Handler Digital Controllers (AHDC's), Unitary Digital Controllers (UDC's), shall be interconnected in a communicating network to provide facility wide access and sharing of information. A Gateway Digital Controller (GDC's) shall be provided to allow interface with third party microprocessor based control systems that are specified for integration within specification. A Local Area Network (LAN) shall be provided to interconnect SDC's for high-speed data transmission.
2. Specification Nomenclature

a.	FMCS	Facility Management Control System
b.	SDC	Stand-alone Digital Controller
c.	MSDC	Mechanical System Digital Controller
d.	AHDC	Air Handler Digital Controller
e.	UDC	Unitary Digital Controller
f.	HHOT	Hand Held Operator Terminal
g.	GDC	Gateway Digital Controller
h.	GP	Graphical Programmer
i.	CHS	Central Host Station
j.	CCS	Central Control Station
k.	RPTR	Communications Repeater

B. Centralized Host Stations (CHS)

1. The FMCS shall include Centralized Host Stations. CHS's shall, in conjunction with the full compliment of Digital Controllers, provide the performance requirements within this specification. Each CHS shall include all hardware and software components to serve as a centralized facility operator station, providing color graphics, facility wide access, operator initiation of global control strategies, and centralized documentation.
The CHS shall be capable of simultaneously interfacing with the following:

a. -mouse pointing device
b. -two parallel printers
c. -high resolution VGA color graphics monitor
d. -seven auto answer/auto dial modems
e. -color inkjet printer
f. -two serial printers
g. -three FMCS LAN interface
h. -Alarm Graphic and Report FAX dial out service interface
i. -Mass storage tape system

As a minimum, the temperature control contractor shall provide the types and quantities of CHS, CCS, SDC, MSDC, AHDC, GDC, and UDC as required.

2. Computer

    a. The existing FMS computer located in the Maintenance Office shall be utilized with the new CCMS System if compatible with the same. If the selected ATC contractor cannot tie into the existing computer, then a new stand-alone computer shall be furnished. I/P data drop shall be provided adjacent to the network panels.
    b. Coordinate IP address with Owners' I.T. Department for network connection. The CCMS must be fully networkable.
    c. Provide fiber optic cable as required.
    d. Extend Existing Building Management System (BMS) as required to accommodate all equipment on this project.

3. Operator Workstation: One PC-based microcomputer with minimum configuration as follows:

    a. Uninterruptible Power Supply: 2 kVa.
    b. Operating System: Microsoft Windows – Latest Version.
        i. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
        ii. LonWorks Compliance: Control units shall use LonTalk protocol and communicate using EIA/CEA 709.1 datalink/physical layer protocol.

C. Centralized Control Stations (CCS)

1. The FMCS shall include Centralized Control Stations, as required. CCS's shall, in conjunction with the network of SDC's and additional CCS components as required, provide the performance requirements within this section of the specification. Each CCS shall include all hardware and software components to serve as a centralized facility operator station, providing facility wide access, for review and modification of global control strategies, real time system monitoring, controller database editing or creation, and centralized documentation.

D. Local Area Networks

1. The LAN shall utilize packetized transmissions, CRC 16 error checking, and distributed error recovery. Single or multiple SDC failures shall not cause loss of communication between other LAN-connected SDC's.
2. LAN connected SDC's shall be provided with a communications watchdog to assure that an individual SDC cannot permanently occupy the LAN. If an SDC is determined to be monopolizing communications, it shall be automatically shut down and an exception reported to annunciate this fact.
3. The LAN shall employ a token passing, peer-to-peer convention, same as or similar to the industry standard format IEEE 802.4. The content of messages shall be the manufacturer's standard. The Local Area Network components shall be manufacturer's standard or available from third party vendors which utilize the same chip implementation as used by the manufacturer.
4. Industry standard ANSI, RS-485 Network Communication System, Lon, or

Bacnet, or Equivalent shall be utilized.

5. Trunk Wiring Practices - General

   a. The distributed communication network system shall consist of a multi-drop RS-485 bus architecture connecting SDC's, MSDC's, AHDC's, GDC's, and UDC's. The trunk shall consist of:
      i. A twisted pair of wires (24 awg) completely encased in continuous metallic conduit.
      ii. A twisted shielded pair of wires (24awg) with the shield grounded in accordance with the manufacturer's wiring practices.
      iii. Or a dual channel, 62.5 micron fiber cabling system with ST type connectors.

      There shall be no power wiring, in excess of 30 VAC rms voltage, run in conduit with communications trunk wiring. In cases where power or signal wiring is run in conduit with trunk wiring, all communications trunk wiring and power wiring shall be run using separate twisted shielded pairs (24awg) with the shields grounded in accordance with the manufacturer's wiring practices.

   b. Communication Transient Protection
      i. The manufacturer's catalog data sheet shall provide evidence that all FMCS products offered by the manufacturer are tested and comply with the standard for Transient Surge withstand capabilities for electrical devices ANSI C62.41, IEEE-587-1980, Categories A and B. Such testing shall have included power and communication trunk wiring. Compliance with IEEE-587 shall imply conformance with IEEE-472 transient standards based on the stated position of ANSI and IEEE regarding applicability of the rated standards.
      ii. In addition, at each building entry and exit point, the wire communications trunk wiring shall be protected with a transient surge protection device providing the minimal protection specifications of the General semiconductor, Model #422E device. Transient surge protection is not necessary if the communication trunk, external to the building, is fiber optic in nature.
      iii. The communications circuitry and input/output circuitry, of the SDC's, MSDC's, and AHDC's, shall provide protection against a 1000 volt, 3 amp transient signal, directly applied to the communication or input/output terminations. The manufacturer's catalog data sheet shall provide evidence of conformance with this requirement. Systems not complying with this requirement shall provide equivalent protection external to the FMCS controller. Protection shall be provided for the individual communications and input/output terminations for each FMCS controller. Submittal documentation shall clearly define how this requirement will be met and how the external protection will not affect the performance of the controllers.

   c. RS-485 Trunk Distance and Topology

      The manufacturer's RS-485 trunk shall provide operation over end to end linear distances of 4000 feet for wire connections and 6,500 feet for fiber

optic connections, without repeaters, at communication data rates of up to 64 kbps. The trunk may be extended up to 20,000 feet through the use of wire repeaters or 80,000 feet through the use of fiber optic repeaters.

At data rates of up to 19.2 kbps, the trunk distance shall be extendible to distances of up to 20,000 feet using RS-485 communication wire or fiber optic repeaters. A repeater shall be used each 4,000 feet of linear distance for wire or every 6,500 feet for fiber optics. Repeating devices shall contain separate LED indication for each communication interface trunk to indicate proper operation of the repeater as well as the communications trunks.

Contractors shall provide devices which are of FMCS control system manufacturer's design.

d. It shall be possible for the trunk to be "T" eed or "starred", at any location using a repeater, to facilitate the installation. Systems which do not provide this capability shall provide a trunk riser diagram showing end to end distances and locations of system topology necessary to meet the trunk diagram shown on the plans.

e. Fiber Optic Communication Trunk

The temperature control contractor shall provide a dual channel fiber optic data link, as required, to minimize the effects of transient surges caused by lightning or external EMI generating equipment. The data link shall be comprised of a single duplex cable containing two fibers (transmit and receive), of 62.5 micron construction, to accommodate data rates of up to 64 kbps.

The fiber optic trunk shall be connected to SDC devices using manufacturer's standard RS-485 to fiber optic data link modem. Repeating devices shall contain separate LED indication for each communication interface and the fiber modem, to indicate proper operation of all aspects of the device. Fiber modem devices shall be tested and conform with transient surge withstand tests for electrical devices, ANSI C62.41 IEEE-587 Categories A and B. Manufacturer's data sheet shall provide evidence of compliance with this requirement. Manufacturer's products which do not meet this minimum performance requirement shall not be acceptable.

Systems which require a special gateway controller to accommodate the fiber optic trunks, shall provide such a controller per point where the fiber optic cable enters and leaves the building. Gateway controllers shall not inhibit transfer of point data values between SDC controllers throughout the LAN. Such inhibitive systems shall not be acceptable.

In lieu of the above two options, the contractor may provide a fiber optic link to each SDC controller within the LAN. All controllers shall have access to the fiber optic link for LAN.

Fiber optic cable shall be fully tested and terminated by the temperature control contractor.

E. Standalone Digital Controllers (SDC)

1. General

Standalone Digital Controllers (SDC) shall be 16 bit microcomputer based, utilizing a multi-tasking, multi-user operating system.

The SDC controllers shall permit the simultaneous operation of all control,

communication facilities management and operator interface software, as programmed by the Contractor or User. Modification of the on-board SDC controller database shall be performed on-line using the built-in or HHOT interface. Systems which require the SDC to be removed from service while DDC control sequences are modified shall not be acceptable.

SDC controllers shall utilize true floating point arithmetic capabilities. To accommodate totalization of large totalized values, SDC's with reporting capability shall support the calculation, accumulation and display of values within the range of +/-10 to the 10th power.

2. Database and Memory Back-up

All programming defining the functions to be performed by the SDC, including but not limited to application programs and point database within each SDC, shall be protected from loss due to power failure for a minimum of six months. Systems providing non-volatile memory for these functions are preferred. Systems not providing non-volatile memory shall provide a system rechargeable battery backup system sufficient to provide protection for the specified 6 month period. Systems not in compliance shall provide for uninterrupted power to each SDC.

3. Service Ports

SDC controllers shall be equipped with a minimum of one operator service port for the connection of a HHOT. The service port shall be either a built-in RS-232 data terminal port or an RJ-11 type jack which connects to the manufacturer's standard HHOT.

Connection of a service device, to a service port, shall not cause the SDC controller to lose communications with its peers or other networked device controllers.

The service port shall allow utilization of the same HHOT from any location. The same HHOT shall be utilized for any SDC, MSDC, AHDC, or UDC Systems which utilize more than one variety of HHOT shall not be acceptable.

4. Display and Readout Capability

The SDC controller shall provide manufacturer’s standard display and readout capability.

5. Manual/Auto Control and Notification

The SDC controller shall provide commanded override capability from the HHOT or the built-in operator interface. Such overrides shall be annunciated to the CHS's. Such overrides shall be valid as long as power is applied to the controller.

Manual service overrides, such as Hand/Off/Auto switches, shall be provided as indicated on the drawings. Such overrides shall be located at the controlled device location and conform with OSHA Manual lockout regulations, as appropriate, for safety reasons. SDC indication of such manual override actions shall be provided as feedback status indication points shown on the drawings, in conjunction with the application programs within the SDC. Systems which provide built-in H/O/A switching devices with integral feedback shall provide external manual service overrides, as indicated, to comply with OSHA manual lockout regulations. H/O/A switches remotely located at the SDC controller are not acceptable.

6. Adjustments

Every control panel shall provide adjustments for the functions specified. In general, adjustments shall be provided for all set points used by controllers within each control panel. In addition, adjustments shall be provided for throttling ranges, mixed air damper minimum positions, or other items as specified. Adjustments shall be integral to each individual SDC. The built-in operator interfaces shall allow the easy execution of the adjustment through named identifiers within the

SDC. From a single SDC user interface, any other SDC shall be accessible and full adjustment capabilities shall be provided.

7. Sensing and Control Outputs Requirements

a. Sensing

i. All sensing inputs shall be provided via industry standard signals. Temperatures, humidities, differential pressure signals, and other signal inputs shall be one of the following types:

1) 0-20 mA
1) 4-20 mA
1) 0-5 VDC
1) 0-12 VDC

ii. 1000 ohm platinum (at O°C, 2.62 ohms/°C)
iii. 1000 ohm Balco (2.2 ohms/°F)
iv. 10 k ohm Thermistor (at 25°C/77°F)

Custom, definable input signals (accept sensor inputs from RTD devices, other than those of the manufacturer).

All signal inputs shall be compatible with the controllers used, and with the requirements for readout of variables in true scaled engineering units as specified.

b. Control Outputs

i. On/Off Outputs

Control panel shall internally provide test points for the circuit driving the equipment contactor, for the purpose of troubleshooting the 120 VAC or 240 VAC circuit to the contactor. All such relays or digital output modules shall provide a pilot light or LED display of the same status. On/Off output modules shall be of the modular construction that can be easily and quickly replaced, on an individual basis, if the module were to be damaged.

ii. Modulating Outputs

Modulating outputs shall be industry standard 0-5 VDC, or 0-12 VDC with definable output spans, to adapt to industry available control products. Milliamp outputs of 0-20 mA or 4-20 mA are also acceptable. Drive open/Drive closed type modulating outputs are acceptable provided that they also comply with the following requirements.

All modulating outputs shall provide within the control panel, a meter gauge, or display indication via on board display or HHOT, the commanded position signal for the actuating device. This meter, gauge, or display must provide either a 0-100 percent position indication, or read out directly in the engineering unit of the signal being used. Drive open/Drive closed type controllers shall include sufficient components and control algorithms to comply with this requirement. In the case of Drive open/closed technology, position feedback shall be provided to insure positive indication that the control device is at the commanded position.

F. Mechanical System Digital Controllers (Msdc's)

1. General

a. Controls shall be microprocessor based, Mechanical System Direct Digital Controllers (MSDC's). MSDC's shall be provided for air handling units,

central pump systems and other applications as required. MSDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the MSDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates sensor signals. All input/output signal conversion shall be performed through a minimum of a 12 Bit A to D converter. All input/output points shall be universal in nature allowing their individual function definition to be assigned through the application software. All unused input/output points must be available as universally definable at the owner discretion. If input/output points are not fully universal in nature, unused points must be equal in quantity between Analog Input, Digital Input, Analog Output, Digital Output.

Contractor shall provide a minimum of one MSDC controller per mechanical system, as shown on the drawings.

The BAS contractor shall provide and field install al MSDC's specified under this section. Mechanical Equipment manufacturers desiring to provide MSDC type controls as factory mounted equipment, shall provide a separate bid for their product less all controls, BAS/Temperature Control Contractor.

b. All input/output signals shall be directly hardwired to the MSDC. Trouble shooting of input/output signals shall be easily executed with a volt-ohm-milli-amp meter (VOMA). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be used.

c. MSDC shall be in continuous direct communication with the network which forms the facility-wide Building Automation System (BAS). The MSDC's shall communicate with the SDC at a baud rate of not less than 19,200 baud.

2. Non-Volatile Memory

a. All control sequences programmed into the MSDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained. Power failures shall not cause the MSDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The MSDC shall allow for the creation of unique application control strategies. Systems that allow selection of sequences from the library or table are not acceptable.

b. All control sequences shall be fully field programmable at the MSDC controller, allowing for the creation or editing of an application sequence of operations.

c. Each MSDC shall be provided with manufacturer’s standard built-in Operator Interface.

d. The MSDC shall allow for internal processing and reporting of user defined Time of Day Schedules, Alarms, Trend Reports, Run Time Totalization, Energy Utilization Reports, Application Program Documentation and interface with a peripheral device such as an autodial/autoanswer modem, a VT-100 Display Terminal, or a serial printer.

i. Systems not providing the above functionality at the MSDC are

not acceptable and shall utilize an SDC in place of the MSDC.

e. The MSDC shall provide LED indication of transmit/receive communications performance as well as for the proper/improper operation of the controller itself.

f. The MSDC shall be provided with a battery backed time clock that is capable of maintaining the time of day and calendar for up to thirty days without loss of setting. The battery for the time clock shall be field replaceable by the customer. Integral daily, weekly, holiday and special event scheduling shall be provided, such that all schedules can be custom tailored to the facility. Predefined schedules, with set quantities of on/off cycles are not acceptable.

3. Controller Location

a. To simplify controls, mechanical service and troubleshooting, the MSDC shall be mounted directly in or on the control compartment of the mechanical system. The MSDC shall be provided in a NEMA 1 enclosure to accommodate direct mounting on the equipment to be controlled. The MSDC shall be constructed in a modular orientation such that service of the failed components can be performed quickly and easily. The modular construction should limit the quantities of printed circuit boards to a maximum of three. When required to replace a printed circuit board, it shall not be necessary to disconnect any field wiring. The MSDC shall allow for the creation of, unique, application control strategies. Systems that allow selection of sequences from a library or table are not acceptable. This shall allow all controls maintenance and troubleshooting to be made while at the unit location. MSDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

b. For compatibility to the environment of the mechanical systems, MSDC shall have wide ambient ratings. MSDC shall be rated for service from -40 Deg F (Degrees Fahrenheit) to 140 Deg F.

c. Contractor shall submit description of location for the MSDC's on all mechanical equipment.

G. Air Handler Digital Controller (AHDC)

1. General

a. Controls shall be microprocessor based, Air Handler Digital Controllers (AHDC's). AHDC's shall be provided for air handling units, energy recovery ventilators, and other applications as required. AHDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the AHDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates the sensor signals. All input/output signal conversion shall be performed through a minimum of a 10 bit A to D converter. All input points shall be universal in nature allowing their individual function definition to be assigned through the application software. All unused input points must be available as universally definable at the discretion of the owner. If the input points are

not fully universal in nature, unused points must be equal in quantity between Analog Inputs and Digital Inputs.

Contractor shall provide a minimum of one AHDC controller per air handling system as shown on the drawings.

The BAS contractor shall provide and field install all AHDC's specified under this section. Mechanical equipment manufacturers desiring to provide AHDC type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BAS/Temperature control contractor.

b. All input/output signals shall be directly hardwired to the AHDC. Troubleshooting of input/output signals shall be easily executed with a volt-ohm meter (VOM). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be utilized.

c. AHDC's shall be in continuous direct communication with the network which forms the facility wide Building Automation System. The AHDC's shall communicate with the SDC at a baud rate of not less than 19,200 baud.

2. Non-Volatile Memory

a. All control sequences programmed into the AHDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the AHDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The AHDC shall allow for the creation of unique application control sequences. Systems that only allow selection of sequences from a library or table, are not acceptable.

b. All control sequences shall be fully programmable at the AHDC, allowing for the creation and editing of an application control sequence, while at the unit.

c. The AHDC shall be provided with an interface port for the HHOT. The interface port shall allow the HHOT to have full functionality as described. From the interface port, the HHOT shall be able to directly access any AHDC or UDC in the network.

d. The AHDC shall provide an input/output point trending utility that is capable of accumulating 48 analog point samples and 10 digital point samples, per Input/Output point. Each sample shall be taken on a user defined interval, ranging from 1 second to 255 hours per sample. The digital readings shall be on a change of state occurrence for the digital points. All samples shall be recorded with the engineering units for the value, along with a time and date identifier for each sample taken. The samples shall be protected against loss due to power interruptions through a battery or capacitor backup method for a minimum of 30 days.

Systems unable to provide the above capability shall provide for the individual Input/Output point trending at the SDC. Specifics as to how each AHDC point will be trended, at the SDC, shall be provided in the submittal documents. Included in the explanation shall be the sample intervals, the memory allocation in the SDC and the number of AHDC's

per SDC that can be expected.

e. The AHDC shall provide LED indication of transmit/receive communications performance, as well as for the proper/improper operation of the controller itself.

f. The AHDC shall be provided with a battery backed time clock that is capable of maintaining the time of day and calendar for up to thirty days, upon loss of power to the AHDC, without loss of setting. The battery for the time clock shall be replaceable by the customer. The AHDC shall be provided with integral time schedules; as a minimum, two seven day schedules with eight on/off periods per day shall be provided. Holiday override of weekly schedules shall be provided for pre-scheduling of holidays, for the year in advance.

3. Controller Location

a. To simplify controls and mechanical service troubleshooting, the AHDC shall be mounted directly in or on the controls compartment of the air handling system. The AHDC shall be provided in a NEMA 1 enclosure to accommodate direct mounting on the equipment to be controlled. The AHDC shall be constructed in a modular orientation such that service of the failed components can be done quickly and easily. The modular construction should limit the quantities of printed circuit boards to a maximum of two. All logic, control system, power supply and input/output circuitry shall be contained on a single plug-in circuit board. When required to replace a printed circuit board, it shall not be necessary to disconnect any field wiring. This shall allow all controls maintenance and troubleshooting to be made while at the air handling unit. The AHDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

b. For compatibility to the environment of the air handling unit, AHDC's shall have wide ambient ratings. AHDC's shall be rated for service from -40 Deg F (Degrees Fahrenheit) to 140 Deg F.

c. Contractor shall submit description of location of AHDC's on all mechanical and air handling equipment.

H. Unitary Digital Controller (UDC)

1. General

a. Controls shall be microprocessor based Unitary Digital Controllers (UDC's). UDC's shall be provided for equipment as necessary. UDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the UDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates the sensor signals. All input/output signal conversion shall be performed through a minimum of a 10 bit A to D converter.

Contractor shall provide a minimum of one UDC controller per unitary system as required.

The BAS contractor shall provide and install all UDC's specified under

this section. Mechanical equipment manufacturers desiring to provide UDC type controls as factory mounted equipment, shall provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BAS/Temperature control contractor.

b. All input/output signals shall be directly hardwired to the UDC. Troubleshooting of input/output signals shall be easily executed with a volt-ohm-milli-amp meter (VOMA). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be utilized.

c. UDC's shall be in continuous, direct communication with the network which forms the facility wide building automation system. The UDC's shall communicate with the SDC at a baud rate of not less than 9,600 baud.

2. Non-Volatile Memory

a. All control sequences programmed into the UDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the UDC memory to be lost, nor shall there be any need for batteries to be recharge or replaced to maintain the integrity of the controller database. The UDC shall allow for the creation of unique application control sequences. Systems that allow only selection of sequences from a library or table are not acceptable.

b. All control sequences shall be fully configurable at the AHDC, allowing for the creation and change of a sequence while at the unit.

c. The UDC shall be provided with the ability to interface with the HHOT. The interface port shall be provided at the wall sensor or within the unitary equipment, as specified on the plans. The interface port shall allow the HHOT to have full functionality as described hereinbefore of this specification. From the interface port, the HHOT shall be able to directly access any AHDC or UDC in the network.

d. The UDC shall provide an input/output point trending utility that is capable of accumulating 48 analog point samples and 10 digital point samples per Input/Output point. Each sample shall be taken on a user defined interval, ranging from 1 second to 255 hours per sample. The digital readings shall be on a change of state occurrence for the digital points. All samples shall be recorded with the engineering units for the value, along with a time and date identifier for each sample taken.

Systems unable to provide the above capability shall provide for the individual input/output point trending at the SDC. Specifics as to how each UDC point will be trended, at the SDC, shall be provided in the submittal documents. Included in the explanation shall be the sample intervals, the memory allocation in the SDC and the number of UDC's per SDC that can be expected.

e. The UDC shall provide LED indication of transmit/receive communication performance, as well as for the proper/improper operation of the controller itself.

3. Controller Location

a. To simplify controls and mechanical service troubleshooting, the UDC shall be mounted directly in the controls compartment of the unitary system. The UDC shall be provided with a sheet metal or polymeric enclosure that is constructed of material allowing for the direct mounting within the primary air stream, as defined by UL-465. The direct mounting shall allow all controls maintenance and troubleshooting to be made while at the unitary equipment. The UDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.

b. For compatibility to the environment of the unitary equipment, UDC's shall have wide ambient ratings. UDC's shall be rated for service from 32 Deg F (Degrees Fahrenheit) to 140 Deg F.

c. Contractor shall submit description of location of UDC's on all mechanical and unitary equipment.

I. Gateway Digital Controller (GDC)

1. General

a. Controls shall be microprocessor based, Gateway Digital Controllers (GDC's). GDC's shall be provided for the purpose of integrating microprocessor based, communicating, direct digital control systems from vendors other than the primary, selected controls manufacturer. GDC's shall be based on a minimum 16 bit microprocessor working from software program memory which is physically located in the GDC. All communications interface control programs shall be resident within the GDC.

The BAS contractor shall provide and field install all GDC's specified under this section. Any interface requirement beyond a two wire communications wire link, shall be provided by the equipment manufacturer supplying the non-primary or third party microprocessor based, communicating, direct digital controllers.

b. All GDC's shall exist at the LAN level with the SDC's. The GDC's shall possess all capabilities described under the SDC section while additionally providing the interface to the third party systems described above. The GDC's shall communicate with the third party controllers at the highest possible baud rate offered by the third party system. As a minimum, 9,600 baud communications shall be utilized.

c. All control sequences programmed into the GDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the GDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The GDC shall allow the standard database information from the third party system to be integrated in standard FMCS data formats, allowing for the creation of unique application control sequences. Systems that only allow selection of data and sequences from a library or table, are not acceptable.

d. Each GDC shall be provided with manufacturer’s standard built-in operator interface.

The GDC shall provide Alarming, point trending and Energy report generation capabilities. Alarming points shall be uniquely definable, with

multiple alarms assignable to a single point. Such alarm shall be provided with a unique 80 character message. Systems utilizing an alarm message library, shall describe the size of the library and verify how all alarming within the GDC will be guaranteed unique 80 character messages.

The quantities of trended point values shall be limited only by total controller memory space. If necessary, a GDC may be dedicated fully to a trending task, allowing all controller memory to be available for the trend storage. Each unique trend report shall contain a minimum of 4 different points and a minimum of 128 samples per point. Trending frequency for each report shall be operator definable from a sample once a second to a sample once every 24 hours. Trend reports shall be internally formatted by the GDC and shall be reportable directly to a serial printer, a VT-100 display terminal, a CCS, CHS or any other device capable of receiving a formatted ASCII data file.

e. The energy reports shall not be limited in quantities only by available memory within the GDC. Each Energy Report shall be fully formatted and reportable to a serial printer, a VT-100 display terminal, a CCS, a CHS or any other device capable of receiving a formatted ASCII data file. As a minimum, each Energy Report shall provide a daily report and a monthly report with summary information such as outside air temperature, outside air humidity, total energy consumed and degree day calculations.

f. The GDC shall be provided with a battery backed clock that is capable of maintaining the time of day and calendar for up to thirty days, upon loss of power to the GDC, without loss of setting. The battery for the time clock shall be field replaceable by the customer.

2.11 SYSTEM SOFTWARE DESCRIPTION

A. General

1. Contractor shall provide all software for a complete and operational system as described herein. Software shall include manufacturer's standard multi-tasking, multi-user operating system for operator consoles and controllers, network communication software for dial-up and hard trunk applications, operator man-machine interface software, control application software and all other software necessary to provide the functions specified herein.
2. System software shall be as manufactured by Siebe Environmental Controls, Johnson Controls, Johnson Controls Facility Explorer, Honeywell, Siemens, Alerton, Reliable Controls, Schneider Electric, Advanced Power, Trane, or approved equal.

2.12 EXCEPTION REPORTING SEQUENCES

A. Alarm/COS Reports

1. For those digital points indicated on the drawings, the Contractor shall provide a unique change-of-state alarm message of up to 70 characters. The message shall report to all devices assigned to the alarm class.

2. For those points indicated on the drawings which are designated as interrupt priority, the Contractor shall provide an interrupting process display at the CHS location which displays the current conditions for the operator.
   In addition, the CHS computer shall automatically send a picture of the process graphic display to the remote locations via e-mail.
3. For those points designated in paragraph 3 above, the FMCS shall also send a history log to the system report printer of the immediate prior history of the points causing the interrupt priority. This log shall contain 1 minute samples of the previous 15 minutes of operation.
4. For those points on the drawings designed as Hard Facts points, the Contractor shall provide an alarm message to a remote facsimile location designated by the Owner. The FMCS system shall provide at the remote location, a facsimile print-out showing location, time/date of alarm and alarm message of the point. For interrupt priority fax alarms, the remote facsimile machine shall receive a hard copy of the interrupt process screen showing on-line dynamic data values of the current conditions.

B. Off Hours Exception Reporting

1. The Owner shall specify up to five sites to which off hours exceptions shall be auto-dialed and reported. This shall allow the owner to assign off hours exception responses to various facility personnel as necessary. Selection of the site to be dialed can be programmed by the Owner, and set to change automatically per time of day and day of week.

2.13 MONITORING SYSTEM, SENSORS AND WIRING

A. Sensors and other Devices for Input/Output Summary Schedule:

1. Provide all necessary sensors, relays, panels, conduits and wire for the points indicated in the input/output summary as shown on the contract drawings.
2. Analog sensing elements for remote indication shall be independent of local sensors used for local control loops.
3. Temperature sensors shall be Resistance Temperature Detector (RTD) type of 1000 ohm balco. Space (60-90 degrees F); Duct/Well (-30-250 degrees F); Averaging Duct (-30-225 degrees F) or as required under Division 26.

   a. Space temperature sensors shall be provided with blank commercial type locking satin chrome covers.
   b. Duct temperature sensors shall be rigid stem or averaging type as specified in the sequence of operation. Water sensors shall be provided with a separable copper, monel or stainless steel well. Outside air wall mounted sensors shall be provided with a sun shield.
   c. The dew point temperature sensor shall employ a non-reactive organic bobbin material to give precise dew point temperature readings with accuracy of not more than + 1.5 degrees F. The dew point temperature sensor shall incorporate an integral draft shield as part of the instrument for air velocities in excess of 50 feet per minute. The dew point temperature sensor shall operate over a minimum dew point temperature

range suitable to application.

4. Relative humidity sensors shall be capacitance type with 10 percent to 90 percent range. Duct mounted relative humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with covers identical to temperature sensors. Space 10 percent -90 percent RH; Duct 10 percent - 90 percent RH.
5. All wall mounted temperature sensors, dew point temperature, relative humidity sensors, and CO2 sensors shall be installed with stainless steel wire guard. Set point adjustment shall be achievable without removing the wire guard.
6. Differential and Static Pressure Sensors and Switches

    a. Fan proof-of-flow switches shall be U.L. listed adjustable set point and differential pressure type. Switches shall be piped to fan discharge except where fans operate at less than one inch WG, they shall be piped across the fan. For fractional horsepower and non-ducted fans, relays or auxiliary contacts may be used. Maximum pressure rating shall be at least 10 inches WG. with .05-12 inch W.C. range.
    b. Pump proof-of-flow switches shall be U.L. listed adjustable differential pressure or flow type as specified in the sequence of operation or data point summary. Devices shall be 150 psi rated except chilled water flow switches shall be provided with totally sealed vapor tight switch enclosure on 300 psi body. Differential pressure switches shall have valved manifold for servicing, and a range of 3 psi-150 psi.
    c. Air flow and static pressure analog sensors shall be high accuracy suitable for the low velocity pressures to be encountered, be selected for approximately 50 percent overrange, and have a 4 to 20 ma output. These differential pressure sensors shall be connected to the air flow measuring station with valved lines for testing and calibration, and shall have adjustments for zero and span. 5 inch W.C. range.
    d. Water flow analog sensors shall be provided complete with flow element and shall be an all solid state precision industrial type with stainless steel meter body, maximum error of no more than .5 percent or span, and 4 to 20 ma output. Sensor shall be rated for 250 psi minimum and installed in strict accordance to the manufacturer's instructions complete with three-valve manifold for calibration and maintenance.

7. Overall system accuracy, including electronic analog sensing elements, shall be as follows:

    a. Air: Plus or minus 1.0 degrees F temperature, plus or minus 2.5 percent r.h., plus or minus 2.0 percent static pressure.
    b. Water: Plus or minus 0.7 degrees F over full scale range for water points, plus or minus 1.0 degree F for others.
    c. Proof of fan or pumps operating status, or alarm conditions shall be through positive feedback from differential pressure switches across fan or pump. Auxiliary dry contacts may be used for proof of fans or pumps if the motors are fractional H.P., and other non-ducted fans.
8. Digital inputs from devices with isolated, dry type contacts (no grounds, no voltage) of either normally open (N.O.) or normally closed (N.C.) configuration

shall be provided. Live contact inputs, those that have voltage present, shall be provided with isolating devices to meet dry contact requirements.

9. Liquid flow data shall be received and transmitted by commercial grade instrument similar in quality to Honeywell 411, Rosemount, Foxboro, MAMAC Systems or approved equal, type differential pressure transmitter. Pulse type data sensors shall not be acceptable. Speed response of differential pressure transmitters shall be at least 500 milliseconds. Maximum error signal shall be +/- 1 foot.
10. Start-stop relay module shall contain relays for start-stop function at the remote point, with relays mounted and factory wired to numbered terminal strips.
11. Outage Devices:

    a. Control Relays: Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life-span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression limiting transients to nondamaging levels.
    b. Time Delay Relays: Time delay relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels. Delays contact opening or closing shall be adjustable from one to 60 seconds with a minimum accuracy of plus or minus 2 percent of setting.
    c. Latching Relays: Latching relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dustproof enclosure. Relays shall have silver-cadmium contacts with a minimum life-span rating of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.
    d. Reed Relays: Reed relays shall be encapsulated in a glass-type container housed in a plastic or epoxy case. Contacts shall be rated for the application. Operating and release times shall be one millisecond or less. Reed relays shall have a minimum life span rating of 10 million operations.
    e. Contactors: Contactors shall be of the single-coil, electrically operated, mechanically held type. Positive locking shall be obtained without the use of hooks, latches, or semi-permanent magnets. Contacts shall be double-break silver-to-silver type protected by arcing contacts. Number of contacts and ratings shall be selected for the application. Operating and release times shall be 100 milliseconds or less. Contactors shall be equipped with coil transient suppression devices to limit transients to nondamaging levels.
    f. Solid-State Relays: Input-output isolation shall be greater than 1000 megohms with a breakdown voltage of 1500 V rms or greater at 60 Hz. The contact life shall be 10 million operations or greater. The ambient temperature range shall be minus 20 degrees to plus 140 degrees F. Input impedance shall not be less than 500 ohms. Relays shall be rated for the

application. Operating and release times shall be one millisecond or less. Transient suppression shall be provided as an integral part of the relay to limit transients to nondamaging levels.

12. Audible Alarm:

    a. All alarms shall annunciate on the ATC system front end computer and via pagers.

2.14 MAKE-UP WATER FLOW METER/ALARM

A. In-line T-mounted Flowmeter: Made for installation between pipe flanges; measures flow directly in gallons per minute. As manufactured by Aaliant, Badger, Hersey, Kele, Data Industrial or approved equal.

1. Construction: Stainless steel body, with integral transmitter and direct - reading scale.
2. Pressure rating: 400 psig maximum.
3. Temperature Rating: 221 F maximum
4. Display: Two lines; alphanumeric characteristic each. Visual instantaneous rate of flow, with register to indicate total volume in gallons.
5. Output: Two simultaneous outputs; 4 to 20 mA, two-wire, pulse.
6. Transmitter: Universal flow transmitter with pulse output (totalization) to convert digital pulses to totalized gallons.
7. Electronic Housing: NEMA4, 3/4 NPT conduit connection, epoxy coated aluminum.
8. Accuracy: Plus or minus 1 percent of reading.
9. Key Pad: Setting of recalibration, engineering units, data logging sample time, alarms, response time.

B. Power and control wiring to be furnished and installed under this Section of Division 23.

2.15 FLOW MEASURING STATIONS

A. Furnish and install an Onicon Model F-1210, Hersey, Kobold or approved equal dual turbine insertion flow sensor complete with hot tap full port ball valve and installation hardware. The dual turbine element shall have counter rotating axial turbine elements, each with its own rotational sensing system, and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Paddle type rotors will not be acceptable. Rotational sensing of each turbine shall be accomplished electronically by sensing impedance change and not with magnetic or photo-electric means. Each sensor shall be individually calibrated and tagged accordingly against the manufacturers primary standards which must be accurate to within 0.1 percent and traceable to the U.S. National Institute of Standards and Technology (NIST).

B. The sensor shall have a maximum operating pressure of 400 PSI, maximum operating temperature of 220 degrees F (optional 300 degrees F) and a pressure drop of less than 1 PSI at 17 feet per second flow rate. Flow sensor shall have 100:1 turndown ratio. Accuracy

shall be + 2 percent of actual reading from 0.4 feet per second to 20.0 feet per second.

C. The sensor shall have integral analog outputs of 0-10 VDC and 4-20 mA current output for connection to the Central Control System. The sensor shall also include three integral frequency outputs, (top turbine, bottom turbine, average frequency) for diagnostic purposes and for connection to peripheral equipment (local display, BTU meter, etc.). All outputs shall be linear with flow rate.

D. The turbine elements shall be made of polypropylene with sapphire jewel bearings and tungsten carbide shafts. The flow sensor shall be constructed of 316 stainless steel with an aluminum electronics enclosure and gasketed cover.

E. Install flow measuring stations with minimum straight lengths of pipe upstream and downstream from sensor as prescribed by manufacturer's written instructions.

F. Make electrical connections to power supply and interlock with ATC system.

G. Calibrate meters per manufacturer’s requirements.

2.16 WATER METER

A. A building consumption water meter and water heater consumption meter shall be provided and installed under Division 23 Section, “Plumbing Fixtures” and “Plumbing Equipment”. Refer to plumbing sections and drawing for type and location. The ATC contractor shall provide all necessary wiring, relays, terminations, etc., as required to interlock meter with ATC system. Building and water heater water flow shall be reported on ATC central computer. Flow rate and volume should be reported in ATC system.

B. At Contractor's option the building water meter may be furnished and installed under this Division.

C. Trend, hourly, daily, monthly, and yearly water use (in gallons) and forward to Engineer for one year. Create graphic on ATC system.

2.17 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.

2.18 CO2 SENSORS/TRANSMITTER

A. Furnish and install wall mount CO2 sensor/transmitters at locations indicated on floor plans. CO2 sensor/transmitter shall be model CD-W00 as manufactured by Johnson Controls or approved equal.

B. Measuring Range: 0 to 2,000 ppm CO2.

C. Response Time: 1 minute

D. Output Signal: As required by ATC system

E. Max power consumption: Less than 2 watts.

F. Listing: U.L. Listed

G. Accessories: Mounting Kit, Transformer required.

H. Where installed in toilet rooms and corridors install heavy duty stainless steel guards.

2.19 MECHANICAL FLOW SWITCHES

A. Furnish and install piping flow switches at all boilers, and additionally as shown on the Contract Documents.

B. Flow switches shall be Vaporproof, single pole double throw type as manufactured by McDonald and Miller or approved equal.

C. Enclosure shall be NEMA 4X rated for 150psig and suitable for temperatures between 0°F and 180°F with 1 inch MPT connection for upright mounting in horizontal pipe.

D. Size and select flow switches based on pipe size, insertion depth, pipe material and expected flow rate. Interlock status with ATC system.

E. At contractor's option based on manufacturer's requirements thermal dispersion flow switches may be utilized rather than mechanical flow switches.

2.20 DEW POINT TEMPERATURE SENSORS

A. Furnish and install dew point temperature sensors where indicated on the Contract Documents.

B. Dew point temperature sensor shall be model DP4AS as manufactured by TelAire or approved equal. Unit shall monitor dew point temperature and dry bulb temperature and report the same on the ATC system.

C. Units shall comply with the following:

Accuracy	
Enthalpy	± 2 BTU/lb
Dew Point Temperature	± 1.8°F (± 1°C)
Wet Bulb	± 3°F (± 1.7°C)
Dry Bulb	± 0.5°F (± 0.9°C)
Supply Voltage	18-30 VDCm 100 mA

Signal Output	Field selectable: 4-20 mA (700Ω max load), 0-5 V, or 0-10 V Humidity and dry bulb temperature
Measurement Range	
Dew Point: Space	40° to 90°F (4.4° to 32.2°C)
Enthalpy: Space	0-50 BTU/lb
Wet Bulb Space:	40° to 90°F (4.4° to 32.2°C)
Dry Bulb Space:	40° to 90°F (4.4° to 32.2°C)
Sensing Technology	Capacitive and replaceable
Operating Humidity	0 to 99% RH, non-condensing
Warranty	1 Year

D. Where installed in toilet rooms and corridors install heavy duty stainless steel guards.

2.21 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).

2.22 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 GENERAL

A. The Automatic Temperature Control System and Central Control and Management System, shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner.

3.2 BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a color graphic system flow diagram display for each new system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

B. Custom Reports:

1. Provide custom reports as required for this project:

3.3 WORKSTATION INSTALLATION

A. Desktop Workstations Installation:

1. Install workstation(s) at location(s) directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on workstation(s) and verify software functions properly.
4. Develop Project-specific graphics, trends, reports, logs and historical database.
5. Power each workstation through a dedicated UPS unit. Locate UPS adjacent to workstation.

B. Portable Workstations Installation:

1. Turn over portable workstations to Owner at Substantial Completion.

2. Install software on workstation(s) and verify software functions properly.

C. Color Graphics Application:

1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
4. Submit sketch of graphic layout with description of all text for each graphic for Owner's and Architect's review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing shall be done on-site with Owner's and Architect's review and feedback.
7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

3.4 INSTALLATION & SUPERVISION

A. All wiring and tubing shall be properly supported and run in a neat and workmanlike manner. All wiring and tubing exposed and in equipment rooms shall run parallel to or at right angles to the building structure. All piping and wiring within enclosures shall be neatly bundled and anchored to prevent restriction to devices and terminals.

B. The control contractor shall be responsible for all electrical installation required for a fully functional control and automation system and not shown on the electrical plans or required by the electrical specifications. All wiring shall be in accordance to all local and national codes.

1. All line voltage wiring, all wiring exposed, and all wiring in equipment rooms shall be installed in conduit in accordance to the electrical specifications.
2. All electric and electronic wiring shall be minimum #20 AWG minimum THHN and shielded if required.
3. All wiring in the central control room shall be concealed in an approved manner.

C. Verify locations of temperature sensors, relative humidity sensors, CO2 sensors, and other exposed control sensors with plans and Owner prior to installation.

D. The installation and supervision of this project shall be carried out by factory trained personnel who are employed by the Contractor and licensed for this type of work.

E. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

F. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation.

G. Install in accordance with manufacturer's instructions.

H. Check and verify location of space temperature sensors, relative humidity sensors, CO2 sensors, and other exposed control sensors with plans and room details before installation. Align with lighting switches and relative humidity sensors, and dewpoint temperature sensors.

I. Mount freeze protection thermostats using flanges and element holders.

J. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

K. Provide separable sockets for liquids and flanges for air bulb elements.

L. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

M. Install equipment plumb and level.

N. Install all equipment to be accessible for service and maintenance.

3.5 ACCEPTANCE TESTING

A. Point Verification

To verify end-to-end operation of the system the Contractor shall provide a hard copy of an All Points Summary Listing to the Owner of each part or system to be placed in warranty by the Owner. For CHS systems, the Contractor shall additionally provide a print screen of the process display showing real time dynamic point information for all points on the subsystem(s) to be accepted.

B. Sequence Verification

1. The Contractor shall notify the Owner's representative of systems which perform all specified sequences.
2. The warranty acceptance test shall be of 5 days duration and the system shall perform as follows:

    a. During the five days, the FMCS system shall not report any system diagnostics from the subsystem under test.
    b. The subsystem shall be performance verified as operational using temporary trends of each control loop located in the SDC or MSDC.
    c. During the occupied periods, BAS control loops, under test, shall maintain control of the process variable within the following scales:
        i. Duct Static Pressure +/-0.3 inch WC
        ii. Pump Head Pressure +/-10 percent of control range
        iii. Duct Temperature Loops +/-2 degrees F

iv. Room Temperature Loops +/-1degrees F
v. Pipe Temperature Loops +/-2 degrees F
vi. Duct Relative Humidity +/-2x rated error of Humidity Transmitter

d. The contractor shall provide a hard copy printout of the process variable, process variable set point and control loop output percent for the period of 2 hours prior to occupancy to 2 hours after occupancy with samples taken every 15 minutes.

3.6 COORDINATE WITH TAB AGENCY

A. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water reset, freeze stats and duct smoke detectors.

B. Verify that all controlling instruments are calibrated and set for design operating conditions prior to commencement of TAB work.

C. Calibrate sensors after installation, and before the sensor control verification tests are performed. Prove the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditional space for each separately controlled zone.

D. Allow sufficient time in the project to provide assistance and instruction to the balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers, or any other device that may need set points changed so that the testing and balancing work can be performed.

E. All control sequences, software, equipment, and components shall be started-up by a qualified technician. Start-up report shall be submitted to Engineer prior to the commencement of testing and balancing work. Testing and balancing shall not commence until start-up reports are completed, reviewed by Engineer and forwarded to Testing and Balancing Agency.

3.7 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Verify that conditioned power supply is available to the control units and to the operator

work station. Verify that field end devices, wiring, and tubing is installed prior to installation proceeding.

3.8 INTERLOCK REQUIREMENTS

A. The fan and equipment interlock requirements are as scheduled on the contract drawings.

B. Furnish and install all necessary relays, transformer, contactors, wiring, conduit, and accessories to perform fan, pumps, equipment, and damper interlocks.

C. Unless otherwise noted, fan interlocks shall be arranged such that dampers associated with fan shall be open when fan starts and close when fan stops.

D. In projects with ductless 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.

E. All boiler primary pumps shall be hardwired interlocked with boilers so that if primary pump fails, boiler shall de-energize.

3.9 SUBMITTALS AT PROJECT CLOSEOUT

A. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

3.10 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

C. Connect hand-off-auto selection switches to override automatic interlock controls when switch is in hand position.

3.11 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.
8. Test all end switches and verify status is reported on the ATC system.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
6. Check temperature instruments and material and length of sensing elements.
7. Check control valves. Verify that they are in correct direction.
8. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

E. All temperature control and interlock wiring shall be installed in conduit unless otherwise noted on the plans. Power or interlock wiring shall be run in separate conduit from sensor and communications wiring.

3.12 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using volt-ohm-milli-amp meter (VOMA) at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 0, 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers.
9. Stroke and adjust low water cutoffs.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial CO_2, temperature, dewpoint temperature, static pressure, differential pressure, 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.

3.13 ON-SITE ASSISTANCE

A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

3.14 SCHEDULING

A. Submit spreadsheet to Owner indicating occupied/unoccupied times for each item controlled by ATC system. Incorporate all scheduling requirements into sequence of operation.

3.15 STAGING

A. Coordinate staging requirements with equipment being controlled. Where multistage units are scheduled or specified, provide all devices, controllers, wiring to control and sequence all stages.

END OF SECTION

DIVISION 23 SECTION 23 09 23
AIRFLOW MONITORING STATIONS
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SECTION 23 09 23 – AIRFLOW MONITORING STATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Airflow measurement stations and sensors.
2. Airflow switches.
3. Airflow transmitters.

B. Related Requirements:

1. Section 230900 "Instrumentation and Controls of HVAC and Plumbing Systems" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

A. Ethernet: Local area network based on IEEE 802.3 standards.

B. FEP: Fluorinated ethylene propylene.

C. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.

D. PEEK: Polyetheretherketone.

E. PTFE: Polytetrafluoroethylene.

F. PPS: Polyphenylene sulfide.

G. RS-485: A TIA standard for multipoint communications using two twisted pairs.

H. RTD: Resistance temperature detector.

I. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.
5. Product certificates.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include diagrams for air and process signal tubing.
5. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Delegated-Design Submittal:

1. Schedule and design calculations for flow instruments, including the following.

a. Flow at Project design and minimum flow conditions.
b. Pressure drop at Project design and minimum flow conditions.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each product requiring a certificate.

B. Product Test Reports: For each product, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Documentation of NIST traceability.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Provide parts, as indicated by manufacturer's recommended parts list, for product operation during two-year period following warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Select and size products to achieve specified performance requirements.

B. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 GENERAL REQUIREMENTS FOR FLOW INSTRUMENTS

A. Air sensors and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions and to provide flexibility for changes in operation.

B. Source Limitations: For flow instruments, obtain products from single source from single manufacturer.

2.3 AIRFLOW MEASUREMENT

A. General Requirements:

1. Adjustable for changes in system operational parameters.
2. Airflow Sensor and Transmitter Range: Extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions.
3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.

    a. Product certificates are required.

4. System Accuracy: The total system accuracy, including array averaging error, transducer error, etc… when installed in accordance with the manufacturer’s

recommendations and without field adjustment shall be as follows throughout the entire operating range.

a. Ducts and plenums: +/- 3% of reading
b. Outside air intakes +/- 5% of reading
c. Fan inlets +/- 10% of reading

5. Recalibration:

a. If the technology provided requires recalibration, the contractor shall be responsible for recalibrating the system on a semi-annual basis during the construction phase through the end of the project warranty period.

6. Product Applications

a. Select from instrument types to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
   i. The contractor will be required as part of the submittal process to provide a working demo that demonstrates that the unit will operate at the lowest air flows possible on the project. If the manufacture is unable to provide a working demo than their submittal will not be reviewed by the design team.
b. Duct-Mounted Airflow Sensors:
   i. Measured Velocities 500 fpm and Less:
      1) Thermal dispersion airflow station.
   ii. Measured Velocities Greater than 500 fpm:
      1) Thermal dispersion airflow station

B. Duct Mounted Thermal Dispersion Airflow Measuring Station:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ebtron: Gold Series. (Basis of Design)
b. Air Monitor Corporation: Electra-Flo

2. Source Limitations: Obtain airflow and temperature measuring sensors and transmitters from single manufacturer.
3. Description: Airflow station shall consist of one or more sensor probes and a remotely mounted microprocessor-based transmitter.
4. Performance:

a. Capable of independently processing up to 16 independently wired sensor assemblies.
b. Airflow rate of each sensor assembly shall be equally weighted and averaged by transmitter prior to output.
c. Temperature of each sensor assembly shall be velocity weighted and averaged by transmitter prior to output.
d. Listed and labeled by an NRTL as successfully tested as an assembly

according to UL 873, "Temperature-Indicating and Regulating Equipment."

e. Components shall be interconnected by exposed NRTL-listed plenum-rated cable or non-listed cable placed in conduit.

f. Each flow station shall be factory calibrated at a minimum of 16 airflow rates and three temperatures to standards that are traceable to NIST.

g. Airflow Accuracy: Within 2 percent of reading over the entire operating airflow range, with 0.25 percent repeatability.

i. Devices whose accuracy is combined accuracy of transmitter and sensor probes must demonstrate that total accuracy meets the performance requirements throughout the measurement range.

h. Temperature Accuracy: Within 0.15 deg F over entire operating range of minus 20 to plus 160 deg F.

i. Sensor Ambient Operating Temperature Range: Minus 20 to plus 160 deg F.

j. Transmitter Ambient Operating Temperature Range: Minus 20 to plus 120 deg F.

k. Sensor and Transmitter Ambient Operating Humidity Range: Zero to 99 percent, non-condensing.

l. Instrument shall compensate for changes in air temperature and density throughout calibrated velocity range for seasonal extremes at Project location.

m. Pressure Drop: 0.05-inch wg at 2000 fpm across a 24-by-24-inch area.

n. Instruments mounted in throat or face of fan inlet cone shall not negatively influence fan performance by reducing flow more than 1 percent of Project design flow or negatively impact fan-generated sound. Losses in performance shall be documented with submittal data, and adjustments to compensate for performance impact shall be made to fan in order to deliver Project design airflow indicated.

5. Sensor Assemblies:

a. Each sensor probe shall contain two individually wired, hermetically sealed bead-in-glass thermistors.

b. Mount thermistors in sensor using a marine-grade, waterproof epoxy.

c. Thermistor leads shall be protected and not exposed to the environment.

d. Each sensor assembly shall independently determine airflow rate and temperature at each measurement point.

e. Each sensor probe shall have an integral cable for connection to remotely mounted transmitter.

f. Sensor Probe Material: Gold anodized, extruded 6063 aluminum tube or Type 316 polished stainless steel.

g. Probe Assembly Mounting Brackets Material: Type 304 stainless steel.

6. Transmitter:

a. Integral digital display capable of simultaneously displaying total airflow

and average temperature, individual airflow, and temperature readings of each independent sensor assembly.

b. Capable of field configuration and diagnostics using an onboard push-button interface and digital display.

i. Include an integral power switch to operate on 24-V ac (isolation not required) and include the following:

1) Integral protection from transients and power surges.

2) Circuitry to ensure reset after power disruption, transients, and brownouts.

3) Integral transformer to convert field power source to operating voltage required by instrument.

2.4 AIRFLOW TRANSMITTERS

A. Airflow Transmitter with 0.10 Percent Accuracy and Auto-Zero Feature:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ebtron
b. Air Monitor Corporation: Veltron Mass-tron II

2. Transmitter shall receive total- and static-pressure signals from a primary element, amplify signals, extract the square root, and scale the signals to produce 4- to 20-mA dc output signals linear to airflow.
3. Transmitter shall have built in capability for both process temperature and pressure compensation.
4. NEMA 250, Type 1 enclosure.
5. Construct assembly so that shock, vibration, and pressures surges of up to 1 psig will neither harm transmitter, nor affect its accuracy.
6. Transmitter shall include automatic zeroing circuit capable of automatically readjusting transmitter zero at predetermined time intervals. The automatic zeroing circuit shall re-zero transmitter to within 0.1 percent of true zero.
7. Performance:

a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
b. Calibrated Span: Field adjustable, minus 40 percent of the range.
c. Accuracy: Within 0.10 percent of natural span.
d. Repeatability: Within 0.15 percent of calibrated span.
e. Linearity: Within 0.2 percent of calibrated span.
f. Hysteresis and Deadband (Combined): Less than 0.2 percent of calibrated span.

8. Integral multi-line digital LED or digital display for continuous indication of

airflow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Provide the services of an independent inspection agency to confirm that proposed mounting locations comply with requirements indicated and approved submittals.

1. Indicate dimensioned locations with mounting height for all surface-mounted products to walls and ceilings on shop drawings.
2. Do not begin installation without submittal approval of mounting location.

E. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

F. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to force.

D. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for

Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Refer to Division 26.

C. Furnish and install power wiring. Refer to Division 26.

D. Furnish and install raceways. Refer to Division 26.

3.4 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

A. Mounting Location:

1. Rough-in: Outline instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
2. Install switches and transmitters for air and liquid flow associated with individual air-handling units and connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
3. Install airflow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Mounting Height:

1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Unless indicated otherwise, mount switches and transmitters, located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements, within a range of 42 to 72 inches (1050 to1800 mm) above the adjacent floor, grade, or service catwalk or platform.

    a. Make every effort to mount at 60 inches (1500 mm).

3. Where indicated for rooftop equipment, mount display within rooftop equipment.

C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or

grommets.

3.5 FLOW INSTRUMENTS INSTALLATION

A. Airflow Sensors:

1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.

B. Transmitters:

1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Division 26.

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.7 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.8 CHECKOUT PROCEDURES

A. Description:

1. Check out installed products before continuity tests, leak tests, and calibration.
2. Check instruments for proper location and accessibility.
3. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

B. Flow Instrument Checkout:

1. Verify that sensors are installed correctly with respect to flow direction.
2. Verify that sensor attachment is properly secured and sealed.
3. Verify that processing tubing attachment is secure and isolation valves have been provided.
4. Inspect instrument tag against approved submittal.
5. Verify that recommended upstream and downstream distances have been maintained.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION

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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 or shall be corrosion resistant and shall include a corrosion resistant finish.

1.2 REFERENCES

A. ASTM A 36 - Structural Steel

B. ASTM A 90 - Weight of coating on Zinc-Coated (Galvanized) Iron or Steel Articles

C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

D. ASTM C 916 Type II – Standard Specification for Adhesives for Duct Thermal Insulation

E. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality

F. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

G. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

H. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality

I. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled

J. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality

K. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate

L. AWS D9.1 - Welding of Sheet Metal

M. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

N. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems

O. SMACNA - HVAC Air Duct Leakage Test Manual

P. UL 181 - Factory-Made Air Ducts and Connectors.

Q. NFPA 90A - Installation of Air Conditioning and Ventilating Systems

R. NFPA 70 - National Electrical Code

S. SMACNA - HVAC Duct Construction Standards - Metal and Flexible

T. UL 33 - Heat Responsive Links for Fire-Protection Service.

U. UL 555 - Fire Dampers

1.3 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the projects specified in this section with minimum five (5) years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum five (5) years' experience.

1.4 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA- 90A and NFPA-90B.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturer.

B. Maintain temperatures during and after installation of duct sealants.

1.6 ALTERNATES

A. Refer to Division 01 Section, “Alternates” for description of work under this section affected by alternates.

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, ventilation, outside air and combustion air ductwork shall be constructed for low pressure service (2 inch W.G.).

2.3 DUCT CONSTRUCTION

A. Rectangular and/or Round Ductwork (Low Pressure):

1. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G-90 Zinc coating in conformance with ASTM A90.
2. Make allowance for internal duct lining where required. Sizes shown on the drawings are inside clear dimensions.
3. Determine duct gauges for the longest duct side and use for all four sides. Joints and reinforcing requirements apply to the longest duct side.

4. Reinforce all ducts to prevent buckling, vibration, or noise as recommended in the referenced construction standards, and as required to suit the installed conditions.
5. Do not cross break duct which will receive rigid insulation covering.
6. Where tap sizes of divided-flow fittings are not indicated, make branch and main/connection sizes proportional to their respective air flows and maintain uniform transverse velocities in the fitting.
7. Make radius elbows and radius tee connection with throat radius equal to or greater than the width of the duct. Use vaned elbows where shown and where radius elbows will not fit the space, and in all square bends.
8. Turning vanes shall be the air-foil type with extended trailing edges, 36-inch maximum vane length. Where longer vanes are required, use two or more sets of vanes with intermediate runners securely fastened together.
9. Bolt, screw, rivet, or spot weld reinforcing members securely to the duct on not less than 6-inch centers.
10. Where ducts are open-ended without grilles, registers, or other means of stiffening, reinforce and stiffen the open end with standing seams or an angle frame. Provide rolled edges to prevent any exposed sharp edges.
11. Paint all cut ends on galvanized angles, rods, and other uncoated surfaces with aluminum paint.
12. Where ductwork is not painted or otherwise finished, remove all exposed traces of joint sealers, manufacturer's identification and other markings.
13. Determine duct gauges per SMACNA based on duct size and pressure indicated.

2.4 CONDENSING BOILER INTAKE (PIPING) MATERIAL

A. Boiler Intake Piping – PVC Pressure Pipe: ASTM D2665, solid wall drain, waste and vent (schedule 40).

1. PVC Socket Fittings: Schedule 40 PVC, ASTM F89 socket fittings.
2. Joints: Solvent weld with solvent cement.
3. Use PVC solvent cement that has a VOC content of 510 g/L of less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
5. Boiler and water heater intake ductwork shall be PVC.

B. For Boiler Exhaust/Flue Ductwork refer to “Stacks and Breeching” in Part 2 of this specification section.

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, "Instrumentation and Controls of HVAC & Plumbing System".

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.

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 with flexible galvanized spiral wire sheath.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover-Plate Material: Steel.

G. Where volume dampers are located above hard ceilings, special ceilings, bulkheads, high ceilings, and where shown on the contract drawings, furnish and install remote manual volume damper cable operators.

H. Damper controller and cable shall be concealed above the ceiling.

I. Cable to consist of Bowden cable .054" stainless steel control wire with a tensile strength of 260,000 lbs. that is encapsulated in 1/16" flexible galvanized spiral wire sheath.

J. Control kit shall consist right angle bracket that is fastened to a stud above the ceiling, a 3" diameter zinc plated primer powder coat cover, and 14 gauge steel rack and pinion gear drive capable of delivering 35 in. lbs. of push/pull torque that converts rotary motion to push-pull motion. Final color selection of cover plate shall be determined by the Architect.

K. Control shaft shall be D-style flatted 1/4" diameter with 265-degree rotation providing graduations for positive locking and control, and 1-1/2" linear travel capability.

L. Control kit shall be imbedded in the ceiling flush with the finished surface.

M. Control kit shall be manually operated using Young Regulator Model 030 wrench or approved equal. Cover plates shall be secured with tamper proof screws.

N. Control kit shall be Young Regulator Model 270-301 or prior approved equal.

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 energy recovery ventilators and ducted fan coil units 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 FIRE DAMPERS

A. Furnish and install automatic fire dampers where indicated, in all 2-hour fire-rated partitions, shafts, slabs, etc., and where required by NFPA Standard No. 90A and by the Fire Marshal. Refer to the architectural drawings for location of all fire-rated walls, shafts and slabs. Fire Dampers shall also be provided at all transfer air devices installed in rated walls at all floor penetrations, and as shown on the contract drawings.

B. Construction of fire dampers shall conform to requirements of NFPA No. 90A, UL Standard 555 and shall bear UL label. Fire dampers shall be set in frames adequately secured to fire partitions, floors, etc., and installed in strict accordance with UL listing and manufacturer's instructions.

C. Fire damper shall be Dynamic Type for rectangular ductwork and round ductwork as manufactured by Ruskin, Air Balance, Inc., Arrow, Greenheck, Lloyd Industries, Nailor, Vent Products Company, or approved equal, multi-leaf accordion type, held open by adequate heavy gauge wires and suitably calibrated fusible links. Vertical dampers (horizontal air flow) shall close by gravity. Horizontal dampers (vertical air flow) shall be closed by suitable and positive spring closing devices.

D. Damper frames shall provide pocket which shall store the damper leaves in open position outside of the air stream and shall provide for 100 percent opening connecting to ductwork or grille face. Damper material shall match connecting ductwork.

E. Provide adequately sized hinged access doors with cam locks for access to all fusible links and for resetting fire dampers. Where applicable, access to fire dampers shall be through registers or grilles. Provide identification on access door indicating fire damper within. Letters shall be not less than ½-inch in height.

F. Submit complete information to the Engineer including installation details. Furnish and install sleeves, angles, break-away duct connections, per UL listing.

G. Furnish to the Owner in a suitable storage container not less than six (6) fusible links of each type, size, and rating used on the project. Where required, furnish Greenheck Type CR, CO, or Type C transition sleeves.

2.11 DUCT ACCESS DOORS

A. Furnish and install adequately sized duct access doors at fire dampers, smoke dampers, air measuring devices, motor-operated dampers, duct smoke detectors, duct coils at all volume dampers, 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.

2.12 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.

2.13 DUCT LINING (LOW PRESSURE DUCTWORK)

A. All low pressure supply and return ductwork within 10 feet of air handling units, energy recovery ventilation units, ducted fan coil units, and as additionally shown on Contract Drawings, shall be lined on the interior for sound attenuation and thermal insulation.

B. All low pressure ductwork within 10 feet of return or exhaust air fans and as additionally shown on Contract Drawings shall be lined on the interior for sound attenuation and thermal insulation.

C. All internal duct lining for low pressure duct systems shall be provided with an interior galvanized perforated liner.

D. Provide additional exterior insulation where required and as indicated in Division 23 Section, "HVAC Insulation".

E. The lining insulation shall be 1 inch thick, 3.0 pcf density, Aeroflex plus Duct Liner Type 300, Owens Corning Quiet R Rotary Duct Liner, Manville, Knauf, or approved equal. The material shall be specifically designed for this application, shall have a black, fire-resistant coating, shall meet NFPA Standards 90A and 90B and shall have a UL Fire Hazard Classification of Flame Spread 25 or less and smoke developed of 10 or less. The black-coated surface shall face the air stream.

F. All exposed edges and the leading edge of all cross joints of the liner shall be coated with the same adhesive used to secure the duct liner to metal surface. All air stream surfaces shall be treated with EPA registered fungicide Foster 40-20. Coating shall meet ASTM D 5590 with 0 growth rating.

G. The duct liner shall be adhered to the metal with 100 percent coverage of adhesive. Adhesive shall conform to Adhesive and Sealant Council Standards for adhesives for duct liner; ASTM C916, Type II (ASC-A-7001-A-1971). Adhesive shall be Foster 85-60, Childers CP-127 or approved equal.

H. The duct liner shall be additionally secured with mechanical fasteners, which shall compress the duct liner sufficiently to hold it firmly in place. Mechanical fasteners shall conform to Mechanical Fastener Standard MF-1-1971, available from Sheet Metal and Air Conditioning Contractors National Association.

I. All duct lining shall be installed in complete accordance with the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Duct Liner Application Standard, First Edition and Green Guard Indoor Air Quality certification program requirements.

J. Dimensions on drawings indicate inside clear opening of rectangular ductwork. Increase duct dimensions 2 inches each way for accommodating insulation on all shop or field-fabricated rectangular ductwork where lining is specified.

2.14 STACKS AND BREECHING CONDENSING BOILERS

A. The factory-built modular connector, manifold and breeching system shall be laboratory-tested and listed by Underwriters Laboratories, for use with building heating equipment which produces exhausted flue gases at a temperature not exceeding 550 degrees Fahrenheit (F) under continuous operating conditions and shall comply with UL-1738, ULC 5636, NFPA-54, and NFPA-211 when burning gaseous, solid or liquid fuels as described in NFPA 211. The breeching system shall be designed and installed to be gas and water tight and thus prevent leakage of combustion products into a building. The system shall be designed to compensate for all flue gas induced thermal expansions.

B. Vent shall be factory-built special gas type, double wall, engineered and designed for use

on Category I, II, III, and IV appliances, or as specified by the equipment manufacturer.

C. The double wall breeching shall have an inner gas carrying pipe of Type AL29-4C stainless steel for natural gas. Vent shall be listed for an internal static pressure of 15" w.g. and tested to 37"w.g. There shall be a nominal 1-inch fiber insulation between the walls. The outer jacket shall be Type 430 stainless steel. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL listing.

D. The stack system shall be installed according to the manufacturer's installation instructions and shall comply with the codes and standards of the State of Delaware, International Mechanical Code, and applicable N.F.P.A. pamphlets. Stack termination height shall be sufficient to prevent re-entrainment into other building openings. Stack termination shall be minimum of 15 feet away from all building openings, intakes. All breeching stack terminations with a 15 foot radius of any building opening intake, or louver shall be extended 3 feet above the opening, intake or louver.

E. Inner wall joints shall be designed with a male and female overlapping metal-metal connection to maintain condensate in the AL29-4C stainless steel. Proper ¼" per foot pitch must be maintained at all times and condensate should flow back toward the appliance to the required number of drains. All inner wall conduit components shall be manufactured from AL-29-4C stainless steel. The joint closure system shall be an inner wall mechanical locking strap design. Joints shall not use screws or fasteners that penetrate inner conduit.

F. When installed according to the manufacturer's installation instructions, the piping and its supporting system shall resist side loads (whether system is horizontal or vertical) at least 1.5 times the weight per foot of the piping. Wall supports shall support 40 feet of pipe with a factor of safety of at least four (4). Plate supports shall support (as verified by manufacturer testing) 200 feet of pipe in 6-inch through 20-inch ID sizes and 100 feet of pipe in 24-inch ID and larger sizes with a factor of safety of at least four (4).

G. The entire breeching system from the equipment to termination, including all required accessories (ventilated roof thimbles, guy wires, storm collar, guy tensioners, expansion joints, discharge cone, supports, etc.), shall be from one manufacturer.

H. The breeching shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of fifteen years from date of installation. Drawings showing the actual layout and drawn to scale shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's 15-year warranty and in conjunction with sound engineering practice. The inner diameter for breeching and stacks shall be verified by the manufacturer's computations. The computations shall be technically sound, shall follow ASHRAE calculation methods, and incorporate the specific flow characteristics of the inner pipe. The Contractor shall furnish the exact boiler model and operating characteristics to the factory representative. Operating characteristics shall include flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout, and available external pressure at boiler or equipment outlet, etc., necessary to determine system operation at maximum and minimum levels of burner turndown range.

I. Boiler or equipment breeching, as hereinbefore specified, shall be provided for all new fuel-fired equipment, including but not limited to boilers.

J. General Electric RTV106 (aka Momentive) or Dow Corning 736 High Temperature Sealant shall be used to seal all joints on systems where the maximum flue gas temperature will not exceed 550°F.

K. Boiler breeching shall be Type Saf-T Vent CI Plus as manufactured by Selkirk Metalbestos, Type CS Plus by Van Packer, Type SD by Schebler, or Type CG by Metal-FAB.

2.15 AIR DEVICE REQUIREMENTS

A. Furnish and install air supply, return, exhaust devices of sizes and capacities as scheduled on the drawings. Catalog numbers shown are Titus, Inc., products for equipment which have been found suitable for the application. Other manufacturers listed below or approved equal will be considered only if performance characteristics including throw, drop, pressure loss, sound pressure level, etc., are equal to or better than the performance characteristics of the specified products. All air devices shall be ADC certified. Ductwork behind registers, grilles, open ended ducts, and diffusers shall be given two coats of flat black paint. Perimeter of all ceiling diffusers shall be caulked to provide a neat, aesthetic appearance.

B. Where air terminal devices are installed in duct collars or branches, furnish and install air extractors. Furnish and install control grids, volume dampers, and/or other accessories necessary to ensure uniform air flow across the terminal devices. Accessories shall be of the same material as the terminal device. Install fixed blade terminals so that blades block the normal line of vision. Furnish three (3) of each type of removable key operators.

C. Contractor shall determine frame and mounting type as per type of ceiling as shown on Architectural drawings.

D. Air devices and accessories that are installed in a finished, non-white ceiling shall be of a color as selected by the Architect.

E. Noise Criteria: All air devices shall be sized and selected to limit maximum NC (Noise Criteria) levels to 30.

2.16 SUPPLY AIR DEVICES

A. SD1 Diffuser, Square/Rectangular

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Titus Model TDCA-AA
    b. Metal-Aire

c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: Baked Enamel, color selected by Architect
c. Face Style: Louvered
d. Mounting: Lay-in or Gypboard
e. Pattern: Adjustable core style
f. Damper: Integral, Opposed Blade type

3. Accessories:

a. Square to round neck adaptor
b. Adjustable pattern vanes

4. Provide auxiliary panel for lay-in tile installation.
5. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

B. SG1 Grille, Square/Rectangular

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Titus Model 300FS
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a. Material: Aluminum
b. Finish: Baked Enamel, color selected by Architect
c. Face Style: Grille
d. Mounting: Surface
e. Pattern: Double Deflection; spaced 3/4 inch apart.
f. Damper: Integral, Opposed Blade type

3. Accessories:

a. Drop control

4. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

C. SLB1 Diffuser, Linear Bar

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Titus Model CT-PP
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a.	Material:	Aluminum
b.	Finish:	Baked Enamel, color selected by Architect
c.	Face Style:	Linear Bar
d.	Mounting:	Surface
e.	Pattern:	30° Deflection
f.	Damper:	Integral, Opposed Blade type

3. Accessories:

a. Pencil Proof

4. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2.17 RETURN/EXHAUST/TRANSFER GRILLES

A. RLB1 Return Air, Linear Bar

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

b. Titus Model CT-PP
c. Metal-Aire
d. Price
e. Tuttle & Bailey
f. Anemostat
g. Carnes
h. Nailor
i. Krueger

2. Construction:

j.	Material:	Aluminum
k.	Finish:	Baked Enamel, color selected by Architect
l.	Face Style:	Linear Bar
m.	Mounting:	Surface
n.	Pattern:	30° Deflection
o.	Damper:	Integral, Opposed Blade type

3. Accessories:

p. Pencil Proof

4. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

B. RG1 Return/Exhaust/Transfer Grille, Square/Rectangular

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Titus Model 350FS
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a.	Material:	Aluminum
b.	Finish:	Baked Enamel, color selected by Architect
c.	Ceiling Type:	Lay-in, Gypboard, Sidewall
d.	Blades:	Fixed, 35° Angle, 3/4” Spacing

3. Accessories:

a.	Face:	Grille
b.	Damper:	Integral, Opposed Blade type

4. Provide auxiliary panel for lay-in tile installation.
5. The register shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

C. RG2 Return/Exhaust/Transfer Grille, Square/Rectangular with Filter, Aluminum

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Titus Model 350FSF
b. Metal-Aire
c. Price
d. Tuttle & Bailey
e. Anemostat
f. Carnes
g. Nailor
h. Krueger

2. Construction:

a.	Material:	Aluminum
b.	Finish:	Baked Enamel, color selected by Architect
c.	Ceiling Type:	Lay-in, Gypboard, Sidewall
d.	Blades:	Fixed, 35° Angle, 3/4” Spacing

3. Accessories:

a.	Face:	Grille
b.	Damper:	Integral, Opposed Blade type

4. Provide auxiliary panel for lay-in tile installation.
5. Provide return air filter racks and 1” thick filters. Provide a spare filter with each air device.
6. The register shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

D. Noise Criteria: All air devices shall be sized and selected to limit maximum NC (noise criteria) levels to 30.

2.18 INTAKE HOODS

A. Furnish and install heavy gauge aluminum intake hoods of size, capacity, and arrangement as shown on Contract Drawings. Intake hoods shall be Greenheck Model FHI for intake 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 and actuators shall be provided by the ATC Subcontractor and installed by Mechanical Contractor.

2.19 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.

2.20 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”.

2.21 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.

2.22 AUXILIARY DRIP PANS

A. Furnish and install suitable watertight, aluminum drip pans for all ducted fan coil units. 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 fan coil unit. 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 additional 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”

2.23 FILTER MEDIA DURING CONSTRUCTION

A. Filter media installed during construction: Minimum MERV 8.

2.24 SECURITY DUCT BARS

A. Barrier duct bars shall be model SEC-DBS manufactured by METALAIRE, Titus or approved equal. Units shall be barrier maximum security duct bars constructed with 1/2" diameter bars on 6” center welded in a 7-gauge steel sleeve. Units to include two angle frames 1”x1” x 3/16”, one welded and one shipped loose.

B. Performance Specification. The manufacturer shall provide published performance data. Data shall be tested in accordance to ANSI/ASHRAE Standard 70-2006.

C. Paint Specification. Process shall be anodic electro-deposition using an anodic acrylic paint. Units shall undergo pre-treatment, including a pressurized spray stage using an alkaline cleaner and a de-ionized water rinse.

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 closets 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 air devices, 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, air flow monitoring stations, duct-mounted equipment, duct coils and elsewhere as indicated. Provide minimum 10 x 10 inch size for hand access, 18 x 18 inch size for shoulder access. Review locations prior to fabrication.

C. Provide duct test holes where required for testing and balancing purposes. Review locations with Test and Balance Engineer prior to installation.

D. For all motor operated dampers, mark the shaft so operators know the position of the damper.

E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion-resistant springs, bearings, bushings and hinges.

F. Demonstrate re-setting of fire dampers to Owner's representative.

G. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment and supported by vibration isolators. Refer to Division 23 Section, "Vibration Control for HVAC and Plumbing Systems".

H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum duct widths from duct take-off.

I. Use splitter dampers only where indicated.

J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

K. Install diffusers, registers, and grilles to ductwork with airtight construction.

L. Check location of all air outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangements.

M. Install duct thermometer support flanges in wall of duct. Attach to duct with screws. Locate duct mounted thermometers, minimum 10 feet downstream of mixing dampers, coils or other devices causing air turbulence.

N. Install remote - reading duct dial thermometers in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length. Mount control panel 60 inches above finished floor and label each dial thermometer.

O. Install duct accessories according to applicable details shown in SMACNA's HVAC Duct Construction Standards Metal and Flexible for metal ducts.

P. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

Q. Provide test holes at fan inlet and outlet and elsewhere as indicated.

R. Install fire dampers according to manufacturer's UL approved written instructions.

1. Install fusible links in fire dampers. Label access doors according to equipment served.

S. Adjust duct accessories for proper settings.

T. Adjust fire dampers for proper action.

U. Adjust fire dampers for proper action.

V. Coordinate the locations of all cable operational volume damper operation stations with ducted mounted volume dampers. For stations label all cable operations as to the volume damper served. Cover plates shall be finished in a color to match ceiling per the Architect.

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 STACKS AND BREECHING INSTALLATION REQUIREMENTS

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54 (ANSI Z223.1) and NFPA 31.

C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Support breechings from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot (4 m) spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.

E. Install concrete inserts for support of breechings and stacks in coordination with formwork.

F. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.

G. For double wall gas vents, maintain UL listed minimum clearances from combustibles Assemble pipe and accessories as required for complete installation.

H. Install vent dampers, locating close to draft hood collar, and secure to breeching.

I. 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.

J. Level and plumb chimney and stacks

K. Clean breechings and stacks during installation, removing dust and debris.

L. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, or stacks.

M. Do not install bull head tee at connections to equipment.

N. For condensing boilers provide and install flue pipe thermometers.

3.5 CONDENSING BOILER INTAKE 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 flues/combustion air ducts as required to clear existing structure.

3.6 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.

3.7 LEAKAGE TESTS

A. All low pressure sheet metal ductwork shall undergo leakage tests at 2 inch W.G. Tests shall be accomplished under this section and witnessed as specified under Division 23 Section, "Testing, Adjusting, and Balancing for HVAC and Plumbing".

B. All medium pressure sheet metal ductwork shall undergo leakage tests at 5 inch W.G. Tests shall be accomplished under this section and witnessed as specified under Division 23 Section, "Testing, Adjusting, and Balancing for HVAC and Plumbing".

C. Leakage from each duct system shall not exceed 5 percent for low pressure systems and 1 percent for medium pressure systems of the normal air handling capacity of the system. If the system ductwork is tested in sections, the leakage shall not exceed ½ of 1 percent of the CFM to be handled by that section, and the total leakage of the system shall not exceed 1 percent of the total system CFM. Test pressure shall not exceed the pressure limits of the duct construction as defined in SMACNA High Pressure Duct Construction Standards. Repair all leaks which are audible, regardless of the leakage rate of the duct system as a whole, by remaking the entire defective joint or seam. Spot sealing of ducts in place will not be acceptable.

D. All duct accessories, including but not limited to volume dampers, ATC sensors, motor operated dampers, duct access doors, and duct detectors shall be installed prior to duct leakage testing.

E. Submit a complete report of the ductwork leakage tests to the Architect and include final approved copies in test and balance reports.

3.8 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.

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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. 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 number.

C. Every submittal including, but not limited to the list below, shall be forwarded with its own transmittal as a separate, distinct shop drawing. Grouping of items/systems that are not related shall be unacceptable.

Items and Systems

1. Analysis and Coordination Study
2. Automatic Transfer Switches
3. Ballasts
4. Basic Electrical Materials
5. Cable – 600 Volt
6. Circuit Breakers
7. Conduit and Surface Raceway
8. Contractor and Subcontractor Qualifications
9. Controllers and Control Devices
10. Engine/Generator
11. Equipment Connections
12. Equipment Pads
13. Firestopping
14. Ground Conductors, Rods

15. Identification System
16. Lamps
17. Lighting Control Equipment
18. Light Fixtures
19. Low Voltage Fuses
20. Material and Equipment List
21. Motor Controllers
22. Occupancy and Vacancy Sensors
23. Outlet Boxes
24. Panelboards
25. Receptacles
26. Record and Information Booklet
27. Safety Switches
28. Schedule of Values
29. Sleeves, Hangers, Supports
30. Submittal Schedule
31. Surge Suppression Devices
32. Switchboards
33. Tests and Reports
34. Transformers
35. Wiring Devices
36. 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. Generator and Automatic Transfer Switch(es)

3. Grounding and Bonding System

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.

J. Submit the following Shop Drawings to the Utility Company for approval:

1. Automatic Transfer Switch
2. C/T Cabinets
3. Metering (Utility)
4. Switchboard

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 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. Pad-mounted equipment and equipment connections.
2. Underground conduits, ductbanks, and 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 coor

dination 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 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. The Contractor shall pay for all energy charges for temporary service.

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.

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 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. 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.

B. The Contractor shall be responsible for visiting the site and determining the existing conditions in which the work is to be performed.

C. Refer to phasing plans for additional requirements.

D. Where any abandoned conduits in existing floors, walls, pipe tunnels, ceilings, etc., conflict with new work, remove abandoned conduits as necessary to accommodate new work.

E. The location of all existing equipment, conduits etc., indicated is approximate only and shall be checked and verified. Provide all new electrical work required to connect to or clear existing work as applicable.

F. Maintain egress at all times. Coordinate egress requirements with the State Fire Marshal, the Owner and the Authorities Having Jurisdiction (AHJ).

G. Make provisions and include in bid all costs associated with confined entry/space requirements in crawl spaces and all other applicable OSHA regulations.

H. 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.

I. At completion of project all temporary conduit, wires, etc., shall be removed in their entirety.

J. Existing conduit, equipment, wiring, etc., not required for re-use or re-installation in this project, shall be removed from the project site.

K. Deliver to the Owner, on the premises where directed, existing equipment and materials which are removed and which are desired by the Owner or are indicated to remain the property of the Owner.

L. All other materials and equipment which are removed shall become property of the Contractor and shall be promptly removed, from the premises, and disposed of by the Contractor, in an approved manner. Contractor shall be responsible for proper disposal of all removed equipment containing PCB's.

M. Where conduit and wiring are removed, remove all conduit hangers which were supporting the removed conduit. Patch the remaining penetration voids with like materials and paint to match existing construction.

N. Where required, provide and coordinate removal and re-installation of existing equipment. Take care to protect materials and equipment indicated for reuse. Contractor shall repair or replace items which are damaged. Contractor shall have Owner's representative present to confirm condition of equipment prior to demolition.

O. Before demolition begins, and in the presence of the Owners representative, test and note all deficiencies in all existing systems affected by demolition but not completely removed by demolition. Provide a copy of the list of system deficiencies to the Owner and the Engineer. Videotape existing conditions in each space prior to beginning demolition work.

P. The Owner shall have the first right of refusal for all fixtures, devices and equipment removed by the Contractor.

Q. All devices and equipment designated by the Owner to remain the property of the Owner shall be moved and stored by the Contractor at a location on site as designated by the Owner. It shall be the Contractor's responsibility to store all devices and equipment in a safe manner to prevent damage while stored.

R. All existing equipment refused by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor in a timely manner and disposed of in a legal manner.

S. Work Abandoned in Place: Cut and remove conduit a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

T. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

U. Terminate services and utilities in accordance with local laws, ordinances, rules and regulations.

3.23 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 SECTION

OUTAGE REQUEST

DATE APPLIED: _____ BY: _____

DATE FOR OUTAGE: _____ FIRM: _____

START OUTAGE-TIME: _____ DATE:_____

END OUTAGE - TIME: _____ DATE:_____

AREAS AND ROOMS: _____

FLOOR(S): _____

AREA(S): _____

ROOM(S): _____

WORK TO BE PERFORMED: _____

SYSTEM(S): _____

REQUEST APPROVED BY: _____
(FOREMAN OR OTHER PERSON IN CHARGE)

(FOR OWNER'S USE ONLY):

APPROVED: _____

YES ____ NO ___ BY: _____DATE: _____

DATE/TIME-AS REQUESTED: _____ OTHER: _____

OWNER'S PRESENCE REQUIRED: _____

YES: ____ NO: ___ NAME: _____

POINT OF CONTACT: _____ PHONE: _____

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DIVISION 26 SECITON 26 05 03
ELECTRICAL DEMOLITION FOR REMODELING
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SECTION 26 05 03 - ELECTRICAL DEMOLITION FOR REMODELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.

1.2 SCOPE

A. Provide all demolition of existing electrical equipment including all conduit and wiring as required by the Contract Documents unless otherwise noted on the drawings. Electrical demolition shall be performed in accordance with the Contract Documents.

B. Provide all cutting and patching for electrical construction.

C. Coordinate with project phasing.

D. Provide temporary service and provisions to maintain existing systems.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements and circuiting arrangements are as shown on the Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Verify whether or not PCB ballasts exist in light fixtures which will be disposed of. If PCB light fixture ballasts exist, then follow requirements in “PCB Ballast Handling and Disposal”, included in this Section.

D. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to the Owner, and Architect before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect and make electrically safe electrical systems in walls, floors, and ceilings scheduled for removal.

B. Coordinate utility service outages and removal with the Owner, Architect, and Engineer and other trades. Also, coordinate utility service outages and removal with Utility Company.

3.3 CONNECTIONS AND ALTERATIONS TO EXISTING SYSTEMS

A. Keep all existing electrical systems in operation during the progress of the work. Provide temporary electrical connections to systems of equipment, etc., where necessary to maintain continuous operation until the new systems and equipment are ready for operation.

B. When existing electrical work is removed, remove all conduit, ducts, supports, etc. to a point below the finished floors or behind finished walls and cap. Such points shall be far enough behind finished surfaces to allow for the installation of the normal thickness of finished material.

C. When the work specified hereunder connects to any existing equipment, conduit, wiring, etc., perform all necessary alterations, cuttings, fittings, etc., of the existing work as may be necessary or required to make satisfactory connections between the new and existing work and leave the complete work in a finished and workmanlike condition.

D. When the work specified under other divisions necessitates relocation of existing equipment, conduits, wiring, etc., perform all work and make all necessary changes to existing work as may be required to leave the completed work in a finished and workmanlike condition.

E. Provide responsibility for removing and replacing existing floor tile within the raised floor areas as required. Provide all necessary cutting and fitting of bushed holes for cable passage through tiles. Any tiles damaged during the Contract shall be replaced with like kind at no cost to the Owner.

F. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations. In particular, all security and safety systems must be maintained in operation at all times as required by the Owner. This includes security and safety lighting.

G. Existing Electrical Service: Provide temporary generator for existing building service during switchover of existing to new building service. Disable system only to make switchovers and connections. Obtain permission from Owner, Architect/Engineer and other trades at the site at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

H. Existing Fire Alarm System: Maintain existing system in service until new system is complete and ready for service. Provide fire watch as required by AHJ where switchover of system requires an outage. Disable system only to make switchovers and connections.

Notify Owner, Architect and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

I. Existing Communication / Data System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner/Architect/Engineer and Telephone Utility Company at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

J. Existing Security System: Maintain existing intrusion detection and access control system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from/Notify the Owner/Architect/Engineer at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

K. Trace all circuits and controls to be disconnected to ensure that vital services to other areas are not interrupted.

3.4 PROTECTION

A. Provide protection for all existing and new cabling. Provide innerduct, conduit or other suitable means of protection to prevent damage to cables located in renovated areas.

B. Damage to wiring, cabling or equipment shall be repaired by skilled mechanics for the trade involved at no additional contract amount.

C. Fixtures, materials and equipment shall be protected at all times. The Contractor shall make good any damage caused either directly or indirectly by his workmen. Conduit openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water and chemical or other injury. At the completion of all work, the fixtures, materials and equipment shall be thoroughly cleaned and turned over in a condition satisfactory to the Owner.

D. Damage: Where wiring, raceways, lighting fixtures, devices or equipment to remain is inadvertently damaged or disturbed, cut out and remove damaged section and provide new of equal or capacity or quality.

3.5 ELECTRICAL DEMOLITION

A. Remove from the premises and dispose of all existing wiring, conduit, material, fixtures, devices, equipment, etc., not required for re-use or re-installation.

B. Deliver on the premises where directed existing material and equipment which is removed and is desired by the Owner or is indicated to remain the property of the Owner.

C. All other equipment and materials which are removed shall become the property of the demolisher and shall be removed by him from the premises.

D. Where electrical equipment is removed, also remove all wiring back to source panelboard or switch or to last remaining device on the same circuit. All conduit, hangers, supports, etc., shall also be removed unless otherwise noted. Such conduit may remain to be reused for new work provided said conduit is of the proper size and type as that specified and in a condition acceptable to Engineer and Owner.

E. Any conduit abandoned in concrete slabs, walls, or other inaccessible locations shall be left empty except for a nylon pull wire. Ends shall be capped with push plugs for future use.

3.6 EXISTING CONDUIT WORK

A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Abandoned Work: Concealed electrical work abandoned in place, shall be cut out approximately 2 inches beyond the face of adjacent construction, capped and the adjacent surface patched to match the existing finish.

D. Disconnect abandoned outlet boxes and remove devices. Remove abandoned outlet boxes if raceway servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes which are not removed.

E. Ensure access to existing boxes and other installations which remain active and which require access. Modify installation or provide access panel as appropriate.

F. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

G. Clean and repair existing raceway and boxes which remain or are to be reinstalled.

H. Remove all abandoned wiring from existing conduits and ductbanks. Abandoned wiring that cannot be removed shall be tagged at each end as “Abandoned”.

I. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors and patch surfaces.

3.7 EXISTING POWER POLE WORK

A. Disconnect abandoned utility columns and remove. Patch surfaces.

B. Ensure access to existing utility column wiring which remains active and which requires access. Modify installation or provide access panel as appropriate.

C. Clean and repair existing utility columns which remain or are to be reinstalled.

3.8 EXISTING WIRING AND CABLING WORK

A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.

B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes if wire and cable servicing them is abandoned and removed. Provide blank cover for abandoned boxes which are not removed.

C. Ensure access to existing wiring connections which remain active and which require access. Modify installation or provide access panel as appropriate.

D. Extend existing circuits using materials and methods compatible with existing electrical installations or as specified.

E. Clean and repair existing wire and cable which remain or is to be reinstalled.

3.9 EXISTING WIRING DEVICES WORK

A. Disconnect abandoned wiring devices and remove them.

B. Ensure access to existing wiring devices which remain active. Modify installation as appropriate.

C. Clean and repair existing wiring devices which remain or are to be reinstalled.

D. Provide painted blank coverplates over existing device boxes. Paint shall match existing finish of surrounding area.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlet boxes if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlet boxes which are not removed.

3.10 EXISTING DISTRIBUTION WORK

A. Disconnect and remove abandoned panelboards and distribution equipment.

B. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.11 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work to meet all requirements of these specifications.

B. If certain raceways and boxes are abandoned but not scheduled for removal, those items must be shown on the As-Built Drawings.

C. Remove, relocate, and extend existing installations to accommodate new construction.

D. Remove abandoned wiring to source of supply.

E. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

F. Repair adjacent construction and finishes damaged during demolition and extension work.

G. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

H. Extend existing installations using materials and methods (compatible with existing electrical installations, or) as specified. This includes the extension of the circuit from the last active device to the next device in the system to be activated.

3.12 LAMP HANDLING AND DISPOSAL

A. It is the responsibility of the Contractor to properly handle and dispose of all contaminated lamps. All lamps (fluorescent, incandescent, and HID) contain mercury and/or lead (in the base) as well as other heavy metals and compounds which are regulated by the EPA and DNR during the disposal process. As a result, regulations have been issued covering the handling and disposal of all lamps. Therefore, lamps which have been removed from service for disposal shall be handled as follows.

1. Very carefully remove all lamps (fluorescent, incandescent and HID) from light fixtures before removal of the fixture from its mounted position. This is to reduce the likelihood that the lamp(s) will be broken.
2. Removed lamps shall be placed in containers and placed in storage in a location on the Owner's property (this may be in another building) arranged by the Owner's field representative. Label the area as *Hazardous Material Storage – Mercury.*
3. Provide to the Owner's field representative, in written form, a count of all stored lamps by type at the completion of the project.
4. The Contractor will have the responsibility to dispose of all contaminated lamps as required by EPA and DNR Rules and Regulations.
5. Provide to the Owner's Representative copies of all documents including manifests, certificates, etc. that show the handling, transportation, delivery and disposal of stored lamp materials identified above.

3.13 PCB BALLAST HANDLING AND DISPOSAL

A. It is the Contractors responsible to properly handle and dispose of contaminated ballasts. Generally, all high power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain PCB compounds in their capacitors. The Contractor shall inspect

all ballasts in light fixtures (which will become the property of the Contractor and will be removed from the project site as part of this project). The handling, removal and disposal of all PCB contaminated ballasts shall be the Contractors responsibility. The Contractor shall take the actions described below.

1. All ballasts labeled as NON PCBs or NO PCBs shall become the property of the Contractor. If the PCB content is *not* stated on the ballast label, the ballast shall be handled as a PCB ballast.
2. All PCB ballasts shall be removed from the light fixtures and shall have the wires clipped off. However, before removal, all PCB ballasts shall be carefully inspected for leaks. If a ballast appears to be leaking (evidenced by potting compound leaking out or by an oily film on the ballast surface) the ballast must be handled per EPA and DNR PCB regulations). Basically, this means the ballast is to be carefully removed from the fixture and placed in an approved drum. The person removing the ballast from the fixture shall wear protective gloves, eye protection, and protective clothing as necessary.
3. If the fixture has also been contaminated, it must be cleaned to less than 10 micrograms/100 square centimeters contamination before disposal. This cleaning must be done by an approved PCB Contractor and is not considered a part of this contract.
4. The ballasts shall then be placed in US DOT approved Type 17C or Type 17H drums (barrels). Fifty-five gallon and 30 gallon drums are available from most drum suppliers. The quantity and size of the drums will be determined at the time of construction.
5. These barrels shall be placed in storage with the cover that came with the barrels, in a location within a building, as designated by the Owner's project representative. The barrels are *not* to be placed outside where they are exposed to weather.
6. THESE BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE. To do so, would be a violation of DNR and DOT hazardous waste regulations and may result in a fine.
7. Label and mark the PCB storage drums with EPA-approved PCB labels and the storage area with signs, marks, and lines to meet the regulations of Code.
8. Provide approved PCB-absorbent materials to be stored immediately adjacent to the drum storage area. Do not place loose absorbent material in the drums.
9. Provide to the Owner's project representative, in written form, a total count of these ballasts (or their total weight by barrel) and where they are stored.
10. The Contractor will have the responsibility to dispose of all contaminated ballasts as required by EPA and DNR Rules and Regulations.
11. Provide to the Owner's Representative copies of all documents including manifests, certificates, etc. that show the handling, transportation, delivery and disposal of stored ballast materials identified above.

3.14 CLEANING AND REPAIR

A. The Consultant shall show, on the drawings, all items to be cleaned or repaired.

B. Clean and repair existing equipment and materials that remain or are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.15 INSTALLATION

A. Install relocated materials and equipment under the provisions of other related Sections.

END OF SECTION

DIVISION 26 SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL 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 the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

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. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS Section 7.3.1. 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: Service Entrance Cables, Power & Lighting Distribution Feeders and Feeders to all major mechanical equipment at 60A and over (i.e., chillers, AHU’s, etc.).

1. Tests shall be performed with a 1000-volt megger, and conductors shall test free from short-circuits and grounds.
2. Conductors shall be tested phase-to-phase and phase-to-ground.
3. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Contracting Officer.
4. Test readings shall be recorded and delivered to Owner and Engineer in a report.
5. Copy of Test results shall be included in O&M Manuals.

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.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work are 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. Encore Wire.
g. CommScope.
h. nVent PYROTENAX

2. Connectors and Accessories for Wires and Cables:

a. AMP Incorporated.
b. Buchanan.
c. General Signal; O-Z/Gedney Unit.
d. Monogram Company; AFAC.
e. NSI Industries, Inc.
f. Square D Company; Anderson.
g. 3M Company; Electrical Products Division.

B. Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN/THWN-2, XHHW, USE, and SO.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal clad cable, Type MC and Type SO with ground wire.

2.2 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8. for stranded conductors.

D. Conductor Insulation:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type XHHW-2: Comply with UL 44.
4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.

E. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, and sunlight- and oil-resistant outer PVC jacket.

2.3 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

D. Conductor Insulation:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.

2.4 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Circuits:

1. Single circuit and multicircuit with color-coded conductors.
2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation:

1. Type THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

G. Armor: Steel, interlocked.

H. Jacket: PVC applied over armor.

2.5 FIRE-ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.6 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 "Wire and Insulation Applications" Article.

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°C and shall be material flame-retarded per IEEE 383 “Vertical Tray Flame Test”. Motor connection kits shall consist of heat-shrinkable, polymeric insulating material over the connection area and a high dielectric strength mastic to seal the ends against ingress of moisture and contamination. Motor connection kits shall accommodate a range of cable sizes for both in-line and stub-type configurations. Connection kits shall be independent of cable manufacturer’s tolerances.

I. Wire Nut Connectors:

1. Wire nuts install 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 appropriately sized according to manufacturer’s recommendation for the suitable wire sizes and voltage rating (600 volt minimum).
3. Connectors body shall have a color-coded outer shell.
4. Connectors shall be as manufactured by King Technology or approved equal.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Soft Drawn Copper, 98% conductivity minimum, solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Aluminum STABILOY for feeders rated 100A and larger under **Alternate No. XX**. Feeder ampacity shall be the same or greater than the equivalent copper conductor sizes indicated with associated conduit sizes increased as required to maintain maximum 40% fill.

B. Branch Circuits: Soft Drawn Copper. 98% Conductivity minimum, Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. 600 volt, unless otherwise noted, #12 AWG minimum (except control cable may be #14 AWG).

B. Service Entrance: Type RHW, single conductors in raceway.

C. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

J. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

K. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.

L. Conductors shall be rated 75 deg C in wet locations and 90 deg C in dry locations.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 260429, "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 260553, “Identification for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 260529 "Hangers and Supports for Electrical Systems."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.

    a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.

3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device: 1 inch (25 mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 8 inches (200 mm) of slack.

D. Comply with requirements in Section 284621 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

E. Wiring for general 15 and 20 amp 120 volt and 277 volt branch circuit work shall be as follows unless otherwise indicated:

HOME RUN LENGTH AND WIRE SIZE				CIRCUIT LENGTH AND WIRE SIZE			
120 Volt		277 Volt		120 Volt		277 Volt	
0 – 60’	#12	0 – 175’	#12	0 – 100’	#12	0 – 200’	#12
60 – 100’	#10	175 – 350’	#10	100’ & Up	#10	200’ & Up	#10
100’ & Up	#8	350’ & Up	#8				

Circuit length as given above shall be the wire length between the first and last outlet on the circuit. Home run length as given above shall be the wire length between the first outlet and the panelboard. In accordance with the above, where the size of branch circuit conductors is increased by the minimum required by the NEC for the branch circuit rating, it is the Contractor’s responsibility to insure that the termination provisions of all equipment connected to such circuits are listed as suitable for the conductor sizes involved.

F. Joints of #10 AWG and smaller shall be made with properly insulated solderless type pressure connectors. Where stranded conductors or multiple solid conductors are connected to terminals, solderless lugs manufactured by Thomas and Betts Company or equivalent shall be used.

G. Joints of #8 AWG and larger in power and lighting circuits shall be of the type indented into the conductor by means of a hand or hydraulic pressure tool. Connectors shall be Burndy “Hy-dent’, T&B “St-Kon”, or equivalent. Connectors for control wiring shall be Burndy “Hy-Lug”, or equivalent.

H. 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 as larger on the Drawings.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 26 Section "Firestopping" and “Basic Electrical Materials and Methods”.

B. Install to seal underground exterior-wall penetrations according to Division 26 Section, “Basic Electrical Materials and Methods”.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors.

    a. Tests shall be performed with a 1000-volt megger, and conductors shall test free from short-circuits and grounds.
    b. Conductors shall be tested phase-to-phase and phase-to-ground.
    c. Furnish the instruments, materials, and labor required. Perform the tests in the presence of the Contracting Officer.
    d. Test readings shall be recorded and delivered to Owner and Engineer in a report.
    e. Copy of Test results shall be included in O&M Manuals.

2. Perform each of the following visual and electrical tests:

    a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.

b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

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. Demonstration: Subsequent to wire and cable hook-ups, energize circuit and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

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GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Grounding arrangements and connections for separately derived systems.
4. Grounding for sensitive electronic equipment.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, grounding connections for separately derived systems based on NETA MTS.

a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter, unless otherwise noted.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor, unless otherwise noted.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches (6 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with socket set screw.

I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

J. Lay-in Lug Connector: Mechanical type, aluminum terminal with set screw.

K. Straps: Solid copper, copper lugs. Rated for 600 A.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:

1. Mechanical type, two pieces with zinc-plated bolts.

a. Material: Die-cast zinc alloy.
b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4-inch by10 feet (19 mm by 3 m) in diameter.

B. Ground Plates: 1/4 inch (6 mm) thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches (900 mm) below grade.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits of the same type as the circuit conductors. Install in same conduit with circuit conductors.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-24-inch (6-by-50-by-600-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

E. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Where ground lug and bonding conductors installed indoors exceed 3 feet in length, install in EMT conduit.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 30 inches (900 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. Use exothermic welds for all below-grade connections.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ductbanks," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor. Provide all test wells with twist lock cover, Harger#GAW910 or approved equal.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

I. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System: 5 ohms.
2. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm.
3. Substations and Pad-Mounted Equipment: 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

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DIVISION 26 SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Concrete Bases

B. Related Sections include the following:

1. Metal Fabrications – For requirements for miscellaneous metal items involved in supports and fastenings.
2. Joint Sealants – For requirements for firestopping at sleeves through walls and floors that are fire barriers.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.

D. Welding certificates.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide slotted metal angle and U-channel systems by one of the following:

a. Thomas & Betts Corporation.
b. Alstrut.
c. Unistrut; Diversified Products
d. Power-Strut.

2. Manufacturers: Subject to compliance with requirements, provide conduit sealing bushings and accessories by one of the following:

a. Bridgeport Fittings
b. GS Metals, Corporation
c. O-Z / Gedney
d. Raco, Inc.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
6. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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) Hilti Inc.
   2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
   3) MKT Fastening, LLC.
   4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   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) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

C. Submit structural calculations for load and strength of each component and detailing of each assembly.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1, NECA 101 and NECA 105 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Provide a bond break between equipment and concrete. Electrical equipment (switchgear, switchboards, transformers, etc.) may not be in direct contact with concrete surfaces.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

DIVISION 26 SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS
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SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Section 262726 “Wiring Devices” for multi-outlet assemblies.
2. Section 260543 Section "Underground Ductbanks" for exterior ductbanks, manholes, and underground utility construction.

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. LFNC: Liquidtight flexible nonmetallic conduit.

F. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Source quality-control test reports.

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.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Steel City.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3.

E. FMC: Zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket.

G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel compression type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

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. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

2.3 BOXES, ENCLOSURES, AND CABINETS

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. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.

3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes: Cast metal (slab on grade application) or sheet metal, fully adjustable, rectangular, listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round.

H. Metallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:

1. Description: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:

    a. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
    b. Walker Systems, Inc.; Wiremold Company (The).
    c. FSR, Inc.

3. Applicable Standards:

    a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
    b. General Characteristics:
        1) Reference Standards: UL 514A and UL Category Control Number QCIT.

I. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

J. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

K. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

L. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

M. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

N. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep), except shallow boxes shall be permitted to accommodate framing.

O. Gangable boxes are allowed.

P. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

Q. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.4 WIREWAYS AND AUXILIARY GUTTERS

A. Metal Wireways and Auxiliary Gutters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
b. EGS/Appleton Electric.

c. Erickson Electrical Equipment Company.
d. Hoffman.
e. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
f. O-Z/Gedney; a unit of General Signal.
g. RACO; a Hubbell Company.
h. Robroy Industries, Inc.; Enclosure Division.
i. Scott Fetzer Co.; Adalet Division.
j. Spring City Electrical Manufacturing Company.
k. Thomas & Betts Corporation.
l. Walker Systems, Inc.; Wiremold Company (The).
m. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

2. Applicable Standards:

a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
b. General Characteristics:
1) Reference Standards: UL 870 and UL Category Control Number ZOYX.
2) Fittings and Accessories: Include covers, 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.
3) Finish: Manufacturer's standard enamel finish.

c. Options:
1) Degree of Protection: Type 12 unless otherwise indicated.
2) Wireway Covers: Screw-cover type unless otherwise indicated.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass.

1. Standard: Comply with SCTE 77.
2. Color of Frame and Cover: Gray.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "ELECTRIC."
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried, unless otherwise noted.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT, support 6’ on center maximum for sizes over 2-inches.
2. Exposed, Not Subject to Severe Physical Damage: EMT, support 6’ on center maximum for sizes over 2-inches.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT, support 6' on center maximum for sizes over 2-inches.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway.
8. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3. Fasten rigid steel conduit with threaded galvanized steel fittings, double locknuts, and insulated bushings. Insulated bushings shall be OZ Gedny Type B.
4. Exterior rigid steel conduit box connections shall be made with a Meyers Hub fitting only. Meyers Hub fittings shall be Cooper Crouse-Hind type.
5. All LB"s, C, and T condulets shall be constructed of malleable iron. No aluminum/die pot metal type permitted.
6. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
7. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Below Slabs:

1. Refer to section 260543 for additional requirements.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
4. Change from PVC to GRC before rising above floor.
5. Arrange stub-ups so curved portions of bends are not visible above finished slab.
6. Conduits in close proximity to each other shall be located and wrapped with wire mesh to prevent cracking of slab.
7. Permitted below slab where specifically indicated below and specifically indicated on the Drawings.

I. Raceways In Slabs:

1. Refer to section 260543 for additional requirements.
2. Run conduit larger than 1-inch (27 mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3 m) intervals.
3. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
4. Arrange raceways to keep a minimum 2 inches of concrete cover in all directions.
5. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
6. Change from PVC to GRC before rising above floor.
7. Arrange stub-ups so curved portions of bends are not visible above finished slab.
8. Conduits in close proximity to each other shall be located and wrapped with wire mesh to prevent cracking of slab.
9. Permitted in-slab where specifically indicated below and specifically indicated on the Drawings.

    a. Branch circuits to floor boxes only. Branch circuit conduits shall stub-up at nearest wall or panel, whichever is closer.

J. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

M. Install pull wires in empty raceways. Use polypropylene 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 pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

O. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

P. Expansion-Deflection Fittings: 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 sleeve, 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.

1. Expansion/deflection fitting shall accommodate the following movements without collapsing or fracturing the conduit and damaging the wires it contains:

   a. Axial expansion or contraction up to 3/4-inch.
   b. Angular misalignment of the axes of the conduits up to 30 degrees in all directions.
   c. Parallel misalignment of the axes of the conduits up to 3/4-inch in all directions.

2. Expansion/Deflection fitting shall be OZ/Gedney Type DX or approved equal by Crouse Hinds (Type XD).

Q. Bushings:

1. Bushings for 1-inch conduit and smaller shall be self-extinguishing thermoplastic type – 150 deg C temperature rating.
2. Bushings for 1-1/4-inch conduit and larger shall be malleable iron body with 150 deg C insulating ring. Insulating material shall be locked in place and non-removable. Provide O-Z/Gedney Type B.

R. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

S. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

T. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

U. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

V. Locate boxes so that cover or plate will not span different building finishes.

W. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

X. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Y. Set metal floor boxes level and flush with finished floor surface.

Z. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

AA. Exposed conduits in finished spaces where there is no ceiling, and where ceiling is perforated, shall be painted, color as selected by architect.

3.3 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

B. Provide Specified Technologies, Inc (STI) EZ Path Cable Pathway sleeves at all cable penetrations through walls in the telecommunications rooms (MDF and IDF rooms) and through-fire rated partitions. Provide multiple Series 33 and Series 44 as needed to serve cabling being installed plus 100% spare capacity.

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

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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.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks, and in single duct runs.
2. Handholes and boxes.

1.3 DEFINITION

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank:

1. Two or more ducts installed in parallel, with or without additional casing materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit.

E. RNC: Rigid nonmetallic conduit.

F. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for manholes, handholes, boxes, and other utility structures.
4. Warning tape.

5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

D. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

E. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

F. Qualification Data: For professional engineer and testing agency.

G. Source quality-control test reports.

H. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

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. ARNCO Corp.
2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

C. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section.
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
4. Color. Red dye added to concrete during batching
5. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

D. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

E. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

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. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering, "ELECTRIC," "TELEPHONE," and/or as indicated for each service.
4. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

    a. Extension shall provide increased depth of 12 inches (300 mm).
    b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

    a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
    b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
    c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

    a. Type and size shall match fittings to duct or conduit to be terminated.

    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Color: Gray.
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC," "TELEPHONE," or as indicated for each service.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. NewBasis.

C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. Christy Concrete Products.
    d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
    1. Tests of materials shall be performed by a independent testing agency.

    2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
    3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of ducts, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

C. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-80-PVC where direct-buried, RNC, NEMA Type EPC-40-PVC where concrete-encased, unless otherwise noted.

D. Underground Ducts for Telephone, Communications, or Data Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts Crossing Paved Paths, walks, driveways and roadways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

F. Ducts for electrical feeders over 600V: RNC, NEMA Type EPC-80-PVC where direct-buried, RNC, NEMA Type EPC-40-PVC where concrete-encased, unless otherwise noted.

3.3 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Division Section "Earthwork" but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division Sections "Lawns and Grasses" and "Exterior Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.5 DUCT AND DUCTANK INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two handholes to drain in both directions.

B. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 25 feet (7.5 m), both horizontally and vertically, at other locations, unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Duct Entrances to Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

F. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Basic Electrical Materials and Methods."

G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

H. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in ducts, including spares.

I. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger

separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
    b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

    b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

9. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning

tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

J. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division Section "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
4. Install backfill as specified in Division Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division Section "Earth Moving."
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
10. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

11. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF CONCRETE HANDHOLES, AND BOXES

A. Precast Concrete Handhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Install handholes with bottom below the frost line, below grade.
2. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
3. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Dampproofing: Apply dampproofing to exterior surfaces of handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Division 07. After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars.

E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, , as required for installation and support of cables and conductors and as indicated.

F. Field-Installed Bolting Anchors in Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

G. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line, below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

a. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.

b. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding of Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding of Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

DIVISION 26 SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS
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SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field for normal feeders, black letters on a yellow field for emergency feeders.
2. Legend: Indicate voltage and system or service type.

C. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Black letters on an orange field for normal circuits, black letters on a yellow field for emergency circuits.
2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape: Permanent, bright-colored, continuous-printed polyethylene tape.

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
4. Embedded continuous metallic strip or core.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

C. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background for equipment connected to normal power source, white letters on a red background for equipment connected to an emergency power source. Minimum letter height shall be 3/8 inch (10 mm).

B. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

C. Comply with NFPA 70E and Section 260573 “Coordination Study" requirements for arc-flash warning labels.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. In finished spaces, nameplates for panelboards shall be secured to the interior behind the door.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach signs and plastic labels with stainless screws.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands 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.

F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

G. Outdoors: UV-stabilized nylon.

H. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 8 inches (200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 20 A: Identify with snap-around label applied in bands. Install labels at 10-foot (3-m) maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Critical Operations Power System and Life Safety System - Yellow.

2. Power - Orange.
3. Fire Alarm System – Red.
4. Security System – Blue and Yellow.
5. Mechanical and Electrical Supervisory System – Green and Blue.
6. Telecommunication Systems - Green and Yellow.
7. Control Wiring – Green and Red.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White.
      5) Ground: Green.
      6) Isolated Ground: Green with two or more yellow stripes.

   c. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral: Gray.
      5) Ground: Green.

   d. All control wiring shall be color-coded when using wires of different color from the type used to designate phase wires.
   e. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
   f. All emergency wiring shall have the same color-coding, but shall be clearly identified as emergency in all outlets, fixtures, etc.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs and metal-backed, butyrate warning signs.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. For electrical equipment such as disconnect switches, motor starters, contactors, relays, pushbutton stations, etc., the label shall have the same designation as the equipment it serves. Systems include power, lighting, control, communication,

signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Engraved, laminated phenolic nameplates. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated phenolic nameplate, “Panel (designation)”, “Served from “(designation)”.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchboards.
    e. Transformers.
    f. Electrical rooms/closets.
    g. Emergency system boxes and enclosures.
    h. Motor-control centers.
    i. Enclosed switches.
    j. Enclosed circuit breakers.
    k. Enclosed controllers.
    l. Variable-speed controllers.
    m. Push-button stations.
    n. Power transfer equipment.
    o. Contactors.
    p. Remote-controlled switches, dimmer modules, and control devices.
    q. Monitoring and control equipment.

END OF SECTION

DIVISION 26 SECTION 26 05 73
SHORT CIRCUIT ANALYSIS, COORDINATION STUDY,
AND ARC FLASH HAZARD ANALYSIS
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SECTION 26 05 73 - SHORT CIRCUIT ANALYSIS, COORDINATION STUDY, AND ARC FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SCOPE

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study. Electrical equipment shop drawings will not be reviewed/approved until the overcurrent protective device coordination study has been submitted.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current version of NFPA 70E – Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584-2002, the IEEE Guide for Performing Arc-Flash Calculations. Arc-Flash Hazard Labels shall be provided for all electrical distribution equipment with level as determined by Study.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 – Guide for Performing Arc-Flash Hazard Calculations.

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Power Circuit Breakers Rated on a Symmetrical Current Basis.
4. ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 – National Electrical Code, latest edition.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.

1.4 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Qualification Data: For coordination-study specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.
4. Arc Fault Hazards Evaluation.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Engineering Analysis and Coordination Study performed by Coordinated Power Engineering, Inc., or a comparable product by one of the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.
4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit-breaker and fuse-current ratings and types.
    b. Relays and associated power and current transformer ratings and ratios.
    c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    d. Generator kilovolt amperes, size, voltage, and source impedance.
    e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    f. Busway ampacity and impedance.
    g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Ratings, types, and settings of utility company's overcurrent protective devices.
    f. Special overcurrent protective device settings or types stipulated by utility company.
    g. Time-current-characteristic curves of devices indicated to be coordinated.
    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system, determined from both the utility and generator sources. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchboard busses.
2. Distribution panelboards.
3. Branch circuit panelboards.

B. Study electrical distribution system from normal power sources throughout electrical distribution system for Project.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, and IEEE 242.

1. Transformers:

a. IEEE C57.12.00.
b. IEEE C57.96.

2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

E. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.
b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
d. Fuse-current rating and type.
e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching

schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.
b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

F. Completed data sheets for setting of overcurrent protective devices.

3.5 ARC-FLASH HAZARD

A. Perform Arc-Flash Hazard Analysis for each piece of distribution equipment and provide results indicating personnel protective equipment required for the potential hazard. Provide arc flash hazard labels as required by the NEC on each piece of equipment indicating the calculated arc-flash hazard.

3.6 AVAILABLE FAULT CURRENT LABELING

A. Contractor shall provide a 4.0 in. x 4.0 in. Brady thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The labels shall include the following information:

1. Line 1 – “Maximum Available Fault Current”
2. Line 2 – “_____ Amperes”; Contractor shall field mark maximum available fault current available at the line terminals of the equipment.
3. Line 3 – Date of Installation

C. Labels shall be printed by a thermal transfer type printer.

D. Labels shall be field-installed by the Contractor.

END OF SECTION

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DIVISION 26 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. Contactors.

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 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)

F. Provide unit suitable for Low Temp/High Humidity environments in SHOPS and other unconditioned spaces.

G. Provide single or dual zone control capability, as applicable.

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. 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.
3. Sensitivity Adjustment: Separate for each sensing technology.
4. 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).
5. 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).
6. 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.
7. 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.

8. Detection Coverage (high bay): Detect occupancy anywhere within a 20 foot (6096 mm) radius when mounted at ceiling at 180-inches (4572 mm) above the finished floor. Provide stem mount as required to maintain manufacturer's recommended mounting height.

2.7 SWITCHBOX-MOUNTED LOW VOLTAGE OCCUPANCY/VACANCY SENSORS

A. Subject to compliance with requirements, provide Sensor Switch nWSX-PDT-LV or nWSX-PDT-LV-DX (On/Off or Dimming 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 Mode: Automatic-on when coverage area is occupied, and automatic-off when unoccupied.
b. Vacancy Sensor Mode: 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.

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

1. Basis-of-Design Product: Subject to compliance with requirements, provide nLight nPP16 or comparable product by one of the following:
2. Wattstopper DLM
3. Hubbell NX
4. 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.

8. Discrete model listed for connection to receptacles, for occupancy-based control of plug loads within the space.

    a. One relay configuration only.
    b. 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 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 SECTION

DIVISION 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

A. 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

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.

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 SECTION

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DIVISION 26 SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS
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SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer 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. Wiring Diagrams: Power, signal, and control wiring.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For Testing Agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as

defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

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.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturers: Square D Co./Group Schneider NA; Schneider Electric. Subject to compliance with requirements, provide products by one of the following:

1. Powersmiths.
2. Siemens Energy & Automation, Inc.
3. ABB-GE Electrification Equipment.
4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum or Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

E. Taps for Transformers Smaller Than 3 kVA: None.

F. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

I. Energy Efficiency: All transformers shall meet or exceed Department of Energy (DOE)) 2016 efficiency requirements per 110 C.F.R. &421/196 (2015).

J. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to K-factor of 9.
2. Indicate value of K-factor on transformer nameplate

K. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

L. Wall Brackets: Manufacturer's standard brackets.

M. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. 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-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, and grounding.
c. Verify that resilient mounts are free and that any shipping brackets have been removed.
d. Verify the unit is clean.
e. Perform specific inspections and mechanical tests recommended by manufacturer.
f. Verify that as-left tap connections are as specified.
g. Verify the presence of surge arresters and that their ratings are as specified.

2. Electrical Tests:

a. Measure resistance at each winding, tap, and bolted connection.
b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.

c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.

d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

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SWITCHBOARDS
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SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Disconnecting and overcurrent protective devices.
3. Instrumentation.
4. Control power.
5. Accessory components and features.
6. Identification.

B. Related Requirements:
1. Section 26 4343 "Surge Protection for Low Voltage Electrical Power Circuits."
2. Section 23 0900 "Instrumentation and Controls of HVAC and Plumbing Systems" for interface between electricity meters and building automation system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Detail utility company's metering provisions with indication of approval by utility company.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
8. Include schematic and wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. 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.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two 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. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace circuit breakers that fail in materials or workmanship within five years from date of Substantial Completion, and all remaining components for two years from Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Nominal System Voltage: As indicated on the Drawings.

D. Main-Bus Continuous: As indicated on the Drawings

E. Indoor Enclosures: Steel, NEMA 250, Type 1.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Customer Metering Compartment: Provide PowerLogic power meters (or equal). A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Provide for service entrance switchboard only.

H. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

I. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, with tin-plated copper feeder circuit-breaker line connections.
2. Ground Bus: 1/4-by-2-inch- (6-by-50-mm), hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
4. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

J. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100A through 225 A, field adjustable short time and continuous current settings for circuit-breaker frame sizes 250A through 400A.
2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings for circuit breaker frame sizes 600A and larger:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor material.
c. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system.
d. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current. Provide for main circuit breaker(s) and where noted on the drawings.

1. Fixed circuit-breaker mounting.

2. Two-step, stored-energy closing.

3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time time adjustments.
c. Ground-fault pickup level, time delay, and I^2t response.

4. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
5. Control Voltage: 120-V ac.

C. Fuses are specified in Section 26 2813 "Fuses."

D. Provide an energy-reducing maintenance switch with local status indicator for all circuit breakers rated, or which can be adjusted to, 1200A and higher.

E. Provide ground fault protection for all circuit breakers rated 1200A and higher.

2.3 INSTRUMENTATION

A. Instrumentation Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type wit integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; would type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.

3. Control-Power Transformers: Dry type, mounted in separate compartments for unit larger than 3 kVA.

B. Multifunction Digital-Metering Monitor (Service Entrance Switchboard only): Microprocessor-based unit suitable for three- or four-wire systems. Provide Square D PowerLogic ION7650 series web-enabled digital utility feeder meter (or approved equal) with option cards, power pack, factory installed software as required to function as a complete metering system. Provide with the following features:

1. Advanced meter with wide-range voltage inputs (57-347 V line-neutral or 100-600V line-line), transient detection, data and waveform recording, IEC 61000-4-30 Class A & EN50160.Supports ION, IEC 61850 (only for meters with 5 MB memory and Ethernet comm card) Modbus-RTU, and DNP 3.0.
2. True RMS 3-phase voltage, current, and power that meets stringent ANSI C12.20 0.2, Class 2, 10, & 20. Power quality: sag/swell, harmonics - individual, even, odd, total to the 63rd, waveform capture at 256 samples/cycle.
3. 10MB log/event memory, waveform logging up to 96 cycles, up to 800 channels historical, min/max, timestamp resolution to 0.001 seconds, GPS time synchronization and historical trends through front panel.
4. Dial-out capability when memory is near full.
5. Data push capability through SMTP (email).
6. 65 configurable _ cycle setpoints for single, multi-condition and dial out on alarm and math, logic, trig, log, linearization formulas.
7. Waveform capture up to 1024 samples/cycle.
8. Transient detection to 17µs at 60Hz.
9. Harmonics: magnitude, phase and inter-harmonics to the 40th.
10. Flicker to EN50160 and IEC 6100-4-7/4-15 (also configurable for IEEE 519-1992, IEEE159, SEMI), plus CBEMA/ITIC.
11. Symmetrical components.
12. Integrated display with front optical port, 10 MB logging memory, and 1024 samples/cycle resolution. Display panel be high visibility, adjustable contrast, 3.5”x4.5” (minimum) backlit LCD color graphic display.
13. Current Probe Inputs with three Universal Technic 10 A clamp on CTs; meets IEC 1036 accuracy. Provide a fourth CT connectivity for measuring neutral current to provide calculated ground current value.
14. Voltage Inputs: 57 to 347 V AC line-to-neutral / 100 to 600 V AC line-to-line
15. Power supply: Standard power supply (85-240 V AC, ±10%/47-63 Hz / 110-300 V DC, ±10%)
16. Calibrated for 60Hz system frequency.
17. Communications: 1 RS-232/RS-485 port, 1 RS-485 port, 1ANSI Type 2 optical port, 10BASE-T/100BASE-TX Ethernet (RJ45) and 100BASEFX Ethernet Fiber, 56 k universal internal modem (RJ11). Ethernet/modem gateway uses serial port, ION, DNP 3.0, Modbus RTU - master & slave, Modbus TCP and MV-90.
18. I/O: Standard (8 digital ins, 3 Form C relays, 4 Form A solid-state out) plus expansion I/O card (8 additional digital inputs & four 0 to 20 mA analogue inputs and four 0 to 20 mA outputs).
19. Security: Password protected, no hardware lock.
20. Special order options: EN 50160 compliance monitoring and IEC 61000-4-30 Class A measurements.

21. Provide with energy management software (EcoStruxure Power Monitoring Software) factory installed with standard edition BASE license. Meter shall be equipped with user-friendly installation and set-up, multi-user, multi-level security with controls and customized access to sensitive data for up to 16 users.
22. Provide two year all-inclusive labor and material warranty.

C. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems. Provide Square D PowerLogic PM8000 series digital power quality meter (or approved equal) for feeders indicated with option cards, power pack, factory installed software as required to function as a complete metering system.

2.4 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

B. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

2.6 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with manufacturers mounting and anchoring requirements for seismic controls.

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Additional connections to metering systems, where applicable, shall be done in the field by the manufacturer’s start-up service group.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 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 "Overcurrent Protective Device Coordination Study."

3.6 STARTUP SERVICES FOR MONITORING

A. Engage a factory-authorized service representative to perform startup service.

B. Train Owner's maintenance personnel on procedures and schedules for energizing and de-energizing, troubleshooting, servicing and maintaining equipment and schedules.

C. Verify that the meters are installed and connected according to the Contract Documents.

D. Verify that the electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.

E. Complete installation and startup checks according to manufacturer's written instructions.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units. Provide minimum 4-hours on-site training.

END OF SECTION

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PANELBOARDS
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SECTION 26 24 16 - PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Fusible panelboards.

B. Related sections include the following:

1. “Surge Protection Devices” Section 264300.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. SPD: Surge Protection Device.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.

7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Qualification Data: For qualified testing agency.

D. 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.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.8 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor bolt inserts into bases. Concrete, reinforcement, and form-work requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Enclosures: Flush and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Wash-Down Areas/Kitchen: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R.
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
5. Multiple-Section Panelboards shall consist of two or more cabinets with identical interiors mounted under separate trims. Cabinets, trim, and doors shall be of the same size. Main lugs and busses of each section shall be rated as indicated on the Drawings. Where main breakers are indicated in multi-section panelboards, the main breaker shall be contained in one section with through-feed lugs and sub-feed cables installed within panel, equal to the incoming feeder size. All busses and lugs shall have ampere capacity equal to or greater than the main breaker ampere rating. Loads shall be divided as evenly as practical between the sections, in addition to being balanced over the phases.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.
4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

F. Service Entrance Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting of overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

I. Provide surge suppression device for each panel with SPD disconnect indicated in schedule on the drawings.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. ABB-GE Electrification Equipment.
4. Siemens Energy & Automation, Inc.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only, as indicated.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. ABB-GE Electrification Equipment.
4. Siemens Energy & Automation, Inc.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only, as indicated.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc,; Cutler-Hammer Business Unit.
3. ABB-GE Electrification Equipment.
4. Siemens Energy & Automation, Inc.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 100A to 225A, field-adjustable short-time and continuous current settings for frame sizes 250A and larger.
2. GFCI Circuit Breakers: Single-and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. Ground Fault Equipment Protection (GFEP) Circuit Breakers; Class B Ground Fault Protection (30-mA trip).
4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    g. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    j. Handle Clamp: Loose attachment for holding circuit breaker handle in ON position for breakers serving clocks, telephone, and communications equipment, refrigerators, exit signs, fire alarm systems, controls, etc., to prevent accidental operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

H. Comply with NECA 1.

I. Air distribution panels shall be installed on galvanized formed steel channels designed to distribute the weight on the supporting wall.

J. Conduits entering the tops and bottoms of flush panels shall be located back from the front ledge of the panels to allow approximately 2-inches between the finished wall and the edge of the conduits.

K. Where panelboard is mounted flush in a wall or partition, provide 3/4-inch empty conduit, from panelboard to ceiling space for each three or less spare single pole breakers and/or spaces in the panel unless otherwise noted on the drawings.

L. Surge protective device units shall be installed immediately above or below panelboard enclosure, per manufacturer’s recommendations, connected to circuit breaker disconnecting means with lead length of conductors less than 18 inches.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

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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. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Snap switches.
4. Pendant cord-connector devices.
5. Cord and plug sets.
6. 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.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

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. Subject to compliance with requirements manufacturers offering products that may be incorporated into the work include, but are not limited to, the following available manufacturers' names:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, Tamper-Resistant 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; BR20*.
b. Leviton; 5362-SG*.
c. Pass & Seymour; TR5262*.

2.3 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. GFCI Convenience Receptacles, Tamper-Resistant 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Hubbell; GFTR20.
   b. Pass & Seymour; 2095TR.

2. Receptacle(s) shall also be weather-resistant type for exterior applications.

2.4 USB RECEPTACLES

A. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.

1. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
2. USB Receptacles: USB Type A/C, 5 V dc, and 2.1 A per receptacle (minimum).
3. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Available Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper Crouse-Hinds.
   b. EGS/Appleton Electric.
   c. Killark; a division of Hubbell Inc.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper; L520R.
   b. Hubbell; HBL2310.
   c. Leviton; 2310.
   d. Pass & Seymour; L520-R.

2.7 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, or as noted on the Drawings.

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.

2.8 DUAL FLIP-UP TABLE BOX

A. Description: Dual Flip-up recessed hard wired unit with 6’-0” cord. Unit shall include (1) One Nema 5-20R receptacle and (1) One opening for communications

1. Catalog No. DQF-F-20-BK-2A; black finish; dual flip-up unit which includes one (1) 20A black tamper-resistant duplex receptacle and one (1) opening that will accept an adapter for one (1) Wiremold CM Series Open System 2A module, one (1) Ortronics® Series II or one (1) TracJack adapter that accommodates a wide range of communication outlets. Adapters are included. Units are supplied with a 6 foot [1.83m] cord.

2.9 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; with 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.

2.10 TOGGLE SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
   b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
   c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
   d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper; 2221PL for 120 V and 277 V.
   b. Hubbell; HPL1221PL for 120 V and 277 V.
   c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
   d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Cooper; 2221L.
   b. Hubbell; HBL1221L.
   c. Leviton; 1221-2L.
   d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Wattstopper; LVS-1.
   b. Cooper; 1995.
   c. Hubbell; HBL1557.
   d. Leviton; 1257.
   e. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Wattstopper; LVS-1K-G.
b. Cooper; 1995L.
c. Hubbell; HBL1557L.
d. Leviton; 1257L.
e. Pass & Seymour; 1251L.

2.11 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel or per Architect.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

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, die-cast aluminum 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 6a jacks for UTP cable.

2.13 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.

2.14 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.
3. Steel City.

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.

C. Boxes shall be manufactured from cast-iron and shall be approved for use on-grade floors. The boxes shall be a minimum 14-1/2"L x 11-7/8"W x 3-7/16" H (368mm x 302mm x 87mm). There shall be four (4) independent wiring compartments that allow capacity for up to six duplex receptacles and/or communication services. The RFB4 and 6 Series Boxes shall permit tunneling from adjacent or opposite compartments. Four of the compartments shall have a minimum wiring capacity of 27 cubic inches (443 cubic cm) and two compartments shall have a minimum wiring capacity of 36 cubic inches (590 cubic cm). The boxes shall provide the following minimum number of conduit hubs: four 1" (25mm) and four 1-1/4" (32mm). The boxes shall be fully adjustable, providing a maximum of 1-7/8" (48mm) pre-our adjustment, and a maximum of 3/4" (19.1mm) after-pour adjustment.

D. Activation covers shall be manufactured of die-cast aluminum or die-cast zinc, and shall be available in a brushed aluminum finish, plated brass finish, or a powder-coated paint finish. Activation covers shall be available in flanged and flangeless versions. Covers shall be available with options for tile or carpet inserts, flush covers, or covers with one 1" trade size screw plug opening and one combination 1-1/4" and 2" trade size screw

plug openings for furniture feed applications. Flanged covers shall be 7-3/4" L x 6-9/16" W (197mm x 167mm). Flangeless covers shall be 6-3/4" L x 5-9/16" W (171mm x 142mm). The activation cover shall have been evaluated by UL to meet the applicable US and Canadian safety standards for scrub water exclusion when used on tile, terrazzo, wood and carpet.

E. Box manufacturer shall provide a complete line of faceplates and bezels to facilitate mounting of UTP, STP (150 ohm), fiber optic, coaxial, and communication devices. The boxes shall provide a series of device mounting plates that will accommodate specified outlets and modular inserts.

F. The minimum concrete pour depth shall be 3-7/16" (87mm) for the RFB4, RFB4-4DB, and the RFB4-CI-1 Series Boxes. The boxes shall contain four locations to accommodate leveling for pre-concrete pour adjustment and shall provide four leveling screws for the pre-pour adjustment. The floor boxes shall be warranted for one year from the date of final acceptance.

G. Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly. Comply with UL 514 scrub water exclusion requirements. Service-Outlet Assembly shall be flush type with devices indicated on drawings and complying with requirements in Section 27. Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness. Unit is listed and labeled for fire rating of floor-ceiling assembly. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of cables that comply with requirements in Division 27.

2.15 SERVICE POLES

A. Dual-Channel Service Poles:

1. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
2. Poles: Nominal 2.5-inch- (65-mm-) square cross-section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.
3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
4. Material: Aluminum.
5. Finishes: Satin-anodized aluminum.
6. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, balanced twisted pair data communication cables.
7. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
8. Data Communication Outlets: Blank insert with bushed cable opening.

2.16 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 FLOOR BOXES

A. Set metal floor boxes level and flush with finished floor surface.

3.4 IDENTIFICATION

A. Comply with Division 16 Section "Identification for Electrical Systems."

B. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

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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. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, switchboards, and enclosed controllers.
2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

    a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Coordination charts and tables and related data.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 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: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Feeders: Class J, time delay.
2. Motor Branch Circuits: Class RK1, time delay.
3. Other Branch Circuits: Class RK1, time delay, time delay.
4. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

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 other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

C. Wiring Diagrams: For power, signal, and control wiring.

D. Qualification Data: For qualified testing agency.

E. 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.

F. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.6 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).

1.7 COORDINATION

A. 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.

1.8 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: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. ABB-GE Electrification Equipment.
4. Siemens Energy & Automation, Inc.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, lockable in either open or closed positions, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum 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: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary. Contacts would reactivate before blades open as indicated on the Drawings.
5. Lugs: Compression type, suitable for number, size, and conductor material.
6. Accessory Control Power Voltage: Remote-mounted and powered; 120-VAC. Provide as required with auxiliary contact kit.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. ABB-GE Electrification Equipment.
4. Siemens Energy & Automation, Inc.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, lockable in either open or closed position, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contacts, arranged to activate before switch blades open, where indicated in the Drawings.
4. Lugs: Compression type, suitable for number, size, and conductor material.
5. Accessory Control Power Voltage: Remote mounted and powered; 120 VAC. Provide as required with auxiliary contact kit.

2.4 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. ABB-GE Electrification Equipment.
4. Siemens Energy & Automation, Inc.

B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, ampacity as indicated on the drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism;

horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 600-V ac, ampacity as indicated on the drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight green ON pilot light.
3. Isolated neutral lug; 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 24-V ac coil voltage, unless otherwise indicated on the drawings.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
9. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
10. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
11. Hookstick Handle: Allows use of a hookstick to operate the handle.
12. Lugs: Compression type, suitable for number, size, and conductor material.
13. Service-Rated Switches: Labeled for use as service equipment.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. ABB-GE Electrification Equipment.
4. Siemens Energy & Automation, Inc.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact, as indicated on the drawings.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts, where indicated on the drawings.
7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped, where indicated on the drawings.
8. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac, as required.
9. Provide with lockable handle, lockable in either open or closed position.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R (base bid), NEMA 4X, stainless steel (alternate no.#).
3. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X, stainless steel.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas: NEMA 250, Type 7.

B. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

C. Operating Mechanism: The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

E. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. 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 individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Division 26 section “Seismic Controls for Electrical Systems.”

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:
1) Use a low-resistance ohmmeter.
a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to

values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

E. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
   e. Determine the following by primary current injection:
      1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

   f. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
   g. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
   h. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

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ENCLOSED CONTROLLERS
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SECTION 26 29 13 - ENCLOSED 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, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.

B. Related Sections include the following:

1. Mechanical Divisions for “Variable Speed Drives” and “Power Factor Correction Capacitors”.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.
b. Nameplate legends.
c. Short-circuit current rating of integrated unit.
d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around enclosed controllers where pipe and ducts are prohibited. Show enclosed controller layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Qualification Data: For manufacturer and testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

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.

C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

D. 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.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.5 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 electric heating of sufficient wattage to prevent condensation.

1.6 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Square D.
2. Eaton Corporation; Cutler-Hammer Products.

3. ABB-GE Electrification Equipment.
4. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
5. Siemens/Furnas Controls.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer source of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity. Control power transformers shall have primary and secondary fuse protection.
2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to homeplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, nonfusible switch unless otherwise noted on the drawings.
2. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
3. MCP Disconnecting Means: UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.3 ENCLOSURES

A. Description: Surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R (base bid), NEMA 4X, stainless steel (alternate no.#).

2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X, stainless steel.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

B. Provide lockable handle for combination starter and disconnects that accepts three padlocks and interlocks with cover in closed position.

2.4 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Push-to-Test Red “Power Available” and Green “Running” non-incandescent, Pilot Lights, and Hand-Off-Automatic Selector Switches: NEMA ICS 2, heavy-duty type.

C. Control Relays: Two (2) NO/NC auxiliary contacts and adjustable time-delay relays as required by automatic control sequence.

D. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. 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 complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

C. Install Power Factor Correction Capacitors furnished under Mechanical Divisions with disconnects, overcurrent protection, wire, conduit and ground for capacitor enclosure, all in accordance with the recommendations of the capacitor manufacturer and the National Electric Code.

D. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.4 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Section 260553 "Identification for Electrical Systems."

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 26 Section "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 applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
3. Report results in writing.

C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

D. Perform the following field tests and inspections and prepare test reports:

1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
2. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with drawings and specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, and grounding.
d. Verify the unit is clean.
e. Inspect contactors:
1) Verify mechanical operation.
2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.

f. Motor-Running Protection:
1) Verify overload element rating is correct for its application.
2) If motor-running protection is provided by fuses, verify correct fuse rating.

g. Inspect bolted electrical connections for high resistance using one of the two following methods:
1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:

a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.

b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

c. Test motor protection devices according to manufacturer's published data.

d. Test circuit breakers as follows:
   1) Operate the circuit breaker to ensure smooth operation.
   2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.

e. Perform operational tests by initiating control devices.

4. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

DIVISION 26 SECTION 26 41 13
LIGHTNING PROTECTION SYSTEM
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SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a UL Master Label lightning protection system for the building and associated structures, to be provided.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
2. Include raceway locations needed for the installation of conductors.
3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
4. Include roof attachment details, coordinated with roof installation.
5. Calculations required by NFPA 780 for bonding of metal bodies.

C. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lightning protection cabling attachments to roofing systems and accessories.
2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

D. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

E. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

F. Field quality-control reports.

G. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D

H. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.
2. Ground loop conductor.
3. Surge Protection Devices.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL and LPI as a Master Installer/Designer, 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.

1.5 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. East Coast Lightning Equipment Inc.
2. ERICO International Corporation.
3. Harger.
4. Heary Bros. Lightning Protection Co. Inc.
5. Independent Protection Co.

6. Preferred Lightning Protection.
7. Robbins Lightning, Inc.
8. Thompson Lightning Protection, Inc.

B. Comply with UL 96 and NFPA 780 requirements for Class I buildings.

C. Roof-Mounted Air Terminals: NFPA 780, Class I, aluminum unless otherwise indicated.

1. 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.
2. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in Division 07 roofing Sections.
3. Provide protection caps on air terminal located at high traffic roof areas, walkways and service areas.

D. Main and Bonding Conductors: Aluminum, except down conductors will be Copper.

E. Ground Loop Conductor: The same size and type as the main conductor except tinned.

F. 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 and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200 feet (60 m) of building. Comply with requirements for concealed systems in NFPA 780.

1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
2. Install conduit where necessary to comply with conductor concealment requirements.

D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

E. 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.

F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

G. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

3.2 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.

3.3 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Perform inspections as required to obtain a UL Master Label for system.

C. Prepare test and inspection reports and certificates.

END OF SECTION

DIVISION 26 SECTION 26 43 00
SURGE PROTECTION DEVICES (SPD)
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SECTION 26 43 00 - SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes Surge Protection Devices for low-voltage power, control, and communication equipment.

B. Related Sections include the following:

1. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.

1.3 LISTING REQUIREMENTS

A. UL 1449 (4th Edition).

1.4 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: air of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. NRTL: Nationally recognized testing laboratory.

F. OCPD: Overcurrent protective device.

G. SAD: Silicon avalanche diode.

H. SCCR: Short-circuit current rating.

I. SPD: Surge protective device.

J. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

K. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

L. Type 2A SPDs: Motorola R56 Standards and Guidelines for Communication Sites (2017) Compliant, SAD/MOV type permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

M. Type 2B SPDs: Motorola R56 Standards and Guidelines for Communication Sites (2017) Compliant, MOV permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

N. VPR: Voltage protection rating.

1.5 SUBMITTALS

A. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, mounting provisions, connection notes, wire size and wiring diagram.

B. Equipment Manual: The manufacturer shall furnish an installation manual with installation notes, start-up and operating instructions for the specified SPD. Installation instructions shall clearly state whether the system requires an external overcurrent device to maintain the system's UL 1449 listing.

C. Verification that all SPD are UL tested and labeled with 20kA (In) nominal discharge rating for compliance to UL96A Lightning Protection Master Label and NFPA 780.

D. UL 1449 stipulation for fused SPD – The manufacturer's authorized representative is required to submit the following:

1. Certify that the SPD is UL 1449 listed (UL Card) with UL Card.
2. Indicate the type of internal or external fusing that is incorporated in the SPD and what impact the fusing has on the performance of the device with respect to surge capacity and clamping levels.

E. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated with the manufacturer.

1. Single pulse surge current capacity: single pulse surge current tested in a mode at rated surge currents. Single pulse surge current capacities of 200,000 A or less per mode are established by single pulse testing in a mode.

2. Single pulse surge current capacity test: an initial UL 1449 defined as 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform is applied to benchmark the unit's suppression voltage.
3. A single pulse surge of maximum rated surge current (for units rated over 200,000A per mode, components or sub-assemblies are tested) magnitude with an approximated 8 x 20µs waveform is then applied. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.

F. Minimum Repetitive Surge Current Capacity.

1. Service entrance suppressor units should be tested repetitively to verify repetitive capacity.
2. Minimum Repetitive Surge Current Capacity Test:

    a. An initial UL 1449 surge defined as 1.2 x 50µs, 6000V open circuit voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform is applied to benchmark the unit's suppression voltage.
    b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges defined as a 1.2 x 50µs 10kV or 20kV open circuit voltage waveform and an 8 x 20µs 10,000A short circuit current waveform are then applied at one minute intervals.
    c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.

3. Survival is achieved if the suppression voltage measured from the two UL 1449 surges does not vary by more than 10%.
4. Proof of such testing shall be the test log generated by the surge generator.

G. Short Circuit Fuse Testing.

1. Each design configuration shall be short circuit tested in accordance with the type of fusing utilized in the suppression path.
2. Short Circuit Fuse Test:

    a. Testing shall include application of a sustained overvoltage that causes the unit to enter a bolted fault condition.
    b. This bolted fault condition shall occur with the full rated AIC current of the fuse available.

3. The fuse shall fail in a safe manner with no physical or structural damage to the unit and any failure shall be self-contained within the unit.

H. Surge Current Fuse Testing.

1. Each design configuration shall be surge tested with fusing in series to verify that a transient of maximum surge current capacity magnitude is fully suppressed without fuse failure, operation or degradation.

I. Service Entrance SPD must be subjected to a series of waveforms as described in IEEE C62.41.2-2002. Clamping voltage measurements were taken throughout the tests to evaluate any deviations in performance as a result of the surges. Injected surges included the 1.2/50µs, 8/20µs waveforms at levels of 6kV/500A for bench marking, and high current 10/1000µs surges at 1.5, 3.1, 3.6 and 6.2 kA levels.

J. Motorola R56 Type 2A SAD/MOV and Type 2B MOV SPDs shall be UL Type 2 listed.

1.6 STANDARDS

A. UL 1449. Underwriters laboratories safety standard for Surge Protection Devices.

B. NEC Article 285.

C. NFPA 780. STANDARD FOR THE INSTALLATION OF LIGHTNING PROTECTION SYSTEMS.

D. IEEE (Institute of Electrical and Electronic Engineering Inc.) C62.41.1 and C62.41.2 – 2002 rev.

E. IEEE C62.45 – 2002 rev

F. IEEE Std. 1100 “The Emerald Book” Section 8.4.2.5

G. MOTOROLA R56 STANDARDS AND GUIDELINES FOR COMMUNICATIONS SITES.

H. CBEMA (ITIC) and IEC - (Computer Business Equipment Manufacturers Association or Information Technology Industry Council and International Electrotechnical Commission define clamping voltage tolerance guidelines for sensitive equipment)

I. All manufacturers must comply with above listed standards and any additions current revisions of industry standards. All products that do not comply with current industry standards will not be accepted.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain all suppression devices and accessories through one source from a single manufacturer. SPD’s shall be integrally mounted with equipment and shall be the equipment manufacturer’s standard offering in compliance with these

specifications. Provide externally mounted SPD's where equipment manufacturer's offering does not comply with these specifications, and where indicated on the drawings.

1.8 PROJECT CONDITIONS

A. Placing into Service: Do not energize or connect service entrance equipment, panelboards, control terminals, or data terminals to their sources until the surge protective devices are installed and connected.

B. Each protection device shall have a capacitive filtering system connected in each Line to Neutral (L→N)(Wye) mode or Line to Line (L→L)(Delta) mode to provide EMI/RFI noise attenuation.

C. Protection modes: The SPD shall provide Line to Neutral (L→N)(Wye), Line to Ground (L→G)(Wye or Delta), Line to Line (L→L)(Delta) and Neutral to Ground (N→G)(Wye) protection.

D. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage (MCOV): Should be tested to 115% per UL 1449 3rd.
2. Operating Temperature: 0 to 50 deg F.
3. Humidity: 0 to 95 percent, noncondensing.
4. Altitude: Less than 12,000 feet above sea level.

1.9 COORDINATION

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

B. All devices must be installed on the load side of the facility after the first overcurrent protection or disconnect.

C. Products shall be installed external to service, distribution, and branch panel equipment. All SPDs must have the same or greater AIC, Interrupting, or Fault rating of the equipment the SPD is protecting.

D. All SPDs for panels fed from Data Center electrical distribution system shall comply with Motorola Type 2A requirements.

1.10 WARRANTY

A. General Warranty: Special warranties specified in this article shall not deprive owner of other rights owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by contractor under requirements of the Contract Documents.

B. Manufacturer shall provide a product warranty for a period of not less than ten (10) years from date of installation. Warranty shall cover unlimited replacement of SPD or modules during the warranty period.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSORS

A. Acceptable Manufacturers and Models:

1. Motorola
2. LEA International Inc.
3. Current Technology
4. Liebert
5. ASCO
6. Surge Suppression, Inc.

B. SPD shall be a multi-stage parallel protector. Refer to drawings to confirm voltages. SPD's minimum surge current capacity shall be 400kA per phase (L-N plus L-G) and 200kA per mode (L-N, L-G, L-L and N-G).

C. SPD shall be modular design with field replaceable modules per phase. Each protection module shall have a visual indicator that signifies that the protection circuitry is powered. The unit

D. SPD shall not be taken off line to verify integrity of system. Redundant status indicators shall be mounted on the front of the door that monitors the system protection circuitry.

E. SPD shall contain a technology that utilizes multiple thermally protected metal oxide varistors (MOV) per mode.

F. SPD shall be labeled as minimum with Type 2 (verifiable at UL.com). Every component of every mode, including N-G, shall be protected by internal thermal protection. SPDs relying upon external or supplementary installed safety overcurrent protection do not meet the intent of this specification.

G. All primary transient paths shall utilize copper wire, aluminum bus bar and lugs of equivalent capacity to provide equal impedance interconnection between phases. No plug-in module or components shall be used in surge carrying paths.

H. SPD shall provide the following monitoring features: dry contacts, digital surge counter and audible alarm with alarm disable switch. Equipment shall utilize a NEMA 12 enclosure.

I. If no circuit breaker is available add internal disconnect switch.

2.2 DISTRIBUTION PANEL SUPPRESSORS

A. Acceptable Manufacturers and Models:

1. Motorola
2. LEA International Inc.
3. Current Technology
4. Liebert
5. ASCO
6. Surge Suppression, Inc.

B. SPD shall be a multi-stage parallel protector. Refer to drawings to confirm voltages. SPD's minimum surge current capacity shall be 200kA per phase (L-N plus L-G) and 100kA per mode (L-N, L-G, L-L and N-G).

C. SPD shall meet all specification requirements in section 2.1 (D through F) and as follows:

D. SPD shall be modular design with a field replaceable module. SPD shall provide the following monitoring features: dry contacts, surge counter and audible alarm with alarm disable switch. SPD shall utilize a NEMA 12 enclosure. If no circuit breaker is available add internal disconnect switch.

2.3 PANELBOARD SUPPRESSORS

A. Acceptable Manufacturers and Models:

1. Motorola
2. LEA International Inc.
3. Current Technology
4. Liebert
5. ASCO l.
6. Surge Suppression, Inc.

B. SPD shall be a multi-stage non-parallel protector. Refer to drawings to confirm voltages. SPD's minimum surge current capacity shall be 100kA per phase (L-N plus L-G) and 50kA per mode (L-N, L-G, L-L and N-G).

C. SPD shall meet all specification requirements in section 2.1 (D through F) and as follows:

1. SPD shall be non-modular design. SPD shall provide the following monitoring features: dry contacts and audible alarm. SPD shall utilize a NEMA 1 enclosure or better.

2.4 MOTOROLA R56 TYPE 2A SUPPRESSORS

A. Acceptable Manufacturers:

1. Motorola PolyPhaser/Transtector IMAX 120W or approved equal.

B. The SPD shall consist of primary modules using Silicon Avalanche Diode (SAD) technology and secondary modules using Metal Oxide Varistor (MOV) technology. The SPD shal be listed to UL 1449, 4th edition. A test report from a NRTL, NAVLAP, A2LA, or a certified UL client testing data laboratory detailing the procedures used, and the results obtained shall be made available to Motorola Solutions for approval.

C. SPD shall be a permanently connected, one-port or parallel configuration. See UL 1449 4th edition, section 39A.

D. The suppression components shall be voltage limiting type. Voltage switching components shall not be utilized as a suppression element in the SPD.

E. The enclosure rating of the SPD shall be NEMA 4.

F. Environmental parameters:

1. Operating temperature range: -40 deg C to 65 deg C (-40 deg F to 149 deg F)
2. Storage temperature range: -40 deg C to 65 deg C (-40 deg F to 149 deg F)
3. Operating humidity range: 0-95%, non-condensing
4. Altitude range: -152.4 m to 4572 m (-500 ft to 15,000 ft)

G. Each SPD shall have indicator lamps on or visible from the front of the device showing that power is applied and that protection integrity has not been compromised.

H. The SPD shall include the capability for remote monitoring. Such as form "C" dry contacts or SNMP traps. The device shall indicate when there is an input power failure or the integrity of any module has been compromised.

1. A device using SNMP traps will indicate power failure by a loss of communications in the SNMP managing device.
2. Form C contacts shall be isolated from the AC power circuitry to safeguard the alarm circuit or reporting device should there be a catastrophic event.
3. Connection to the remote monitoring contacts of the SPD shall utilize 0.34 mm² (#22 AWG) or larger conductors.

I. Except in Protected Multiple Earth (PME) systems, suppression modules shall not be connected between any phase conductor or neutral conductor and the equipment grounding conductor or ground (L-G, Common Mode Neutral to Ground).

J. The primary module(s) shall consist of SAD module(s) providing 20kA per phase, per polarity, minimum energy absorption. See "Impulse Surge Durability Test Requirements" on page 7-57 for Motorola Solutions certification requirements.

K. The secondary module(s) shall consist of Metal Oxide Varistor(s) (MOV) module(s). See "Impulse Surge Durability Test Requirements" on page 7-57 for Motorola Solutions certification requirements.

L. SPD shall be properly selected based on the operating voltage and number of phases of the circuits to be protected.

M. Each module or sub assembly shall be modular in design to allow for easy field replacement.

N. The SPD shall use integral overcurrent protective devices and shall have a minimum Short Circuit Current Rating (SCCR) of 25,000 amperes, as defined by UL 1449, 4th edition, section 44.2.

O. The manufacturer declared Nominal Discharge Current value (I_n) for Motorola Type 2A and Type 2B shall be 20kA, (L-L) (L-N), as defined by UL 1449, 4th edition 40.7.1, using 8/20µs waveshape, per IEEE C62.45-2002.

P. The SPD shall have a Voltage Protection Rating (VPR) (at the nominal discharge current of 10,000 amperes) not to exceed 800 $V_ǫ$ (L-N), 1000 $V_ǫ$ (L-L) at 6kV/10kA-8/20µs, per IEEE C62.45-2002.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Provide a surge protection device for all equipment indicated with a disconnecting means identified for SPD. The specified unit shall be installed Internal to the equipment unless external as stand alone product by a named manufacturer is required to meet the performance specifications. Provide a disconnecting means for all SPD's, whether internally or externally mounted.

B. The specified system shall be installed with the shortest lead length possible from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends. Utilize a 60 amp breaker for connection means. See manufacturer's installation manual.

C. Comply with NECA 1.

D. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's written instructions.

E. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's written instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
2. Do not exceed manufacturer's recommended lead length.
3. Do not bond neutral and ground.

F. Use crimped connectors and splices only. Wire nuts are unacceptable.

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 FIELD QUALITY CONTROL

A. Perform the following field quality-control testing with the assistance of a factory-authorized service representative:

1. After installing surge protective devices, but before electrical circuitry has been energized verify that the unit voltage and connecting equipment voltage is same.
2. Verify per NEC 285.6 that the SPD AIC rating is equal or greater to connecting equipment.
3. Inspect anchorage, alignment, grounding, and clearances.
4. Complete startup checks according to manufacturer's written instructions.
5. Perform visual and mechanical inspection of each unit to verify light functionality.

B. SPDs that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. 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 SECTION

DIVISION 26 SECTION 26 51 00
INTERIOR LIGHTING
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SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures.
2. LED lamps and drivers.
3. Emergency lighting units.
4. Exit signs.
5. Integral Emergency Lighting Power Units.
6. Lighting fixture supports.

B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "Wiring Devices" for snap switches and wall switches.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. Fixture: See “Luminaire.”

D. IP: Ingress Protection or International Protection Rating.

E. LED: Light emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, driver, reflector, and housing.

1.4 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. Drivers, including energy-efficiency data.
4. Energy-efficiency data.
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, for 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. Comply with IES LM-79, IES LM-80.

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, and mounting and attachment details.

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 drivers, installed.
2. Cords and plugs.

D. Installation instructions.

E. Product Certificates: For each type of driver for bi-level and dimmer-controlled fixtures, from manufacturer.

F. Field quality-control reports.

G. 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.

H. Warranty: Sample of special warranty.

1.5 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 and complying with applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.6 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.

1.7 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 Emergency Battery Pack and 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: Five years from date of Substantial Completion.

1.8 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. 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. Battery and Charger Data: One for each emergency lighting unit.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
5. LED Modules (light engine and driver): Furnish at least (1) of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are limited to manufacturers specified, or equal per Lighting Fixture Schedule.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. 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.

E. 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.

F. 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. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

G. Recessed luminaires shall comply with NEMA LE 4.

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.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-metal hydride type.
b. Charger: Fully automatic, solid-state type with sealed transfer relay.
c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
f. 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.

2.4 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, nickel-cadmium type.
2. Charger: Fully automatic, solid-state, constant-current type with sealed power 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 Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. 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 LAMPS/LUMINAIRES

A. LED Luminaires: 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: L70 lamp life of 50,000 hours.
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-79-19, IESNA LM-80-15, and ANSI C78.377-17.
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. Comply with UL 1598-14 NMX-J-307/1-ANCE/C22.2 NO.250-0-14, *Luminaires, LEDs.*

2.6 INTEGRAL EMERGENCY LIGHTING POWER UNITS

A. Provide emergency lighting power supply units for fixtures indicated on the drawings with integral emergency battery unit as specified herein.

1. Each fixture indicated to be provided with an emergency ballast shall be provided with an emergency power supply unit which consists of a package assembly containing a rechargeable sealed, maintenance-free nickel-cadmium battery, a rectifier/battery charger, a DC to AC inverter, and an electronic fluorescent ballast as specified elsewhere in these specifications. The battery shall have a normal life expectancy of 10 to 15 years with sufficient capacity to operate the lamp load at full normal brightness for 90 minutes. The float type charger shall be configured for operation at 120 volts. Units shall be UL approved for compliance with UL Standard 924 “Emergency Lighting and Power Equipment.”
2. Each unit shall be unconditionally guaranteed for a period of three years, with an additional three year pro-rated guarantee on the storage battery.

B. Operating Modes

1. Each emergency power supply unit shall automatically operate the lamp in the event of an AC power system failure for 90 minutes. When AC power is restored, the emergency power supply unit shall automatically return to the charging mode.

a. MODE 1: Lamp is controlled by a switched AC ON/OFF circuit. Lamp automatically turns ON when AC power is lost. The unit is shipped from the factory connected for this mode of operation.
b. MODE 2: Same as MODE 1 except lamp does not automatically turn ON when AC power is lost. This mode is established by adding a jumper between the AUTO and GND terminals.
c. MODE 3: The unit can be used to provide continuous unswitched, uninterruptible light. A switched AC circuit is not used for this mode. To establish this mode of operation, connect a jumper between the OVER and GND terminals.
d. MODE 4: The unit can be used to provide an unswitched light which is normally OFF but which automatically turns on when AC power is lost. This mode of operation is established by connecting only the unswitched AC circuit to the power supply unit.
e. MODE 5: Lamp is turned on by external switch or relay contacts. The switched AC ON/OFF circuit is optional in this mode. The switch contacts "override" the (optional) switched AC circuit to turn the lamp on. In order for the lamp to be OFF, the external switch contacts must be open AND the switched AC circuit (if used) must be OFF. This mode is established by connecting the switch contacts to OVER and GND. In this mode, the lamp will also be automatically turned ON in the event of

AC power failure, unless this feature is disabled by connecting a jumper between the AUTO and GROUND terminals.

C. Power supply units for emergency lighting shall be provided with remote test switch to be mounted flush in ceiling adjacent to fixture. Power supply units shall be Lithonia Power Sentry PS3000, equal by Bodine, Emergi-Lite, or the same manufacturer of the lighting fixture as noted in the Lighting Fixture Schedule.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "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 gauge (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge (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.”

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. Integral Emergency Lighting Power Units:

1. Power supply units for emergency lighting shall be mounted on the top of the fixture housing as recommended by the manufacturer. If required, the units shall be permitted to be remote mounted up to 50 feet from the fixture per manufacturer's distant limitations, mounted on the building structure above the ceiling space. Where units are remote mounted, the final four-foot length of connecting raceway shall be Greenfield flexible metallic conduit to facilitate fixture removal.
2. Note that wherever an emergency lighting power supply unit is used in a circuit controlled by a light switch, a four wire connection to the AC power source is required - the switched wire, the hot wire, the neutral and ground.

E. Lay-in Ceiling Luminaire Supports: Use grid as a support element.

1. Install ceiling support system wires (Solid#12AWG safety wire), 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.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
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.

G. Connect wiring according to Division 26 Section "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 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

B. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

C. Luminaire will be considered defective if it does not pass operation tests and inspections.

D. 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. Comply with requirements for startup specified in Section 260923 “Lighting Control Devices.”

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. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer’s authorized replacement parts and supplies.
3. Adjust aimable luminaires in the presence of Architect.

END OF SECTION

DIVISION 26 SECTION 26 56 00
EXTERIOR LIGHTING
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SECTION 26 56 00 - EXTERIOR 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. This Section includes the following:

1. Exterior luminaires, materials, and finishes.
2. LED lamps and drivers.
3. Luminaire-mounted photoelectric relays.
4. Poles and accessories
5. Related Sections include the following:
6. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
7. Section 265100 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. EPA: Equivalent projected area.

D. Fixture: See “Luminaire.”

E. IP: Ingress Protection or International Protection Rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, driver, reflector, and housing.

H. LED: Light-emitting diode.

I. Pole: Luminaire support structure.

J. Standard: Same definition as “Pole” above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-6-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-6-M.

C. Ice Load: Load of 3 lbf/sq. ft. (143.6 Pa), applied as stated in AASHTO LTS-6-M.

D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-6-M.

1. Wind speed for calculating wind load for poles 50 feet (15 m) or less in height is 120 mph (192 km/h).

1.5 ACTION SUBMITTALS

A. Product Data: For each luminaire and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, weights, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data and adjustment factors based on laboratory tests of each luminaire type, complete with indicated lamps, drivers, and accessories. Comply with IES LM-79, IES LM-80.

    a. For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    b. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Drivers, including energy-efficiency data.
8. Lamps, including life, output (lumens, CCT, and CRI), and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.
12. Manufactured pole foundations.

B. Shop Drawings:

1. Include plans, elevations, sections and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights loads, required clearances, method of field assembly, and location and size of each field connection.
3. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
4. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
5. Wiring Diagrams: Power, signal, and control wiring.
6. Lighting Calculations: Point-by-point calculations for fixtures shown on the Site Plan and noted on the Lighting Fixture Schedule. Calculation grid shall be maximum 10’-0” on center, horizontal.

C. Samples for Verification: For products designated for sample submission in Exterior Lighting Fixture Schedule. Each sample shall include lamps and drivers. Finish samples shall be provided upon request.

D. Pole and Support Component Certificates: Signed by manufacturers, certifying that products are designed for indicated load requirements in AASHTO LTS-6-M and that load imposed by luminaire has been included in design.

E. Qualification Data: For agencies providing photometric data for lighting fixtures.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

H. Warranty: Special warranty specified in this Section.

1.6 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 and complying with applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. 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.

E. Comply with IEEE C2, "National Electrical Safety Code."

F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Lamps: Replace lamps and fuses that fail within 24 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 24 months from date of Substantial Completion.
5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic and Plastic Lenses, Covers, and Other Optical Parts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: 1 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. In Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the 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 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit maintenance without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during maintenance and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect driver when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected from manufacturer's standard catalog of colors.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

2.3 LED LAMPS/LUMINAIRES

A. LED Luminaires: A LED luminaire consists of LED light engine and drive, 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: L70 lamp life of 50,000 hours.
3. CRI and CCT: 3000 deg K (+/- 275 K) CCT and greater than 70 CRI.

4. Transient Voltage Protection: Rated to withstand 10 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.

2.4 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-6-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.5 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B221, Alloy 6061-T6, with access handhole in in pole wall.
1. Shape: As indicated on Lighting Fixture Schedule.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Mast Arms: Aluminum type, continuously welded to pole attachment plate. Material and finish same as plate.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Grounding and Bonding Lugs: Bolted 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

F. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

I. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

J. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected by Architect from manufacturer's full range.

K. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.

    a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils (64- to 89-um) dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
    b. Color: As selected by Architect from manufacturer's full range.

2.6 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with NECA/IESNA 501-2006 “Standard for Installing Exterior Lighting Systems”.

3.2 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.3 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).
3. Trees: 15 feet (5 m).

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer’s written instructions.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers, unless otherwise indicated.
4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Raise and set poles using web fabric slings (not chain or cable).

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.7 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

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.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires. Refer to Division 01 Section that includes Demonstration and Training.

END OF SECTION

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DIVISION 27 SECTION 27 05 36
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
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SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ladder cable tray.
2. Cable tray accessories.
3. Warning signs.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
2. Section 260529 “Hangers and Supports for Electrical Systems” for supports of work in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
2. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

a. Vertical and horizontal offsets and transitions.
b. Clearances for access above and to sides of cable trays.
c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
2. Design Calculations: Calculate requirements for selecting seismic restraints.
3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
2. Vertical and horizontal offsets and transitions.
3. Clearances for access above and to side of cable trays.
4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Data: Certificates, for cable trays, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."

2. Component Importance Factor: 1.5.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.3 LADDER CABLE TRAY

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. Cooper B-Line, Inc.
2. Cope - Tyco/Allied Tube & Conduit.
3. GS Metals Corp.

B. Description:

1. Configuration: Two longitudinal side rails with transverse rungs swaged or welded to side rails, complying with NEMA VE 1.
2. Width: 18 inches (450 mm) and 24 inches (600 mm) unless otherwise indicated on Drawings.
3. Minimum Usable Load Depth: 4 inches (100 mm).

4. Straight Section Lengths: 10 feet (3.0 m), 12 feet (3.7 m), 20 feet (6.0 m) or 24 feet (7.4 m), except where shorter lengths are required to facilitate tray assembly.
5. Rung Spacing: 9 inches (225 mm) o.c.
6. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.
7. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.
8. No portion of the rungs shall protrude below the bottom plane of side rails.
9. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.
10. Fitting Minimum Radius: 24 inches (600 mm).
11. Class Designation: Comply with NEMA VE 1 Class 10A.
12. Splicing Assemblies: Bolted type using serrated flange locknuts.
13. Splice-Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

C. Materials and Finishes:

1. Steel:

a. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A1011/A1011M, SS, Grade 33.
b. Steel Tray Splice Plates: ASTM A1011/A1011M, HSLAS, Grade 50, Class 1.
c. Fasteners: Steel complies with the minimum mechanical properties of ASTM A510/A510M, Grade 1008.
d. Finish: Hot-dip galvanized after fabrication, complying with ASTM A123/A123M, Class B2.

1) Hardware: Chromium-zinc plated, ASTM F1136 or Stainless steel, Type 316.

2. Stainless Steel:

a. Materials: Low-carbon, passivated stainless steel, Type 316L, ASTM F593 and ASTM F594.
b. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F593 and ASTM F594.

2.4 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Barrier Strips: Same materials and finishes as for cable tray.

C. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.5 WARNING SIGNS

A. Comply with requirements for identification in Section 270553 "Identification for Communications Systems."

B. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

2.6 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY APPLICATION

A. Indoors: Steel ladder type cable tray.

B. Outdoors: Stainless steel type cable tray.

3.2 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA VE 2.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Fasten cable tray supports to building structure and install seismic restraints.

F. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

G. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

H. Support bus assembly to prevent twisting from eccentric loading.

I. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

J. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.

K. Support center support hangers for wire-basket trays with 3/8-inch- (10-mm-) diameter rods.

L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.

N. Make changes in direction and elevation using manufacturer's recommended fittings.

O. Make cable tray connections using manufacturer's recommended fittings.

P. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

Q. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

R. Install cable trays with enough workspace to permit access for installing cables.

S. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

T. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.3 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."

B. Cable trays shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 72-inch (1800-mm) intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.4 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

E. Tie MI cables down every 36 inches (900 mm) where required to provide a 2-hour fire rating and every 72 inches (1800 mm) elsewhere.

F. In existing construction, remove inactive or dead cables from cable trays.

3.5 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
7. Check for improperly sized or installed bonding jumpers.
8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.7 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION

DIVISION 27 SECTION 27 13 23
COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING
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SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

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. 9/125 micrometer single-mode, indoor-outdoor optical fiber cable (OS1).
2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
3. Cabling identification products.

B. Related Requirements:

1. Section 270100 "General Communications Systems Requirements."

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. RCDD: Registered Communications Distribution Designer.

1.4 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. Cabling administration drawings and printouts.

3. Wiring diagrams to show typical wiring schematics including the following:

a. Telecommunications rooms plans and elevations.
b. Telecommunications pathways.
c. Telecommunications system access points.
d. Telecommunications grounding system.
e. Cross-connects.
f. Patch panels.
g. Patch cords.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Optical fiber cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Product Certificates: For each type of product.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.8 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. Patch-Panel Units: Two of each type.

2. Plugs: Ten of each type.
3. Jacks: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 9/125 MICROMETER, SINGLE-MODE, INDOOR-OUTDOOR OPTICAL FIBER CABLE (OS2)

A. Description: Single mode, 9/125-micrometer, 6 fibers, single loose tube, optical fiber cable.

B. Manufacturers: Subject to compliance with requirements, provide products by Hitachi Cable America Inc. or one of the following:

1. Corning Optical Communications; Corning Incorporated.
2. Berk-Tek.
3. Hubbell.

C. Standards:

1. Comply with TIA-492CAAA for detailed specifications.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with ICEA S-104-696 for mechanical properties.

D. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

E. Jacket:

1. Jacket Color: Yellow.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

1. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFN, Type OFNG, Type OFNP, or Type OFNR in metallic conduit.

2. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.

G. Armor: Aluminum

2.3 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by Hubbell or one of the following:

1. Ortronics.
2. Panduit.
3. Systemax
4. Leviton.

B. Standards:

1. Comply with Fiber Optic Connector Intermateability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

D. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

E. Connector Type: Type LC complying with TIA-604-10-B connectors.

F. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a patch panel or faceplate.

2.4 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.5 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for pathways specified in Section 270528 "Pathways for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."

3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 3.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 3level of administration including optional identification requirements of this standard.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION

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DIVISION 28 SECTION 28 46 21
ADDRESSABLE FIRE-ALARM SYSTEMS
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SECTION 28 46 21 - ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This specification provides the requirements for the installation, programming and configuration of a 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. Addressable fire-alarm system.
2. Fire-alarm control unit.
3. Manual fire-alarm boxes.
4. System smoke detectors.
5. Duct smoke detectors.
6. Heat detectors.
7. Carbon monoxide detectors.
8. Notification appliances.
9. Device guards.
10. Magnetic door holders.
11. Remote annunciator.
12. Graphic annunciator.
13. Addressable interface device.
14. Digital alarm communicator transmitters (DACTs).
15. Fire-alarm radio transmitters.

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. The Fire Alarm System supplied under this specification shall be a microprocessor-based network system. All Control Panel Assemblies and connected Field Appliances shall be both designed and manufactured by the same company, and shall be tested and cross-listed as compatible to ensure that a fully functioning Life Safety System is designed and installed.

D. All related work specified in other sections shall be properly coordinated with the fire alarm equipment.

E. Relate Sections

1. Division 26 – Electrical

1.3 ALTERNATES

A. Refer to Division 01 Section, Alternates for description of work under this section affected by alternates.

1.4 DEFINITIONS

A. DACT: Digital alarm communicator transmitter.

B. EMT: Electrical Metallic Tubing.

C. FACP: Fire Alarm Control Panel.

D. HLI: High Level Interface.

E. NICET: National Institute for Certification in Engineering Technologies.

F. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

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. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    e. Locate detectors according to manufacturer's written recommendations.

12. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to 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. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section, 017800, *Operation and Maintenance Data*, include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
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.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.10 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

B. Automatic sensitivity control of certain smoke detectors.

C. All components provided shall be listed for use with the selected system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems.

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Carbon monoxide detectors.
5. Automatic sprinkler system water flow.
6. Fire-extinguishing system operation.
7. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
9. Activate lighting control.

10. Activate emergency shutoffs for gas and fuel supplies.
11. Record events in the system memory.
12. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Duct smoke detector.
3. Independent fire-detection and -suppression systems.
4. User disabling of zones or individual devices.
5. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.
10. Voice signal amplifier failure.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
4. Transmit system status to building management system.
5. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. Basis-of-Design Product: Subject to compliance with requirements, provide system and integration with ATC by Simplex or comparable product by one of the following or approved equal:

1. Edwards (United Technologies)
2. Notifier by Honeywell

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    d. The FACP shall be listed for connection to a central-station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
5. Serial Interfaces:

    a. One dedicated RS 485 port for central-station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).

c. One RS 232 port for PC configuration.
d. One RS 232 port for voice evacuation interface.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet.

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
b. Programmable tone and message sequence selection.
c. Standard digitally recorded messages for "Evacuation" and "All Clear."

d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals , and supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
2. Batteries: Sealed lead calcium.

L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Provide for all manual fire alarm boxes.

2.5 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 four-wire type.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6. Detector must have functional humidity range within 10 to 90 percent relative humidity.
7. Color: White.

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.

2.6 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.

2.7 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. Detector must have functional humidity range of [10 to 90] <Insert numbers> percent relative humidity.
4. Color: White.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" or “ALERT” as required is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall or ceiling mounted as indicated on the drawings.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red for wall mounted devices, white for ceiling mounted devices.
7. Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

D. Voice/Tone Notification Appliances:

1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
3. High-Range Units: Rated 2 to 15 W.
4. Cone Speakers

a. Wall Mount: Provide speakers with a 4” mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. In - Out screw terminals shall be provided for wiring. Speaker housings shall be white. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speakers shall mount in a North American 4” electrical box with extension ring using the 2 screws provided with ring. It must not be necessary to completely remove the screws to facilitate mounting.

b. Ceiling Mount (4”): Provide speakers with a 4” mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed, protecting the cone during and after installation. In-Out screw terminals shall be provided for wiring. Speaker baffles shall be round, steel with white finish. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide UL confirmed 90 dBA sound output at 2w. Speakers shall mount in a North American 4” electrical box with extension ring.

c. Ceiling Mount (8”): Provide speakers with an 8” cone. In-Out screw terminals shall be provided for wiring. Speaker baffles shall be round, steel with white finish. Speakers shall provide power taps at 1/2w, 1w, 2w, and 4w. Provide square surface mount boxes with matching white finish.

d. High Output: Provide speakers with a 4” mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed, protecting the cone during and after installation. In-Out screw terminals shall be provided for wiring. Speaker baffles shall be round, steel with white finish. Speakers shall provide power taps at 1w, 2w, 4w, and 8w. Speakers shall provide UL confirmed 90 dBA sound output at 2w.

Speakers shall mount in a North American 4" electrical box with extension

5. Re-entrant Speakers: Re-entrant speakers shall have a white housing. Power taps shall be provided at 2w, 4w, 8w, and 15w. Re-entrant speakers shall provide 102 dBA peak sound output at 15w. A metal compression driver shall be inherent to the re-entrant speaker. Cone type drivers are not acceptable. Provide weatherproof wall boxes for outdoor mounting.
6. Matching Transformers: Tap range matched to acoustical environment of speaker location.

E. Color: ceiling mounted devices shall be white, wall mounted devices shall be red.

2.9 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.10 REMOTE ANNUNCIATOR AND GRAPHIC DISPLAY

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Surface cabinet, NEMA 250, Type 1.

B. Graphic: Provide a graphic drawing of the entire facility showing all barriers, rooms and room numbers so that it is easy to correlate the LCD text with the graphic display ensuring timely response to an alarm. The graphic display shall be mounted in a picture frame and placed above the LCD annunciator. Submit the drawing for engineer approval.

C. Display Type and Functional Performance: 80 character alphanumeric display with LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

D. Key-Operated Switches shall include:

1. Alarm Silence.
2. Trouble Silence.
3. Test.

2.11 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.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown.

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. Operate door release, sound system mute, and other functions as indicated on the drawings.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

A. DACT must be acceptable to remote central station and must be listed for fire-alarm use.

B. IP/Cellular based communicator transmitter shall be acceptable to the remote central station and shall comply with UL 864/NFPA. Contractor shall program and test with communicator contact ID reporting. Provide external antenna and cable. Power connections shall be made to communicator via Fire Alarm Control Panel.

C. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of IP/Cellular line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report service restoration to the central station. If service is lost on both IP/Cellular lines, transmitter shall initiate the local trouble signal.

D. Local functions and display at DACT must include the following:

1. Verification that both IP/Cellular lines are available.
2. Programming device.
3. LED display.

4. Manual test report function and manual transmission clear indication.
5. Communications failure with central station or FACU.

E. Digital data transmission must include the following:

1. Address of alarm-initiating device.
2. Address of supervisory signal.
3. Address of trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 NETWORK COMMUNICATIONS

A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet for connection to building automation system.

2.14 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

B. Provide for devices in Gymnasium and where indicated on the drawings.

2.15 REMOTE TEST/INDICATING STATION

A. Provide keyed test switch with LED indicating light for each duct detector. Located below flush in 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. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 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. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

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. Turn over to mechanical contractor for installation in ductwork. Sampling tubes shall be installed so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

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. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

I. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.4 PATHWAYS

A. The Fire Alarm System shall be installed in dedicated raceway, except fire rated type MC cable may be used where concealed above accessible ceilings. The entire system shall be

installed in a skillful manner in accordance with approved manufacturers' manuals and wiring diagrams. The Contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in raceway. Raceway shall be conduit in unfinished spaces and surface metal raceway in finished spaces, painted to match existing wall(s).

B. All junction boxes shall be sprayed red and labeled "Fire Alarm". Wiring color code shall be maintained throughout the installation.

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 Section 087100, *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. Magnetically held-open doors.
3. Electronically locked doors and access gates.
4. Alarm-initiating connection to activate emergency lighting control.
5. Supervisory connections at valve supervisory switches.
6. 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 Section 260553, *Electrical Identification*.

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 Architect, Owner and authorities having jurisdiction (if required).

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. 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. Provide video recording of training to Owner.

END OF SECTION

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SECTION 32 31 19 - ORNAMENTAL METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES
- A. Screening metal fences.
- B. Ornamental metal fences.
- C. Supporting posts.
- D. Cantilever and swing gates.
- E. Accessories.

1.02 RELATED REQUIREMENTS
- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete footings for support of fence posts.
- B. Section 32 31 11 - Gate Operators: Electric operators for gates.

1.03 REFERENCE STANDARDS
- A. ASTM International (ASTM)
  1. ASTM B117 - Operating Salt Spray (Fog) Apparatus.
  2. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
  3. ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  4. ASTM D822 - Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
  5. ASTM D2794 - Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
  6. ASTM D3363 - Test Method for Film Hardness by Pencil Test.

1.04 SUBMITTALS
- A. Product data for components and accessories.
- B. Shop drawings showing layout, dimensions, profiles, spacing of components, details of infill panels, interfaces with electric gate operators, and anchorage and installation details.
- C. Copy of warranty.

1.05 WARRANTY
- A. Twenty-year warranty for factory finish against cracking, peeling, and blistering under normal use.

PART 2 PRODUCTS

2.01 MANUFACTURERS
- A. Basis-of-design Manufacturer: Ameristar Fence Products, Tulsa, Oklamhoma
- B. Other manufacturers
  1. The products of other manufacturers, including but not limited to those listed below, are acceptable subject to conformance with the requirements of this Section.
     - a. Ultra Aluminum Manufacturing Inc., 2124 Grand Commerce Drive, Howell MI 48855, 517-548-6756.
     - b. America’s Gate Company, a division of America's Fence Store, 12330 Cary Circle, La Vista, NE 68128, 844-401-8447.
  2. The Architect shall be the sole judge of the acceptability of any proposed departure from basis-of-design infill panel materials, patterns, and dimensions.

2.02 MATERIALS

A. Extruded aluminum: ASTM B221, Alloy 6061, Temper T-6.

B. Sheet aluminum: ASTM B209, Alloy 6061, Temper T-6.

C. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing additives.

2.03 SCREENING METAL FENCES

A. Fence Height: As indicated on Drawings.

B. Posts

1. Profile: Four inch by four inch (4" x 4") extruded aluminum tubular shapes.
2. Length: As indicated on Drawings.

C. Infill Panels

1. Basis-of-Design Type: Montage Plus by Ameristar Fence Products.
2. Aluminum material for fence framework shall conform to the requirements of ASTM B221. The aluminum extrusions for posts and rails shall be Alloy and Temper Designation 6005-T5. The aluminum extrusions for pickets shall be Alloy and Temper Designation 6063-T52.
3. Pickets shall be 3/4" square x .045" thick. Horizontal rails shall be 1-1/4" x 1-7/16" profile with .090" top wall, .060" internal web and .110" side walls. Rails shall be punched to accept pickets. The rail shall be constructed with an internal web providing a raceway for the pickets to be retained with a 1/8" retaining rod. The number of rails shall vary with the style, height and strength as determined by manufacturer. Fence posts and gate posts shall meet the minimum size requirements.
4.
5. The Architect shall be the sole judge of the acceptability of any proposed departure from the Basis-of-Design Type's material, profile, and orientation.

2.04 ORNAMENTAL METAL FENCES

A. Match Screening Metal Fences.

2.05 GATES

A. Manufacturers

1. Basis-of-design Manufacturer: Ameristar Exodus Egress Gate.

B. Other manufacturers

1. The products of other manufacturers, including but not limited to those listed below, are acceptable subject to conformance with the requirements of this Section.
   a. Ultra Aluminum Manufacturing Inc., 2124 Grand Commerce Drive, Howell MI 48855, 517-548-6756.
   b. America’s Gate Company, a division of America's Fence Store, 12330 Cary Circle, La Vista, NE 68128, 844-401-8447.
2. The Architect shall be the sole judge of the acceptability of any proposed departure from basis-of-design infill panel materials, patterns, and dimensions.

C. Material

1. A. Steel material for gate framework (i.e., jamb frame & gate), shall be galvanized prior to forming in accordance with the requirements of astm a653/a653m, with minimum yield strength of 45,000 psi (310 mpa). The steel shall be hot-dip galvanized to meet the requirements of astm a653/a653m with a minimum zinc coating weight of 0.90 oz/ft^2 (276 g/m^2), coating designation g-90.

2. Infill frame shall be 12ga steel. Expanded metal mesh shall be ¾" x #9 flattened or perforated metal mesh shall be 3/16" round x ½" x 18ga.
3. Ornamental picket infill material shall consist of 1" square x 14 ga. Tubing for pickets. Pickets shall be spaced no greater than 5" o.c. Infill frame shall be 12ga steel. Expanded metal mesh shall be ¾" x #9 flattened or perforated metal mesh shall be 3/16" round x ½" x 18ga.
4. Material for pales shall be 2.75" x .75" x 14ga. Corrugated shape. Standard pale spacing shall be no greater than 6" o.c. Or anti-scale pale spacing at no greater than 4.25" o.c.
5. Gate shall be 1.75" x 14ga steel reinforced structural design with ¼" plate reinforced hinge mounting.
6. Hinges shall be stainless steel five knuckle bearing hinges with non-removable pin and stainless-steel fasteners.

2.06 FABRICATION

1. Gate shall be pre-drilled to accept appropriate hardware set. Infill frames shall be fabricated as a single unit. Frame shall be of welded construction inset with mesh filler, attachment to gate frame by means of security fasteners.
2. Gate jamb frame shall be fully welded consisting of 3" x 12ga square tubing for main jamb, 1" square gate stop, and strike mounting block, with gate stop bumpers. Jamb to include an electrical access point with conduit point of connection. Electrical connection to gate by means of power transfer connection mounted in jamb and gate.
3. Gate threshold to be mounted with fasteners allowing for placement below grade or removal after gate installation.
4. Gate shall have clear opening (from gate stop to face of gate open to 90 degrees) of 41.5" meeting ibc group i-2 egress requirements.
5. Gate hardware to consist of exterior rated devices. Gate and hardware to be pre-assembled prior to shipping.

PART 3 EXECUTION

2.01 EXAMINATION

A. Review proposed locations of fences and gates on site prior to installation.
B. Notify Architect of conditions detrimental to performance of the Work.

2.02 INSPECTION

A. Inspect fence and gate system components.
B. Do not install bent, bowed, or otherwise damaged components.
    1. Replace damaged components with undamaged ones.
    2. Remove damaged components from site.

2.03 PREPARATION

A. Coordinate layouts and locations of following components on site.
    1. Fences and gates.
    2. Gate operators.
    3. Routing of concealed electrical conduit and wiring for gate operators.
B. Coordinate with Construction Manager and paving installer as required to determine cane bolt installation method.
C. Prior to fabrication, field-verify required dimensions.

2.04 INSTALLATION

A. Install fences and gates in accordance with manufacturer's installation instructions and approved shop drawings.
   1. Install posts plumb and level in concrete footings. Temporarily brace until concrete is set.
   2. Secure fences and gate components to posts and to each other as required using stainless steel fasteners.
   3. Install cane bolts at double-swing gates.

B. GATE TESTING AND ADJUSTING
   1. Adjust gate hardware for smooth operation.
   2. If electrical provisions are not installed, provide temporary power to allow testing of gate operators. Coordinate with Construction Manager.
   3. Test gates and operators by opening and closing each gate a minimum of five times.
   4. Correct deficiencies and make final adjustments.
   5. Remove temporary power.

C. FINISHES
   1. Touch-up damaged finishes with paint supplied by manufacturer and matching original coating.

END OF SECTION